In the Name of Allah
Proceedings

The 5th International Symposium of Veterinary Surgery (ISVS)
The 13th Iranian Symposium of Veterinary Surgery, Anesthesia and Diagnostic Imaging (ISVSAD)

5th – 7th December, 2017 - Tehran, Iran

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Tel. No.: +98-5136579430
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Email: Secretariat@ivsa.ir
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Contents

Preface

Congress President’s Welcome Message ........................................ 17
President’s IVSA Welcome Message ........................................... 18
Executive Secretary Welcome Message ..................................... 19
Scientific Secretary Welcome Message ................................. 20
Speakers ..................................................................................... 23
Program ....................................................................................... 25

Oral Presentations

Teaching Methodology of Teaching Surgery to Vet Students (DVM) using PBL (Problem Based Learning) and distributive (Babak Faramarzi) – United States 31

Mini locking plates in oral and maxillofacial surgery – a literature review (Cedric Tutt) – South Africa 33

Dysplastic Hip Joint & Acetabuloplasty in Canine (Davood Sharifi) – Iran 37

Minimal invasive (endoscopically-guided) surgery application in the veterinary field (Daria Saade) - KARL STORZ – ENDOSKOPE 47

Staplers in Veterinary Surgery (Amir Hossein Mavadati) - Iran 55

Lameness detection in dairy cows, a multidisciplinary approach (Ahmadreza Mohamadnia) - Iran 60

Evidence-Based Stem Cell Therapy in Equine Orthopaedic: Is It safe and Effective? (Mohammad Mehdi Dehghan) - Iran 64
Comparison Of Autogenic Costal Cartilage With Chitosan Scaffold In Canine Humeral Defect Healing (Siavash sharifi) 71

Assessment Of Poly Caprolacton (PCL) Nanocomposite Scaffold Compared With β-Tricalcium Phosphate (HA+β-TCP) On Healing Femur Bone Defect In Rabbits (Alireza Jahandideh) 72

The Use Of Fascia Iata As An Autograft For Permanent Treatment Of Anterior Cruciate Ligament Ruptures With Extra Capsular Technique In Dogs; New Surgical Technique (Amirreza Imani) 73

The Role Of Decellularized Fish Scale Derived Scaffold With Platelet Rich Plasma In Healing Of Tibial Bone Defect In Rabbit: An Experimental Study (Nikta Mansouri) 74

Total Vertebrectomy Of L1 And Vertebral Stabilization With Dorsal Tension Band Wire Technique In A Paraplegic Dog (Mahya jazini Dorche) 75

Combination Of Mesenchymal Stem Cells and Platelet Rich Fibrin: A Novel Method For Articular Cartilage Repair and Regeneration (Davoud Kazemi) 76

Gelatin, Fibrin-Platelet Glue and Their Combination on Healing of Critical Bone Defect in Rat (Abdolhamid Meimandi-Parizi) 77

Effect Of Chitosan-Zinc Oxide Nanocomposite Conduit On Transected Sciatic Nerve: An Animal Model Study (Mostafa Araghi) 78

Guidelines for Basic Equine Dental Care (Dave Klugh)-United States 79

Computed Tomographic Imaging in Veterinary Dentistry and Oral Surgery and Extraction Techniques in Veterinary Dentistry (Cedric Tutt) – South Africa 85

My Thirty Years Affair with the Tendon (Farshid Sarafzadeh Rezaei)-Iran 89

Prognostic Markers in Equine Colic (M M S Zama)-India 98

Arthroscopy in Horses (Oliver Michael Crowe) –Britain 101
<table>
<thead>
<tr>
<th>Title</th>
<th>Author(S)</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Surgical Management of Colic in Horses: A Review of Some Cases Operated in Veterinary Referral Hospital of Shahid Bahonar University of Kerman</td>
<td>Mohamad Mehdi Oloumi</td>
<td>105</td>
</tr>
<tr>
<td>Anesthetic Management in Trauma Patients</td>
<td>Naser Vesal</td>
<td>110</td>
</tr>
<tr>
<td>Effect Of Phentolamine Mesylate On Regression Of Epidural Anesthesia With Lidocaine – Epinephrine In Sheep</td>
<td>Fereshteh Alipour</td>
<td>116</td>
</tr>
<tr>
<td>The Effects Of Propofol And Propofol- Epidural Anesthesia On Immunological Indices In Dogs Undergoing Ovariohysterectomy</td>
<td>Maryam Moslemi</td>
<td>117</td>
</tr>
<tr>
<td>Evaluation of The Sedative Effects of Diazepam. Midazolam And Xylazine After Intranasal Administration In Juvenile Ostriches Struthio camelus</td>
<td>Mostafa Araghi</td>
<td>118</td>
</tr>
<tr>
<td>The Effects Of Midazolam –Ketamine On Resistive And Pulsatility Indices Of Aorta In Healthy Domestic Short-Haired Cats</td>
<td>Niloufar Ghabari</td>
<td>119</td>
</tr>
<tr>
<td>Surgical Treatment Of Intraluminal Impaction In A Foal</td>
<td>Zahra Riahi</td>
<td>120</td>
</tr>
<tr>
<td>Diagnostic and Therapeutic Advantages Of Endosurgery As A Minimal – Invasive Technique: Review Of 14 Dogs And 3 Cats</td>
<td>Hamidreza Fattahian</td>
<td>121</td>
</tr>
<tr>
<td>Single-Incision Laparoscopy: Overview And Current Place In Veterinary Surgery</td>
<td>Roja Ebrahimi</td>
<td>122</td>
</tr>
<tr>
<td>Treatment of Cervical Mucocele by Mandibular and Sublingual Salivary Gland Excision in a Male German Sheperd (a case report)</td>
<td>Alireza Bashiri</td>
<td>123</td>
</tr>
<tr>
<td>Distal Limb Injuries in Horses: Incidence and Biomechanics</td>
<td>Babak Faramarzi</td>
<td>124</td>
</tr>
<tr>
<td>Results and Effects of Guidelines for Basic Dental Care</td>
<td>Dave Klugh</td>
<td>127</td>
</tr>
<tr>
<td>Review of Veterinary Anti – Inflammatory Analgesics and Antioyretics</td>
<td>Zahra Khazaee</td>
<td>133</td>
</tr>
<tr>
<td>Review of Veterinary Anti – Inflammatory Analgesics and Antioyretics</td>
<td>Tahr Pazooki</td>
<td>133</td>
</tr>
</tbody>
</table>
Diagnostic Imaging in Small Animal Portosystemic Shunt (Antje Hartmann)- Switzerland 135

Dentistry Radiology in Dogs and Cats (Mohammad Molazem) – Iran 138

MRI Features Of The Brain Lesions In Zinc Deficiency In A Dog. (Leila Mohammadyar) 141

The Diagnosis Of Quadrigeminal Cistern Arachnoid Cyst By MRI In A Dog (Mahsa Zangishe) 142

Functional Magnetic Resonance Imaging: A New Gate Into The ADHD (Yasamin Vali) 143

Comparison Of Quantitative Computed Tomography (CT) Analysis Of Pulmonary Patterns In Dogs Affected By Pneumonia And Pulmonary Edema, Before And After Intravenous Contrast Medium Administration (Saeideh Eftekhar) 144

Computed Tomographic Sex Determination In Caspian Pond Turtle (Mauremys caspica) – (Maryam Mahdipour) 145

Intra Hepatic Porto-Systemic Shunt – (Fatemeh Aramesh) 146

Two-Dimensional Echocardiographic Normal Values In Clinically Healthy Ghezel Sheep- (Seyed Mohammad Hashemiasl) 147

Measurement Of Carotid Artery Blood Flow Velocity Of Camel By Pulse Wave Doppler Ultrasonography- (Aboozar Dehghan) 148

Poster Presentation

Ventral Rhinotomy for Extraction of a Gunshot from Nasal Cavity in a Cat- (Mahya Noormonavar)
A Report of Maxillae Fractures Orthopedic Surgery in Mesopotamian Spiny-Tailed Lizard (Uromastyx loricata) – (Ali Rounagh)

Cranioplasty Using Titanium Mesh for Treatment of Depress Fracture of Skull in a Dog – (Nikta Mansouri)

A Clinical Report of Hemivertebra in a Foal– (Maryam Mahdipour)

Using Antibiotic Poly-Met Acrylate Granules in Management of Osteomyelitis–(Omid Aalianvari)

Effect of 650 nm Light-Emitting Diode (LED) on Functional Recovery of the Transected Sciatic Nerve Following Neurorrhaphy in a Rat Model – (Mohammad Ashrafzadeh Takhtfooladi)

Evaluation of Hip Lameness Disorder in Dogs and Cats by Femoral Head and Neck Ostectomy: Ten Cases over Eleven Month Period– (Fatemeh Sadat Hosseini Omshi)

A Comparative Study of the Efficacy Intra-Articular Administration of Sodium Hyaluronate and Pentosan Polysulfate on Postoperative Recovery of Canine CCL Disease – (Amir Mohammad Fadaei)

Clinical Outcome of Pancarpal Arthrodesis in a Affected Puppy to Low Radial Nerve Plasty– (Bahare Mazloumi)

Occurrence & Comparison of Dog and Cat Bone Freacture:A Retrospective Study(2010-2015)– (Reyhaneh Izadi)

Corrective Osteotomy and Intramedullary Pinning in an Eagle with Malunion Fracture of Radius and ulna– (Ali Ghashghaii)

Toggle-Pin Fixation: A Case Report of Reduction for Chronic Cranio-Dorsal Coxofemoral Luxation in a Dog - (Mohammad-Hazhir Alaei)

Effects of Theranekron on Experimental Bone Fracture Healing in Rabbit Model: Radiological and Histopathological Evaluation – (Amin Bigham-Sadegh)

Malunion Femur Fracture Healing with Spongy Tissue Graft in Gold Eagle (Aquila Chrysaetos) – (Pejman Nezam Zomorrodi)
Histological Changes in the Fracture Callus Following the Administration of Pistacia Khinjuk Extract on Tibial Fracture in Rabbits - (Nima Ilbeygi)

Intramedullary Pin Fixation in Humeral Fracture in the 7 Birds of Prey - (Nematollah Ebrahimi)

Surgical Treatment of Patellar Luxation in Rabbit – (Mohammad Taha Rahmatizadeh)

A Retrospective Study of Prevalence, Causes and Types of injuries in felines with history of fall from height referred to Karaj veterinary clinic – (Pedram Zangiband)

Case report of Pectus Excavatum in a 9-week-old Cat- (Hanieh Rajabpour Kordasiabi)

Comparison of Bacterial Oral Contamination and Incidence of Periodontal Disease in Metal and Ceramic Crown in Canine Teeth in Dogs- (Younes Saghafi)

Photographic Diagnosis of Limb Conformational Defects in Working Horses of Jammu Region- (Malik Mudser Khan)

Vision Dental Implants in Pets- (Amir Hafezian)

Surgical Repair of Oronasal Fistula with History of Canine Tooth Extraction – (Mohsen Akhondi)

A Study on Periodontal Disease in Companion Animals and the Ways of Treatment – (Zahra Tabarsi)

Improvement Of Tendon Repair Using A Novel Tubular Scaffold Of Nano Zinc Loaded Chitosan- (Alireza yousefi)

Restorative surgery of carpus flexion tendons following intense soft tissue injuries and carpal bones fracture by lawnmower – (Reza Ghavirooh)

Prevalence of dental disorders at Urmia and Tabriz cities equestrians in Iran- (Mahdi Ghorbani)

Radiographic Evaluation of Cartilage Grafting Impregnated with the PRP & Mesenchymal Cells in Repair of Tibial Growth Plate Defect in Lamb-(Alaa Ahmad Ibrahim Al-Dirawi)
Evaluation of the Frozen Allograft Tendon Impregnated with the Mesenchymal Cells on the Hydroxyproline Content in Lamb– (Rafid Majeed Naeem Al-Khalifah)

Anesthetic management in pelican orthopedic surgery, case report– (Soroush Moghaddam Jafari)

A dystocia due to pelvic fracture in a golden Rottweiler: clinical report– (Arghavan Mofidi)

Dorsal laminectomy and bone graft and breast for treatment of paralysis due to fracture and thoracic vertebral luxation in two-month kitten– (Mohsen Vahar)

Differential diagnosis of long term lameness’s cause in collar of a guard dog– (Mehdi Khosravi)

Comparative evaluation of the application of marine coral and turmeric powder in the repair of humerus bone fractures of cat – (Shiringol Daram)

Surgical treatment of patellar luxation in dogs-report of 10 cases (2015-2016) – (Reza Samaei)

Unilateral forelimb hemimelia in a dog: a case report – (Kimia Mansouri)

Repair of bilateral severe femoral head, neck, trochanter major and short oblique diaphyseal fracture in a DSH Tomcat– (Amin Nikpasand)

Toggle rod stabilization technique in coxofemoral luxation of 8 month dog: Case report– (Mohammad Bazaei)

Crown Therapy and Endodontic Therapy, Alternative Option for Extraction in Small Animals– (Seyed Shohei Ghazanfari Hashemi)

The Effect of Drinking Alkaline Ionized Water on Wound Healing – (Amir Hesam Torghabe)

Effect of Topical Application of Autologous Platelet Lysates on Corneal Alkali injury in rabbits – (Hamid Reza Moslemi)

Mammary Gland Adenoma in a Male Guinea Pig – (Navid Moeinoroaya)

Evaluation of Metomidate Anesthesia in Koi Carp fish (Cyprinus rubrofuscus) Fingerlings–
(Amin Nematollahi)

Effect of Observing the General Principles on Surgical Success– (Sakineh Hajimohammadi)

Esophageal Fistula in a Parrot due to Syringe Feeding – (Ali Ghashghaii)

Comparison of postoperative pain in ovariecctomy of cats (DSH breed) by laparoscopy and flank laparotomy- (Sevda Abdavineja Mirkoohi)

Tumoral calcinosis cutis in a young male Rottweiler- (Mehdi Behfar)

Comparison of two training methods for skills of surgery principles and use of cheap issue and materials for veterinary students – (Zahra Khorshidi)

Surgical correction of a left-to-right patent ductus arteriosus by ligation of ductus arteriosus in a 3 month old Yorkie – (Siyavash Jahany)

Surgical treatment of a chronic diaphragmatic hernia along with pericardiectomy and successful adhesiolysis between caudal lung lobes and hepatic lobes in a dog: a case report – (Parisa Mazdarani)

Tramadol reduces testicular damage od ischemia-reperfusion rats - (Hesam Aldin Hoseinzadeh)

Myelomalacia in 2 dogs: a clinical report- (Kimia Mansouri)

Esophageal foreign body obstruction in the base of heart in a dog: a clinical report – (Sahar Kadkhodaii)

Esophageal obstruction in a 6 month calf with a magnet- (Nematollah Ebrahimi)

Bladder stone removal in Persian cats with history polluted of Ammonia water consumption- (Omid Aalianvari)

Report on the simultaneous surgical removal of the mammary tumors and a malignant skin tumor in a 16 years old female dog – (Ali Edalat Irani)
Splenectomy due to splenic marginal zone lymphoma in a dog: a clinical report- (Azin Alizadeh)

Nephroureterectomy in a Persian cat with unilateral uretolithiasis – (Seyed Farzin Seyednejad)

Case report of a skin transplantation following a necrosis in tail skin of a terrier dog breed- (Navid Razmian)

Evaluation of the effectiveness of uterine hook application in large breed canine ovariohysterectomy: Physiological study- (Seyedhosein Jarolmasjed)

Sertoli cell tumor caused by cryptorchidism in a dog – (Peyman Shahzamani)

Surgical correction of diaphragmatic hernia associated with gastric dilatation-volvulus in a cat- (Nooshin Ghazaleh)

Scrotal hemangiosarcoma in a Persian Afghan Sarabi dog- (Melika Danesh)

Tracheal collapse diagnosis and management in one cat : clinical report- (Soudeh Ansari)

Determination of minimum infusion rate of ketofol with and without lidocaine in dogs- (Mahmood Khannejad)

A renal cyst in dog: case report-(Fateme Azadi)

Heamatobiochemical Alterations and Acute Phase Response in Equine Colic – (Indu Bhushan Bassan)

Extracapsular cataract extraction in dog – (Hossein Kazemi Mehrjerdi)

Effects of combined low-level laser therapy and ischemic-preconditioning on skeletal muscle ischemia/reperfusion in rats – (Mohammad Ashrafzadeh Takhtfooladi)

Effects of intraperitoneal administration of pyrroloquinoline quinone (PQQ) on ischemia-reperfusion injury in rat testicular torsion and detorsion model: Biochemical assessments – (Rahim Mohammadi)

Evaluation of aseptic preparation with Povidone-Iodine 0.5% and its combination with cefazolin 1% for ophthalmic surgeries in dogs- (Ardalan Ahmadvand)
Experimental myocardial infarction in rabbit; clinical and para-clinical evaluation of method and outcomes – (Seyed Reza Ghiassi)

Oral melatonin administration effects on oxidant and antioxidant parameters and liver and kidney function in castrated and intact dogs – (Saeed Nazifi)

Oral melatonin administration effects on Thyroidal hormones, Leptin, Ghrelin and Galanin in castrated and intact dogs – (Aidin Shojaei Tabrizi)

Effect of intraperitoneal administration of silymarin on esophageal anastomosis wound healing in rat- (Ramin Mazaheri-Khameneh)

Surgical treatment of an enterocele intussusception in a young dog – (Afra Taymouri)

Traumatic diaphragmatic hernia in dogs and cats: 13 cases (2015-2016) – (Reza Samaei)

The topographical study of coelomic cavity organs in Red-Eared slider (Trachemys scripta) using the laparoscopic method - (Shayan Zand)

Review of gunshot injuries in veterinary cases: 15 cases (2015-2017)- (Alireza GeranQarakheyli)

Endocrine and oxidative stress characteristics in different anesthetic methods during pneumoperitoneum in dogs - (Faezeh Alipour)

Retroperitoneal renal approach in dog: A comparative study- (Seyed Masoud Zolhavari)

The protective effects of benidipine against ischemia/reperfusion injury in rats – (Sara Javanmardi)

Effects of oral melatonin administration on sexual hormones, serotonin and cortisol in castrated and intact dogs- (Asghar Mogheishe)

A case report of obstruction colic with mesenteric hernia in a horse- (Reza Teimourifard)

Use of stem cells with scaffolds in the treatment of ischemic heart disease- (Ali Ziaie Kia)

Venous aneurysm in a sheep: a case report – (Narges Sofian)
A case report of gravel disease treatment in a mare – (Ali Ronagh)

Validation of a PCR assay for molecular identification of Treponema phylotypes in bovine digital dermatitis lesions- (Marzieh Faezi)

Surgical resection of preputial hemangiopericytoma in a mule – (Amir Vafafar)

Amputation of wing due to severe burns caused by collision with a high voltage power cable in golden eagle – (Kamyar Kalhori)

Comparison (radioaposite) between two tooth fillers (gutta percha and sealer – glass inomer) - (Younes Saghafi)

A retrospective study of root elongation, dental complication and therapeutic management in rabbit- (Mohsen Akhoondi)

Evaluation of the effect of intravenous lipid emulsion on changes of depth of anesthesia with ketamine-xylazine in new-zealand white rabbits- (Ebrahim Shahroozian)

Diagnosis and Treatment of Inguinal Hernia in a Saline Valley Horse Breed- (Younes haghshenas)

The study of the guttural pouch anatomy on the horse and surgical treatment of related diseases (Hashem Saei)

Topical use of Origanum Vulgare Extract for Corneal Alkali Injury in a rabbit model- (Noushin Zabiee)

Occurring of Fibrosarcoma Tumor Following Skin Injury in a 3 years old Kurdish Stallion- (Saeid Azizi Mahmoud Jigh)

Radiographic reference limits for thoracic in Muscovy duck (Cairina moschata) - (Rasoul Rahimzadeh)

Radiographic Study Of Some Common Disorders In Equine Dental Structures - (Banafsheh Shateri Amiri)

Gastrography Evaluation of normal Anatoly donkey- (Fatemeh Heydari Farsangi)
Measuring cardiac parameters by pulsed wave Doppler echocardiographic in Markhoz goats - (Foad Sadi)

Diagnosis of Kartagener’s Syndrome in Doberman Dog by using radiographic technique and clinical methods. - (Abolfazl Gholami Vanashi)

Spinal hematomat in a 3 month old kitten: a case report with MRI finding - (Mehdi Ghafari)

New methods of degenerative tendinopathy treatment in horse - (Melika Abdollahi)

Prediction of parturition time date in Great Dane dogs by ultrasonography compared to other breeds - (Melissa Pourdonya)

Radiographic evaluation of limb disorders in animals referred to shahrekord university veterinary clinic. - (Faranak Jafari)

Ultrasonographic Detection of Iris Cyst in a Cat- (Maede Beiki Zare)

Ultrasonographic evaluation of the effect of pumpkin seed oil on prostate dimensions in Iranian mix breed dogs- (Roham Vali)

Porcupine quill detection and sonographic assisted removal in a dog temporalis muscle- (Nematollah Ebrahimi)

Effect of nano-capsules containing Risedronate on calvaria bone formation in rabbit: Radiography and biochemical investigation - (Hesam Aldin Hoseinzadeh)

Ultrasonography Diagnosis and Ovariectomy Surgery of Granulosa theca-Cell Tumor by Use of the Flank Approach in a Kurdish Breed Mare- (Reza Ghavirooh)

The study of scleral ring of the eye in common buzzard (Buteo buteo) using CT scan- (Omid Zehtabvar)

contrast radiography in Zarudni’s Spur-thighed Tortoises by Gastrografin®- (Dariush Vosough)

Evaluation of Ultrasonography in the Diagnosis of Nasal Fracture, Comparing it with Plain Radiography in Dogs- (Zahra Tabarsi)
Radiographic Evaluation of Repair and Reconstruction of Tibia Bone by Hybrid Porous Scaffold of Chitosan and Nano-tricalcium Phosphate, Following the Experimental Defect in Rabbit- (Kamyar Kalhori)

Congenital hydrocephalus in a cat using CT-scan : a case report- (Samaneh Abdollahi)

Radiographic evidence of urolithiasis improvement by diet correction (reformulation) and massive urinary bladder calculi in a newzeland rabbit: a case report- (Sajjad Maleki Zarjabad)

Clinical and radiographic evaluation of lameness in a goat - (Faranak Jafari Dehkordi)

Comparison study of transcorneal and transpalpebral ultrasonography of the eye in Iranian mix breed dog- (Roham Vali)
Welcome Message

On behalf of the organizing and scientific committees, I would like to extend a warm welcome to the distinguished speakers, delegates and all the stake holders for attending the 5th International Congress of Iranian Veterinary Surgery Association (ISVA) which is being held in conjunction with the 13th Iranian Symposium of Veterinary Surgery, Anesthesiology and Diagnostic Imaging (ISVSAD), for the first time at the Faculty of Veterinary Medicine, University of Tehran from 5 to 7 December, 2017. This three-day event, focusing on various disciplines of Veterinary Surgery, Veterinary Anesthesiology and Diagnostic Imaging and their applications in the improvement of companion animals health and welfare and the improvement of animal modeling in human-related researches, has attracted many distinguished scientists from different countries and also companies, especially pharmaceutical, at national and international levels to share and discuss new scientific ideas, products and breakthroughs. Different Committees have done their best to select important and emerging hot topics out of 250 abstracts received. They have worked hard to prepare a program of scientific excellence to attract, excite, inspire and inform all the audience in an impressive setting to provide a meeting place for interdisciplinary exchange of newest research highlights and effective national and international networking.

We would like also to thank all the organizations and companies which have added value to our congress through sponsoring and exhibiting their products and services. We have done our utmost to make this event as productive and enjoyable as possible and hope that we, together, experience an unforgettable occasion.

Mahdi Vojgani (DVM, PhD)
Dean Cum President of the congress
Faculty of Veterinary Medicine
University of Tehran
President’s IVSA Welcome Message

Iranian Veterinary Surgery Association (IVSA) founded on 1999 by upholding the first Iranian Symposium of Veterinary Surgery & Radiology. By official registration of IVSA in 2004 by Ministry of Sciences, research and technology, this foundation started its official presence among iranian scientific associations as the first scientific association in veterinary sciences. The main body of IVSA consists of more than 300 specialists in field of veterinary surgery and diagnostic imaging. Thirteen national meetings on veterinary surgery, anesthesia and diagnostic imaging (ISVSAD), five international symposiums on veterinary surgery (ISVS) and related fields, a conference on cow comfort and lameness (RCCCL) besides workshops in these fields are main activities of IVSA in increasing local and international knowledge. Iranian Journal of Veterinary Surgery (IJVS), Extension journal of IVSA (Eltiam), Monthly newsletter (HODHOD) besides monographs in different fields are main publications of IVSA. Being a member of World Veterinary Association (WVA) is another excellent achievement for IVSA and I am sure that it would be a good step in our international activities.

We are proud that in about a decade after our foundation we have good situation (Top grade among scientific associations of Iran) in increasing knowledge of our members and also publishing result of local and international researches in our valuable journals.

IVSA is proud of collaborating with different universities of Iran (Tehran, Shiraz, Eurmia, Ahwaz, Shahrekord, Kerman, Ferdowsi Mashhad, Azad and Tabriz) for upholding our events and activities.

Collaboration with Tehran University (as the oldest and one of the most important universities of Iran) in this event is an honor for IVSA, and collaboration of distinguished lecturers from Iran and overseas countries, precedes a wonderful scientific excellence.

I want to thank all of participants, lecturers, sponsors for helping us in arranging such a wonderful event. I hope that besides getting benefit from scientific excellence of lectures and workshops, enjoying your time in beautiful capital of Iran.

Ahmadreza Mohamadnia (*DVM, DVSc*)
President of IVSA
Executive Secretary Welcome Message

In the Name of Allah
Professors, Dignitaries, Distinguished Colleagues and Honored Students
On behalf of Faculty of Veterinary Medicine, University of Tehran and sincerely participation of Iranian Veterinary Surgery Association (IVSA), it is delightedly informed all dears, colleagues and fans, that the 5th International Symposium and 13th Symposium of Veterinary Surgery (ISVS), Anesthesia and Diagnostic Imaging (ISVSAD) is going to be held in Hamady Seminar Hall of the Faculty of Veterinary Medicine, University of Tehran, Iran in 5th to 7th December 2017.

Selection of venue of congress due to ancient age and main thoroughfare of communication network in the country, provides the temporal situation for all national and international participants to get familiarized closely beside their direct participation in holding congress programs with highly established cultural, social affairs and entertainment facilities, infrastructure of the Faculty and landscape, which definitely establish a permeable and unforgettable memory in the mind of participants, especially representatives and invited speakers. Close observation of invited delegates with research and training facilities and the faculty environment will provide more stable communication opportunities for scientific exchanges.

Undoubtedly, Iranian Veterinary Surgery Association by holding up the last 4 successful international congresses at the universities of various provinces, and 12th national symposium of this forum led to have valuable executive’s experiences, and by getting direct participation in the organizing the 13th national symposium will secure its high position among Scientific societies in the country, especially in the Ministry of Sciences, Research and Technology and will be benefited from more stable social status. Evidence suggests that this forum every year by holding up the National Symposium being successful for accountable of maximum expectation of specialists and demand of participants, so by presence and participation of dignitaries and experts in this forum, provide accessible developed modern non-invasive techniques to the ramifying of veterinary surgery sciences. So association can express itself as responsible and to do its obligations well.

Taking commitments fortunately underpins a proper field and ground for training and selecting competent and committed and passionate individuals as the future forum custodians.

The Faculty of Veterinary Medicine, University of Tehran, according to its rich and sumptuous experiences attempts to provide the best scientific and cultural environment for all participants from different localities as to be witness of the enthusiastic attendance of participants and obtain satisfaction for it’s the Faculty future plans.

The management department of the faculty and members of the executive and scientific committee are still looking forward to actively and passionately attendance of you all dears.

Sincerely
Dr Davood Sharifi
Executive secretary of the symposium
Fall 2017
Scientific Secretary Welcome Message

In the Name of Allah
Honoured professors, dear guests, esteemed colleagues and dear students;
It is an honour to welcome you on behalf of the University of Tehran, the icon of higher education in the country, and Iranian Veterinary Surgery Association, "the first specialized veterinary association of Iran", and thank you, the honoured guests and participants at the Fifth International Symposium on Veterinary Surgery; and the 13th Symposium on Surgery, Anaesthesia and Imaging in Veterinary Sciences in Iran.
So far, the symposiums which have been regularly held by the Veterinary Surgery Association of the country in collaboration with the prestigious universities in the almost past twenty years have always been among the most significant, and updated gatherings on veterinary medicine with highest number of audience; and for this very reason, the Iranian Veterinary Surgery Association has won the first rank among various scientific associations in the ratings of the Ministry of Science, Research and Technology.
Any living organism who has been worthy of being born in the universe by God, the Compassionate the Merciful, has its own value in this world and definitely, helping them and relieving their suffering is of significant importance as much as even their loss of life and putting them to sleep must be with kindness and compassion. Even if this loss of life is for higher human values. In this regard, human beings with praiseworthy moral values, including committed veterinary surgeons with good conscious always rush to assist the life of other creatures whom they can treat through proper and careful fulfilment of the responsibilities entrusted to them; and this is realized when the vets withdraw from harming their lives by using maximum scientific information and benefitting from the most complete facilities in providing the best control and medical actions.
The main goal in holding such gatherings including the recent symposium at the University of Tehran is to provide grounds for exchanging views, sharing the ideas, opinions, transferring knowledge and new technologies, and to offer advanced professional experience in different areas including anaesthesia, diagnostic imaging and associated disciplines. We hope through active participation of all the honoured participants we will succeed in realizing this important issue in a friendly and empathic atmosphere in this symposium.

Seyed Mehdi Ghamsari
Scientific Secretary of the Symposium
Fall 201
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Members of the Executive Committee:
- Prof Mahdi Vojgani
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- Dr Mohammad hashemi
- Dr Mohammad Reza Emami
- Dr Ali Baniadam
- Dr Alireza Ghadiri
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- Dr Omid Zehtabvar

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- Saed Bagherasand
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- Nayere Parhizkar
- Seyed Fakhraddin Borgheie
- Ghazale Zandi
- Ali Shojai
- Alale Vazifedoust
- Arash Kalantari
- Mahsa Dehnavi
Speakers

Dr. Babak Faramarzi
Associate Professor, College of Veterinary Medicine, Western University of Health Sciences, Western University of Health Sciences. 309 E Second St., Pomona, California 91766-1854. bfaramarzi@westernu.edu

Dr. Cedric Tutt
BVSc, MMedVet(Med), Diplomate EVDC, MRCVS
RCVS Recognised Specialist in Veterinary Dentistry
European Veterinary Specialist in Veterinary Dentistry
cedrictutt@gmail.com

Dr. Davood Sharifi
Professor of Veterinary Surgery Department of Veterinary Surgery and Radiology. Faculty of Veterinary Medicine, University of Tehran. P.O.Box:141556453 dsharifi@ut.ac.ir

Dr. Daria Saade
BVsc, MVsc, DVM
Veterinary Marketing Manager for Africa- East Mediterranean & Gulf, KARL STORZ – ENDOSKOPE dsaade@karlstorz-emg.com

Dr. Amir Hossein Mavadati.
DVS
cVeterinary surgeon, Graduated of Faculty of Veterinary Medicine, Ahvaz, Iran. mavadati.amirhossein@gmail.com

Dr. Ahmadreza Mohamadnia
Associate Professor-Department of Clinical Sciences, Faculty of Veterinary Medicine, Ferdowsi University of Mashhad. mohamadnia@um.ac.ir

Dr. Mohammad Mehdi Dehghan
Professor of Veterinary Surgery Department of Veterinary Surgery and Radiology - Faculty of Veterinary Medicine, University of Tehran – Tehran - Iran. mdehghan@ut.ac.ir

Dr. Dave Klugh
Equine Dentist, a member of the American Association of Equine Practitioners the Oregon Veterinary Medical Association The American Veterinary Medical Association and the American Veterinary Dental Society. Email: DrKlugh@EquineDentalPrinciples.com Address: 19621 SW Colby Ln. Hillsboro, Or. 97123 Phone: 503.849.9197

Dr. Farshid Sarafzadeh Rezaei
Professor- Department of Veterinary Surgery And Diagnostic Imaging. University of Urmia Faculty of Veterinary Medicine. f.sarafzadeh@urmia.ac.ir
Dr. M.M.S. Zama  
Dean,  
Faculty of Veterinary Sciences & A.H.,  
Sher-e-Kashmir University of Agricultural Sciences and Technology of Jammu, R.S. Pura-181 102, Jammu, J&K, India.  
Mobile: +91-9419242441, +91-8493860130  
mmszama@yahoo.com

Dr. Oliver Michael Crowe  
BVSc MRCVS Cert ES (orth) Dip ECVS  
RCVS and European Recognized Specialist in Equine Surgery  
B&W Equine Hospital Breadstone  
Ollie.Crowe@bwequinevets.co.uk

Dr. Mohammad Mehdi Olowumi  
Professor of Veterinary Surgery Department of Veterinary Surgery Faculty of Veterinary Medicine  
Shahid Bahonar University of Kerman  
oloumi.m@gmail.com

Dr. Naser Vesal  
Professor- Department of Veterinary Clinical Studies, School of Veterinary Medicine, University of Shiraz, Shiraz, Iran  
nv1340@shirazu.ac.ir

Dr. Antje Hartmann  
Dr.med.vet., DipECVDI, MRCVS  
European Veterinary Specialist in Diagnostic Imaging  
Fachtierärztin für Radiologie und andere Bildgebende Verfahren  
Email: dr.antjehartmann@gmail.com  
working Address: Tierklinik Hofheim, Katharina-Kemmler-Str.7, 65719 Hofheim, Germany  
Occupation: Veterinarian  
Tel.: +49-179-6653245

Dr. Mohammad Molazem  
Assistant Professor of Radiology  
Department of Veterinary Surgery and Radiology, Faculty of Veterinary Medicine  
University of Tehran  
molazem@ut.ac.ir
Program

Tuesday, December 5th, 2017 (Venue: 3rd floor, Main Building, Hamady, Amphe-Theatre)

08:45 - 08:50  Recitation of Holy Quran

08:50 - 09:00  Short Welcome by Executive Secretary

09:00 - 09:50  Teaching Methodology of Teaching Surgery to Vet Students (DVM) using PBL (Problem Based Learning) and distributive (Babak Faramarzi) – United States

09:50 - 10:40  Mini locking plates in oral and maxillofacial surgery – a literature review (Cedric Tutt) – South Africa

10:40 - 11:15  Break Time and Exhibition & Poster

11:15 - 12:05  Dysplastic Hip Joint & Acetabuloplasty in Canine (Davood Sharifi) - Iran

12:05 - 12:40  Minimal invasive (endoscopically-guided) surgery application in the veterinary field (Daria Saade) – KARL STORZ – ENDSKOPE

12:40 - 14:00  Lunch Time and Exhibition & Poster

Attention Afternoon Session:
Venue: 3rd Floor. Amphe-Theater. Dr Rastegar Building,

14:00-14:20  Staplers in Veterinary Surgery (Amir Hossein Mavadati) - Iran

14:20-15:10  Lameness detection in dairy cows, a multidisciplinary approach (Ahmadreza Mohamadnia) - Iran

15:10-16:00  Evidence-Based Stem Cell Therapy in Equine Orthopaedic: Is It safe and Effective? (Mohamad Mehdi Dehghan) - Iran

16:00-18:00  Short Communication

Member of the Session:
1. Prof. Mohammad Mehdi Dehghan (Chairman)
2. Prof. Mehdi Oloumi
3. Prof. Abdolmajid Meimandinejad
4. Dr. Oliver Michael Crowe

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25
16:00 – 16:10 Comparison Of Autogenic Costal Cartilage With Chitosan Scaffold In Canine Humeral Defect Healing (Siavash sharifi)

16:10 - 16:20 Assessment Of Poly Caprolacton (PCL) Nanocomposite Scaffold Compared With β-Tricalcium Phosphate (HA+β-TCP) On Healing Femur Bone Defect In Rabbits (Alireza Jahandideh)

16:20 - 16:30 The Use Of Fascia lata As An Autograft For Permanent Treatment Of Anterior Cruciate Ligament Ruptures With Extra Capsular Technique In Dogs; New Surgical Technique (Amirreza Imani)

16:30 – 16:40 The Role Of Decellularized Fish Scale Derived Scaffold With Platelet Rich Plasma In Healing Of Tibial Bone Defect In Rabbit: An Experimental Study (Nikta Mansouri)

16:40 – 16:50 Total Vertebrectomy of L1 and Vertebral Stabilization with Dorsal Tension Band Wire Technique in a Paraplegic Dog (Mahya jazini Dorche)

16:50 – 17:00 Combination Of Mesenchymal Stem Cells And Platelet Rich Fibrin: A Novel Method For Articular Cartilage Repair And Regeneration (Davoud Kazemi)

17:00 – 17:10 Gelatin, fibrin-platelet glue and their combination on healing of critical bone defect in rat (Abdolhamid Meimandi-Parizi)

17:10 – 17:20 Effect of Chitosan-Zinc Oxide Nanocomposite Conduit On Transected Sciatic Nerve: An Animal Model Study (Mostafa Araghi)

17:20 - 18:00 Question and Answer (Discussion about papers)

18:00 - 18:30 Break Time and Exhibition & Poster

18:30 - 21:30 Inauguration Ceremony and Dinner Party
Wednesday, December 6th, 2017 (Venue: 3rd floor, Main Building, Hamady, Amphitheatre)

09:00 - 09:50 Guidelines for Basic Equine Dental Care (Dave Klugh) - United States

09:50 - 10:40 Computed Tomographic Imaging in Veterinary Dentistry and oral surgery and extraction techniques in veterinary dentistry (Cedric Tutt) – South Africa

10:40 - 11:15 Break Time and Exhibition & Poster

11:15 - 12:05 My Thirty Years Affair with the Tendon (Farshid Sarafzadeh Rezaei) - Iran

12:05 - 12:40 Prognostic Markers in Equine Colic (M M S Zama) - India

12:40 - 14:00 Lunch Time and Exhibition & Poster

14:00 - 14:20 Tele radiology for Veterinarian – Konica Minolta (Dr Ahmadreza Roohian) - Iran

14:20 - 15:10 Arthroscopy in Horses (Oliver Michael Crowe) – (South – Africa, Pretoria) - Britain

15:10 - 16:00 Surgical Management of Colic in Horses: A Review of Some Cases Performed in Veterinary Referral Hospital of Shahid Bahonar University of Kerman (Mohamad Mehdi Oloumi) - Iran

16:00 - 16:50 Anesthetic Management in Trauma Patients (Naser Vesal) - Iran

16:50 - 18:30: Short Communication

Member of the Session:
1. Prof. Naser Vesal (Chairman)
2. Prof. Farshid Sarafzadeh
3. Dr. Mohamad Reza Emami
4. Dr. Feridoun Sberiafshar

16:50 – 17:00 Effect Of Phentolamine Mesylate On Regression Of Epidural Anesthesia With Lidocaine – Epinephrine In Sheep (Fereshteh Alipour)

17:00 – 17:10 The Effects Of Propofol And Propofol- Epidural Anesthesia On Immunological Indices In Dogs Undergoing Ovariohysterectomy (Maryam Moslemi)
17:10 – 17:20 Evaluation of The Sedative Effects of Diazepam, Midazolam And Xylazine After Intranasal Administration In Juvenile Ostriches Struthio camelus (Mostafa Araghi)

17:20 – 17:30 The Effects of Midazolam –Ketamine On Resistive And Pulsatility Indices Of Aorta In Healthy Domestic Short-Haired Cats (Niloufar Ghahari)

17:30 – 17:40 Surgical Treatment Of Intraluminal Impaction In A Foal (Zahra Riahi)

17:40 – 17:50 Diagnostic and Therapeutic Advantages Of Endosurgery As A Minimal – Invasive Technique: Review Of 14 Dogs And 3 Cats (Hamidreza Fattahian)

17:50 – 18:00 Single-Incision Laparoscopy: Overview And Current Place In Veterinary Surgery (Roja Ebrahimi)

18:00 – 18:10 Treatment of cervical mucocele by mandibular and sublingual salivary gland excision in a male German Shepherd (a case report) (Alireza Bashiri)

18:10 - 18:30 Question and Answer (Discussion about papers)

18:30 - 20:00 Business Meeting of Iranian Veterinary Surgery Association
Thursday, December 7th, 2017 (Venue: 3rd floor, Main Building, Hamady, Amphe-Theatre)

09:00 - 09:50 Distal Limb Injuries in Horses: Incidence and Biomechanics (Babak Faramarzi)-United States

09:50 - 10:40 Results and Effects of Guidelines for Basic Dental Care (Dave Klugh) - United States

10:40 - 11:15 Break Time and Exhibition and Poster

11:15 - 11:45 Review of Veterinary Anti – Inflammatory Analgesics and Antipyretics (partI) (Zahra Khazaee)

11:45 - 12:15 Review of Veterinary Anti – Inflammatory Analgesics and Antipyretics (partII) (Tahr Pazooki)

12:15 - 13:00 Exhibition and the Poster Evaluation

13:00 - 14:00 Lunch Time

14:00 - 14:50 Diagnostic Imaging in Small Animal Portosystemic Shunt (Antje Hartmann)- Switzerland

14:50 - 15:30 Dentistry Radiology in Dogs and Cats (Mohammad Molazem) -Iran

15:30 - 17:00: Short communication

Member of the Session:
1. Dr. Abbas Veshkini (Chairman)
2. Dr. Antje Mareike Clarissa Hartmann
3. Dr. Mohammad Molazem
4. Dr. Alireza Ghadiri

15:20 – 15:30 MRI Features of The Brain Lesions In Zinc Deficiency In A Dog.- (Leila Mohammadyar)
15:30 – 15:40 The Diagnosis Of Quadrigeminal Cisterna Arachnoid Cyst By MRI In A Dog (Mahsa Zangishe)

15:40 – 15:50 Functional Magnetic Resonance Imaging: A New Gate Into The ADH – (Yasamin Vali)

15:50 – 16:00 Comparison of Quantitative Computed Tomography (CT) Analysis Of Pulmonary Patterns In Dogs Affected By Pneumonia And Pulmonary Edema, Before And After Intravenous Contrast Medium Administration - (Saeideh Eftekhar)

16:00 – 16:10 Computed Tomographic Sex Determination In Caspian Pond Turtle (Mauremys caspica) – (Maryam Mahdipour)

16:10 – 16:20 Intra Hepatic Porto-Systemic Shunt – (Fatemeh Aramesh)

16:20 – 16:30 Two-Dimensional Echocardiographic Normal Values In Clinically Healthy Ghezel Sheep - (Seyed Mohammad Hashemiasl)

16:30 – 16:40 Measurement Of Carotid Artery Blood Flow Velocity Of Camel By Pulse Wave Doppler Ultrasonography- (Aboozar Dehghan)

16:40 - 17:00 Question and Answer (Discussion about papers)

17:00 - 17:30 Closing Ceremony
The use of PBL and distributive teaching models in veterinary medicine curriculum

Babak Faramarzi DVM, CVA, MSc, PhD.

Providing quality higher education is a hot topic in academia. Refining existing educational programs is a very delicate issue and requires professional input from experts and educational leaders. The core of the teaching philosophy should rest on the idea that an educational program should be designed in a way that not only transfers technical knowledge to the students but also teaches team work, problem solving skills, critical thinking, clinical reasoning, innovation and leadership. The educational system should not only advise students but also train them to develop such characteristics.

Academic curriculums are mainly shaped based on the needs and existing resources. Hence, the goal of each educational system is often aligned with the needs of the society and people. In many cases, required resources might not be available at all times, so effective utilization of available resources is critical. Learning from successful experiences of other institutions and collaboration with pioneer institutions may facilitate curricular development. Technological advancements and availability of new resources allow for further improvement of the educational programs. For instance, the use of new educational software and 3-dimensional models may facilitate teaching complicated subject matters. While accessing most recent medical information i.e., latest publications, was challenging 20 years ago, the availability of internet and online resources allow for immediate access to the most recent scientific publications and sharing such valuable resources.

Traditional educational systems often consist of a lecturer (e.g., professor) and the audience (e.g., students). For many years educational systems involved passive transfer of educational material and information using a didactic teaching style, basically a teacher-centered arrangement. New studies specify that a student-centered educational system is more effective. The goal should be engaging students in the learning process; to teach them to understand and to learn “how to learn”, not to present the material to passive audiences. We learn better when we are actively engaged and when our curiosity is aroused. If the subject matter is introduced to students using practical problems they learn more efficiently; this also helps them to improve their problem solving and critical thinking skills.
A novel approach to teaching is the use of problem (case) based learning (PBL) format. The PBL system changes the focus from a “professor-centered” to a “learner-centered” format and directly engages students in the process. Like any other educational system, the PBL design has its own advantages and disadvantages.

Though over the past years, more academic institutions are becoming interested in PBL format and implementing it into their curriculum. While the PBL format has been used in Law, Business and Medical universities for more than 50 years; recently, some institutions have developed their entire curriculum based on PBL format. It develops critical thinking and enables students to apply concepts/ideas to practical experiences. The design of a PBL curriculum is very important and requires the use of real life clinical cases. Each case should stimulate students’ curiosity and guide them to learn required basic science and clinical materials. The flow of PBL cases is also important, each case should use previous information/knowledge and encourage more in-depth learning.

Facilitation of PBL classes are critical. While it should inspire individual learning, it should also encourage teamwork at the same time. The PBL format teaches students how to learn and how to teach themselves. The old saying “there is no better way to learn than to teach” (Benjamin Whichcote) is absolutely true.

Another approach to clinical education would be the use a distributive teaching model instead of traditional teaching hospitals. The growth of high quality specialty practices provides an excellent opportunity to educate students using collaborations with private practices. While such collaboration would be fruitful, it requires constant supervision and evaluation of students’ learning and progress. Technological advancements and availability of high quality specialty referral veterinary hospitals provide new avenues for offering quality distance clinical education. It allows the student to observe and perform significant numbers of medical/surgical procedures in a clinical setting while faculty monitor student training and oversee achievement of the course objectives. As an example, the Western University of Health Sciences, College of Veterinary Medicine, utilizes a distributive clinical training model for teaching senior veterinary students. Our records shows that during past 3 years, students enrolled in core surgery rotation (both small animal and equine) reported 12,533 patient encounters (mean 45 patient/student per a 4-week rotation) and 19,376 surgery related procedures. The student level of involvement was classified as observed (63%), performed independently (27%), and performed with assistance from a clinician (10%). When collaboration to high quality referral hospitals is feasible, the distributive model improves the student access to quality clinical training and may lower the cost of education for students. Utilizing high surgical caseloads in quality primary and specialty referral veterinary hospitals, with qualified staff and multiple digital communication platforms, provides a robust environment for clinical education of senior veterinary students. Advancements in digital communication (e.g., video conferencing, file sharing, virtual resources) are allowing for more in-depth communication between clinician educators, campus faculty, and student trainees; facilitating greater success in distance clinical education.
Mini locking plates in oral and maxillofacial surgery – a literature review

Cedric LC Tutt BVSc, MMedVet(Med), Diplomate EVDC

Diagnostic imaging modalities have become more efficient in the diagnosis of jaw fractures. Whereas before, standard medical x-ray machines were used that inevitably ended up with some superimposition, these days intra-oral digital radiographic systems (CR – computerised radiography) have become standard practice in veterinary dentistry suites. A step further has been the introduction of Computerised Tomographic capability and Cone-Beam CT. Both of the latter modalities produce excellent images and can be used in 3-D reconstructions (Multiplanar reconstructions) and also provide the data for 3-D printing of specimens that can be used as a template to pre-bend the plates that will be used.

Most bones have a compression and a tension side; in the case of the mandibles the tension side is the tooth-bearing part of the body of the mandibles and the compression side is the ventral margin of the body of the mandibles. When using a plate and screws to stabilise a jaw fracture, the plate needs to be placed as close to the alveolar margin of the body of the mandible as possible – this means as close as possible to the tension side. However, this part of the jaw houses the dentition and there is very little bone between the roots, in which to place the screws. In young animals there is no part of the mandibular body which does not contain roots (Harasen, 2008) as both the deciduous and secondary dentitions are present.

The tension surface of the maxilla is the tooth bearing part. The compression side is comprised of the maxilla and nasal bones on each side. The paired incisive bones form the palatal part of the canine alveolus (approximately one third of the palatal alveolus) and also house the three incisors on each side. There is as a result, no bone in the incisive bone into which screws can be safely secured.

The least invasive jaw stabilisation is achieved by the application of a cloth muzzle (commonly used to prevent nervous dogs from biting staff at the veterinary clinic). These muzzles support the mandibles and keep the canine teeth in occlusion, while allowing the animal to open its mouth sufficiently to prehend food and water and pant when necessary. These are ideal for use in young puppies with jaw fractures. The muzzles must be kept clean and dry to prevent maceration of the lips, which can cause lip necrosis. After feeding the muzzle should be removed, the dog’s face and lips cleaned and dried and a clean, dry muzzle replaced. The used muzzle must be washed and dried, for reuse. Cloth muzzles are contraindicated in brachycephalic dogs as they may interfere with breathing and panting and do not fit correctly.
Jaw stabilization is commonly achieved by interdental wiring and interdental acrylic techniques and under certain circumstances, interfragmentary wiring. Inter-dental wiring techniques include: Risdon, Ivy-loop and Essig’s techniques. Care must be taken when using inter-dental wiring techniques to ensure that the teeth are not avulsed and that the crowns are not damaged during placement of the wires. The wires must be sited in such a way as to prevent interference with normal closure of the mouth and occlusion. When inter-dental acrylic stabilisation is performed, care should be exercised when the acrylic is applied to the teeth as some forms of methyl-methacrylate are highly exothermic and may induce pulpitis and pulp necrosis. When highly exothermic material is used, it should be applied incrementally to prevent a large bulk that will create more heat. Temporary crown material is preferable as this does not have an exothermic reaction and also bonds well with the surface of a clean tooth. There are malleable acrylic sheets that are available for inter-dental stabilisation – once applied to the teeth they are “cured” using a light-curing gun. The bulk of acrylic must be placed on the side of the tooth away from the occlusal contact i.e. lingually on mandibular teeth and buccally on maxillary teeth.

Wire-reinforced acrylic stabilisation is commonly used. This involves the placement of inter-dental wires prior to acrylic being applied to the teeth and covering the wires.

Where there is sufficient jaw bone to allow placement of threaded pins between the roots, external fixation techniques can be used. However, an external fixation device must not be placed at the expense of tooth roots or the mandibular canal contents.

In the past, the tooth roots have been disregarded completely when decisions were made about screw and external fixator placement. Verstraete et al (1992) showed that 61% of screws used to affix plates to the buccal aspect of the mandible, damaged tooth roots, including: periodontal ligament, cementum, dentine, pulp and periapical tissues. They concluded that plates and screws could not be recommended for mandibular repair, (Verstraete F. J., 1992) Not only have screws been driven through the roots and mandibular canal but so have external fixation devices. In rare (fortunately) circumstances, some have chosen to drive an orthopaedic pin down the mandibular canal, some going to such extremes as to amputate the crown of the canine and drive the pin down the pulp chamber and root canal into the mandibular canal. This has devastating effects as it inevitably destroys the neurovascular supply to the teeth and soft tissues beyond the mental foramina. The mandible DOES NOT have a medullary space. It does however have a canal bounded at each end by the mandibular and mental foramina, respectively, through and along which the neurovascular structures traverse.

In a recent publication it was shown that screws were placed superimposed on roots and the mandibular canal, when locking and non-locking plate configurations were placed in the mandibles of cats. (Greiner, Stover, Garcia, Leale, & Arzi, 2017). This publication also showed that locking plate stabilization was mechanically stronger than the non-locking plate stabilisation. (Greiner, Stover, Garcia, Leale, & Arzi, 2017). In a publication by Arzi et al 2016, it was shown that stabilising the fractured jaw of a dog using a single locking plate was not as strong as when an alveolar mini locking plate was used in combination with a mid-body locking plate. However, more roots were damaged in the specimens in which the double plating stabilisation was used. (Arzi, Leale, & JM, 2016).

The aim of functional jaw fracture repair is not only to achieve stabilisation and union but also to restore occlusion. For this to be achievable, the occlusion of the animal prior to the fracture must be known. It is not possible to create a perfect occlusion in an animal that had a malocclusion prior to
the fracture. Gathering an accurate history of the animal’s occlusion prior to the fracture is important. Up to 20% of jaw fracture surgeries are complicated by resultant malocclusions or osteomyelitis (Harasen, 2008).

Verstraete et al (2015) reported that a single 2mm locking miniplate could be used in the stabilisation and treatment of defect non-union fractures, even after years of non-union. These plates were used in combination with bone regenerative materials. Placement of the plate on the mid-buccal aspect of the mandibular body functioned well to buttress the fracture site, the plate was not exposed through the soft tissues, iatrogenic tooth root damage from screw placement was avoided and the plate did not fail. (Verstraete, Arzi, Huey, Cissell, & Athanasiou, 2015).

Lewis et al (2008) described the use of a standard compression plate and a mini locking reconstruction plate used in the repair of a bony defect in the mandible of a dog, following a gunshot wound. (Lewis, Boudrieau, Reiter, Seeherman, & Gilley, 2008)

Reconstruction of the rostral mandibles, resected due to excision as a result of neoplasia, is possible using reconstruction plates and rh-BMP. (Arzi, Cisell, Pollard, & Verstraete, 2015). In this series, the reconstruction plates were contoured and fitted to a 3-D model of the jaws, which was printed using the data acquired using multiplanar reconstruction of the pre-operative CT examination.

Spector et al (2007) performed and immediate reconstruction of a hamartoma excision site which was stabilised using a mini locking plate. (Spector, Keating, & Boudrieau, 2007)

Excellent occlusion, function and cosmesis of maxillofacial fractures can be achieved using locking mini reconstruction plates. (Arzi & Verstraete, Internal Fixation of Severe Maxillofacial Fractures in Dogs, 2014) (Illukka & Boudrieau, 2014). In both of these publications the patients had suffered multiple fractures of multiple of the bones of the head and face. In both cases there were comminuted fractures that were repaired using multiple reconstruction locking plates achieving excellent apposition of the fragments, return to function and cosmesis.

A review of the literature has shown scant publications on the use of mini-locking plates in veterinary oral and maxillofacial surgery, even though this has been the stabilisation means of choice in edentulous jaws for a number of years. Courses are presented annually by the manufacturers of mini locking plate systems in the USA and Europe and are well attended.

Mini locking plates include reconstruction plates and other small plates less than 2mm in thickness which can easily be bent to conform to the shape of the bones on which they will be placed. Mini locking plates have threaded holes that accommodate the threaded head of the fixing screws. When driven home, the screw head will seat just below the surface of the plate.

Mini locking plates are available in a range of sizes and materials ranging from surgical steel to titanium.

There is a system in which stainless steel plates with threaded holes are used. The threaded holes in the plates accommodate the locking bushes which are threaded on their outer surfaces and have a conical inner surface with which the conical screw heads engage. The screw heads and bushings are
locked together by friction, micro-welding and elastic deformation. (Petazzoni, Urizzi, Verdonck, & Jaeger, 2010)

In conclusion, it has been shown that mini locking plates are the modality of choice when treating jaw – mandibular, maxillary and facial – fractures. The plates have minimal contact with the underlying bone. Screws, because they are locked in the plate are more stable in the bone and less likely to pull out as is sometimes seen when compression plates are used. The strength of the mini locking plate system stabilisation is greater than the same sized compression plate system.

References
Dysplastic Hip and Acetabuloplasty in Canine

Dr Davood Sharifi
Professor of Veterinary Surgery, Department of Veterinary Surgery and Radiology, Faculty of Veterinary Medicine, University of Tehran, Tehran, Iran
P.O.Box14155-6453 dsharifi@ut.ac.ir dav.sharifi@gmail.com
Mobile:0098-912-3194096

Dr Alireza Bashiri
Post-Graduate Student, Department of Veterinary Surgery and Radiology, Faculty of Veterinary Medicine, University of Tehran, Tehran, Iran
P.O.Box14155-6453

• The dysplasia diseases is one the common orthopedic diseases in human and animals causing discomfort, pain, joint inflammation and secondary osteoarthritis which is genetically, is a complex inheritance, and usually the condition is mutligenes combined with environmental influences which ultimately cause expression of the condition. Despite of underlying etiology and pathogenesis of this condition remain unclear, and since description of dysplasia by Schnelle in year 1937 till now different treatment of choice in form of surgical interventions beside medical and conservative one, being advocated by different colleagues but its effective treatment depend upon economic dictated by owners. Alexander (1992) ascribed hip dysplasia in dogs a biomechanical disease, represented by the discrepancy between primary muscular mass and rapid growth and Cardinet (1997) suggested that pelvic muscle abnormalities were related to the development of the hip dysplasia. And Sumner-Smith (2000) elaborated that hip dysplasia is a syndrome related to abnormal musculoskeletal development predicted on a genetic predisposition, but influenced by other factors such as rapid growth, environment, and a rich protein diet. One of the best accepted hypothesis currently that dogs affected with disease are born with a normal hip joint articulation and due to genetic factors, muscular strength is insufficient to maintain the femoral head in the acetabulum, thus causing laxity of the hip joint articulation and leading to articular incongruity and later articular degeneration (Numamaker, et al 1973. Alexander, 1992; Charette et al 2001). That canine pelvis is composed of the paired Os-Coxae (or hip bone) the sacrum and the first caudal vertebrae. Each Coxae is developmentally composed of the ilium, ischiium, pubis, and acetabular bones which fuse at 12 weeks of age in the dog (Fig. 1). A normal hip must be an example of symmetry and balance as it develops and maintains itself from birth through adulthood. The hip joint is composed of specialized tissues, all of which participate in a programmed chain of
development. Except in the racing and toy dog types, there is a great chance that the hip will develop abnormally. (Fig. 2)

Every dog is potentially at risk of suffering hip dysplasia—no matter his or her breed (whether it’s a purebred pup or older mix). Pups can be unusually willing to have their joints manipulated. This opportunity means that even the tiniest babies can often receive a tentative diagnosis for at-risk hips. Pups with “crepitance” (a grinding sensation) in one or both hips on manipulation can be flagged as requiring follow-up attention in the form of palpation, of X-rays (ventrodorsal view) and ultrasonographic screening methods as early as four to six months of age for developmental hip dysplasia. The hip laxity early in life has been suggested as being primarily involved as a causative factor in hip dysplasia. Hip dysplasia may lead to pelvic limb discomfort and disability and it is concern for dog owners, dog breeders and veterinarians and a definitive diagnosis by convention, is made only if characteristic radiographic signs are evident on a ventrodorsal view of the pelvis performed after the age of 1 or 2. The developmental changes appear first and because they are related to growth, they are termed primary changes. Subsequently these changes may lead to excessive wear and tear. The secondary changes may be referred to as (osteo)arthritis (OA), (osteo)arthrosis or degenerative joint disease (DJD). Later one or both hip joints may become mechanically defective. At this stage the joint(s) may be painful and cause lameness. Animals system is favored in the many countries using different suggested methods to evaluate the passive hip laxity, and even in some countries radiographic diagnosis has been used for the screening of breeding stock for nearly 40 years.

A dog with normal hips. (Fig. 3) The ball is round and fits well into a deep socket. The red line highlights the socket and the green line outlines the femoral head (ball) and neck. Notice the hourglass appearance of the thin femoral neck. The region of solid green colour represents the part of the femoral head that is buried within the socket. (Fig. 3)
Hip dysplasia which is a concentration of factors ultimately leading to a pattern of progressive remodeling and degenerative joint disease. The degree of involvement varies from minute changes in bone structure to total destruction of the hip joint. Investigators have searched intensively for genetic, chemical, and metabolic defects, but the cause has remained obscure. (Fig. 4). Hip dysplasia affects humans and all other domestic mammals. In humans, 1-3 children in 1000 are affected. In dogs the prevalence may run over 50% in large dogs if control measures have not been practiced. Few data are available on the prevalence of hip dysplasia in other mammals, but it is thought to be low. The disease is undoubtedly rare in undomesticated animals radiographic findings, patient age, and the patient’s overall articular cartilage status, but in contrast to humans hip dysplasia in dogs is not congenital as animals are born with normal hips, though hip joint instability and histologic evidence of acetabular remodeling have been documented as young as 7 weeks. It has been demonstrated that both genetic and environmental influences contribute to development. This is further supported by the fact that bony dysplasia can be increased, decreased, or prevented by controlling the degree of joint instability and incongruity. Different causative factors for hip dysplasia on priority base are listed such as

• Body Size 2-Body type 3-Genetic Influences and Heritability
• 4-Extrauterine Influences 5-Environmental and Man-Made Influences
• 6-Pelvic muscle mass 7- Muscle myopathies
• 8- Abnormal pectineus muscle behavior 9-Growth Pattern
• 10-as femoral anteverision and spastic shortening of the psoas muscle
• 11-Metabolic Influences 12-Sex 13-Hormonal Influences
• 14-Environmental and Man-Made Influences 15-Shape of the Femur
• 16-Physes/ Growth plates 17-Femoral Neck
• 18-Longitudinal Growth of the Femur 19-Femoral shaft
• 19-FEMORAL CONDYLES 20- Growth of the Os Coxae (In nominate Bone) Growth of the Pelvis 21-Relationship of the Femoral head and
• 22-Acetabulum shape 23-Ileum length 24-Ischeium size
No specific genetic pattern of inheritance has been demonstrated in this variable disease. It has been
demonstrated that both genetic and environmental influences contribute to development, regardless
of the species affected. Consequently, the disease has been designated as polygenic or multigenic.
As in most polygenic diseases, there are both major and minor causative factors Body Size is quite
effective as the HDP, it is lowest with ancestral dog. Joint looseness (laxity), 2-inflammation, 3-
pain, 4-new bone formation, 5-and bone erosion. It may cause a range of observable signs from
normal to minor changes in gait and usually two palpation methods (Bardens and Ortolani).
Radiographic distraction view, Three tomographic measurements and two magnetic resonance (MR)
images used for early monitoring of hip morphology and laxity in 7-9 weeks old puppies and
to compare these clinical and imaging methods for their accuracy in predicting passive hip laxity
at 4 months of age and the radiographic signs of hip dysplasia and passive hip laxity after 1 years
of age for radiography, dogs were supine on the X-ray table and a hip extended view and a distraction
view were performed. These views were obtained similarly to the PennHIP method and by
extended view of dog older than 1 year was used to classify. The hip degree of hip dysplasia on
every joint using the FCI scoring system. The breeds with the lowest prevalence of hip dysplasia are
near the size of the ancestral dog. The giant breeds with the highest prevalence of hip dysplasia are
two to three times larger than the ancestral dog...Body Type In general, the body conformation of
the breeds with the lowest prevalence of hip dysplasia is slender and trim and the skin and
subcutaneous tissues and fascia rarely contain over 1% to 2% fat by weight of the high-risk group,
the four breeds of the giant type are not only two to three times the size of the ancestral dog, but
their body conformation is heavy, round, and stocky. Acromegal characteristics are present to
some extent in all four breeds. Fat is abundant in the subcutaneous and fascial spaces and commonly
accounts for 5% to 10% of the weight of the soft tissues of the hindquarters, than that of the smaller
breeds. Growth Pattern: Breeds with the highest prevalence of hip dysplasia grow and mature more
rapidly than those in the low-risk group. Starting at birth, this group gains rapidly. The pups of these
breeds are aggressive eaters, both as they nurse and as they take supplemental food. In a study
involving 222 German shepherds, 63% of the dogs that weighed more than the mean of this group
at 60 days of age were dysplastic at 1 year of age, whereas only 37% of those less than the mean
became dysplastic. The same rapid rise in weight in other breeds of the group at high-risk for
dysplasia has been observed. Hip dysplasia has not been reported in the wild undomesticated
carnivorous animals, such as wolves and foxes. Such an environment favored the completion of
ossification and developmental maturity of the joint before the hips could be subjected to possible
injury, incongruity, or subluxation from excessive extrinsic forces (e.g., excessive body weight).
Genetic Influences and Heritability: Environmental and Man-Made Influences chemical and
hormonal influences: and diet are infact prerequisite factors for inducing dysplasia. (Fig.5), and
breeds with the highest prevalence of hip dysplasia grow and mature more rapidly. Starting at birth,
gains rapidly and the pups of are aggressive eaters with supplement food (Fig.6)
Hip dysplasia has not been reported in the wild undomesticated carnivorous animals, such as wolves and foxes.

A study of their pattern of growth found that the pups were slow-growing and late maturing. The young pups were whelped in dens. Young carnivores were quite mature and 6 to 10 months old before they began to hunt.

The amount of food available for the growing members of a litter was limited. This caused the young to mature slowly and remain thin and light for their body size. Young carnivores were quite mature and 6 to 10 months old before they began to hunt.

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Fig. 8a, b: Subluxation and hip dysplasia occurred when growth, gain in weight, and nursing aggressiveness exceeded the strength of the supporting
The first subluxating stress on the hips occurs when the pup supports itself while nursing and the hind legs are in forceful adduction and extension. (Fig. 8)

The heaviest pups were the more aggressive, worked the hardest while nursing, and spent the most time feeding.

**Medical and Conservative Treatment:** it is based in triad protocol including
1- Pharmacologic treatment which is aimed at pain relief and subsequent amelioration of discomfort caused by articular inflammation by using narcotics, steroids and non-steroidal anti-inflammatories
2- Body weight Control to decrease articular overload and 3) Physiotherapy, were controlled exercise program helps maintain muscle tone improves range of motion (Martinez 2011)
4- Hip dysplasia can be managed in its early stages with enforced rest or analgesia (Fig 13: conservative treatment, Hydrotherapy and medications)
5- Enforced inactivity namely cage rest decreases the pressure on the hip lessens the constant subluxation and rubbing and may make dogs more comfortable for a short time
6- Analgesics or anti-inflammatory drugs decreases the animals discomfort. Aspirin, buffered aspirin, phenylbutazone, or other non-corticosteroid anti-inflammatory drugs are useful
7- Dosage must be titrated to the individual patient. Most dogs will require medical analgesia for the 6 to 10 weeks to hip remodeling, which results in the greatest amount of discomfort. Chronic administration is rarely necessary.

**Surgical Treatment.**
1- many reasons exist for performing surgery on dysplastic animals. one reason is to correct a bony abnormality and thus correct joint incongruitty.
2- PCO- Pelvic Corrective Osteotomy (derotational femoral osteotomy or varus femoral osteotomy
3- BTPO- Bilateral triple pelvic osteotomies
4- TPO- Triple pelvic Osteotomy
5- FHO- Femoral Head and Neck Resection or Osteotomy (Legg-Calvé-Perthes disease)
6- DAR - Dorsal Acetabular Arthroplasty
7- JPS-Juvenile Pubis Symphysiodesis
8- Finally there are pain-relieving procedures such as myotomy and myectomy.
9- AD- Acetabular Denervation (Pelvic denervation) (pain-relieving procedures)
10- The Ischial osteotomy
11- Shelf – Acetabuloplasty
12- AD-Acetabular deepening
13- Arthroplasty (femoral –head and neck resection)
14- pelvic Myotomy and Myectomy.
15- THR-Total Hip Replacement

**Acetabular denervation surgery.**
The hip joint capsule denervation is an innovative technique in dogs reported first by Kinzel and Kupper (1997). These performed a selective neurectomy of the sensory fibers of the joint capsule with the sole objective of providing hip joint analgesia via denervation. It is based on techniques previously described for use in human patient and which is therapeutically mainly for chronic articular diseases of the hands (Fig. 9: Foucher at al1998)
Fig. 9a, b. Age sensitivity about bony changes and suggested Treatment.

**Shelf acetabuloplasty**

It is known to be effective for remodelling subluxated but reducible hips during the early stage of Perthes’ disease in older children, usually over seven years of age. In this group, femoral varus osteotomy carries the risk of limb shortening with coxa vara, and innominate pel-vic osteotomy fails to reduce a subluxated femoral head. This surgical indication was described as ‘reducible subluxation’. 
They confirmed the reduction of the femoral head by dynamic arthrography and stated that shelf acetabuloplasty was contraindicated in unstable hips with hinge abduction. Also performed intra-operative dynamic arthrography to exclude non-reducible hips in which the epiphysis could not be contained in the acetabulum and the labrum tip moved upwards on attempted abduction. Ursal and Erkula 15 used MRI and physical examination to exclude hips with hinge abduction. We also excluded hips with hinge abduction using intra-operative dynamic arthrography, and our typical indication for shelf acetabuloplasty was hips with ‘impending impingement’, in which the subluxed femoral head could be reduced followed by abduction casting with or without soft-tissue release (18 hips) or traction (5 hips). Shelf acetabuloplasty for hips with reducible subluxation was found to produce favourable hip remodeling in older children with early Perthes’ disease. In addition, we were able to identify a prognostic factor associated with increased acetabular wall growth and the prevention of hip subluxation. Shelf acetabuloplasty as a containment procedure seems to be best indicated for subluxed hips in which epiphyseal collapse is not advanced and the extruded epiphyseal segment can slip easily underneath the labrum on attempted abduction without imposing undue pressure on the lateral edge of the acetabulum (Figs10,11,12,13).

Fig. 10, 11: A: Exposure of the full length of 5th rib  B: Rib ready for fixation
CONCLUSIONS
Canine hip dysplasia can cause great discomfort to the animal. The wide indications for various procedures. In general, a dog is better with its hip joint than without it, provided it has stability and an absence of pain. Medical management is very successful in most dogs.
Reconstructive Osteotomies should be designed to completely stabilize and improve hip conformation. These procedures are best done early but with the full realization that future problems (i.e., degenerative joint disease) may still occur.

Myotomy procedures should be used only as pain-relieving procedures in dogs with proven degenerative joint disease of the hips. Myotomy is inappropriate in immature dogs or as a proposed “cure” for hip dysplasia.

Hip Joint Capsule Denervation: An innovative technique as to select neurectomy of the sensory fibers of the joint capsule.

Femoral Head and Neck Resection, a good tool for relief of pain, should be regarded only as a end point salvage procedure when medical management is no longer effective.

Total Hip Replacement seems to be an ideal procedure. It provides for better joint stability and alleviates pain. Technically, the success rate of the procedure is improving with time, as surgeons gain more experience. Small and medium sized dogs seem to be better candidates for hip replacement than large breed dogs. The shallow acetabular small pelvic muscle mass, and body weight of large breed dogs can lead to prosthesis dislocation.

Acetabular Deepening can be used for restoration of the femoral head ligament and joint capsule with good functional results especially in hip joint incongruence resulting from severe hip dysplasia.

Single, Double Even Triple Shelves Acetabuloplasty allows achieving good and stable midterm outcomes in the treatment of severe LCP disease. The procedure improves almost full coverage of femoral head allowing full normal rotation.

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References
Minimal invasive (endoscopically-guided) surgery application in the veterinary field

Minimally invasive surgery (MIS) collectively refers to surgical techniques designed to minimize the extent of an anatomic approach without sacrificing precision and efficiency.

1 This rapidly evolving field includes laparoscopy, thoracoscopy, and arthroscopy, and specialized procedures in cardiology, neurosurgery, osteosynthesis, and interventional radiology. The benefits of MIS are clearly documented in people, and for most surgical diseases, minimally invasive approaches have replaced conventional or “open” surgical procedures as the current standard of care.

2 Since the first laparoscopic cholecystectomy performed in people in 1987, general surgeons now perform >90% of cholecystectomies laparoscopically for more than 1 million Americans diagnosed with gallstones each year.

3 Similar evolution of MIS techniques has occurred in veterinary surgery over the past 15 years, indicating that minimally invasive procedures are technically feasible with adequate training and development. Clinical studies comparing open and minimally invasive approaches have identified significant benefits of MIS techniques in a variety of species. Similar to humans, reductions in postoperative pain, hospitalization time, and wound complications, as well as faster return to normal function and improved cosmesis exist for veterinary patients.

4–11 MIS techniques also provide significant advantages for the surgeon including improved visibility, magnification, and illumination in areas that are typically very difficult to access such as small joints or deep body cavities. Minimally invasive surgery (MIS) collectively refers to surgical techniques designed to minimize the extent of an anatomic approach without sacrificing precision and efficiency.

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Minimal Invasive Surgery Application in Veterinary Field

I. Definition and history of endoscopy

Endoscopy derives from two Greek words: “Endo” meaning inside and “Scope” meaning to view. Over the past decades, there have been major advances in the ability to look inside patients and perform complex operations through small incisions which has given rise to keyhole surgery or what is known as minimum invasive surgery (MIS).

Although the first reports of endoscopy come from Hippocrates (460-377 BC) who described the use of a rectal speculum, the real development of endoscopy started in the early 19th century with the introduction of the light transmitter (Lichtleiter) by the German physician Philipp Bozzini. Following the path of Bozzini, several surgeons of different nationalities have attempted to improve the design and the functionality of the scopes for urogenital and gastrointestinal examination through the natural orifices. However, the first attempt to perform an endoscopic examination the abdominal cavity was carried out on a pregnant woman by Dimitri von Ott in 1901. His technique was called “ventroscopy” introducing the speculum into the abdominal cavity via small colpotomy.

In the same year, the first true laparoscopic examination was performed by George Kelling to examine the peritoneal cavity of a dog by using a Nitze cystoscope and insufflating the abdomen.
with filtered air. Since then, different attempts for endoscopic examinations and procedures were performed which lead to the modification of the instruments and techniques used over the years. Equine laparoscopy was first reported by Tarasevic in 1927 with a purpose to examine the reproductive organs. A revolutionary development was the introduction of cold light fiberglass illumination by Max Fourestier and his colleagues in 1952 in combination with the development of the zoom lens by Harold Hopkins in 1946. The lens system was then improved with the joint efforts of Karl Storz and Hopkins to a rod lens system that allow a much clearer and brighter image. It is until 1954 that the flexible endoscope was developed using fiber optical bundles to transmit the image. Over the following years, further modifications were introduced with the addition or air/water insufflations channel and the instrument working channel. However, after the development of the charged couple device (CCD), the first flexible videendoscope was introduced, in 1983, with a CCD at the distal end improving much the quality of the image by eliminating the pixilated image that the fiberoptics transmit.

Even at this late stage, endoscopy was only performed by internist for mainly diagnostic purposes. With the effort of Kurt Semm, cholecystectomy was then started to be performed under laparoscopy and was declared to be the treatment of choice for uncomplicated cholelithiasis in 1993. By the early 1990s, the surgeons started understanding the value of laparoscopy and thus tried to perform different procedures. Similarly in the veterinary field, endoscopy was utilized for research and diagnostic purposes. In early 1970s, laparoscopy was sporadically reported in therapy of the reproductive tract in mares. Laparoscopic sterilization of male and female dogs was reported in early 1980s by David Wildth. However, therapeutic arthroscopy was globally embraced and started to be practiced much earlier than MIS (1980s). In 1990s, equine laparoscopic procedures were commonly reported and then compiled into the first textbook edited by Fischer in 2000. Although small animal cases were less reported, Dr. Lynetta J. freeman published, Veterinary Endosurgery, the first textbook dedicated to application of MIS in small animals in 1999. Since the early 21st century, many reports and studies were done on interventional laparoscopy which lead to the development of various techniques in both small and large animals.

II. MIS advantages
MIS is defined by surgical technique designed to minimize the extent of anatomic approach without sacrificing precision and efficiency. The advantages of MIS are clearly documented in people which lead MIS to replace conventional or “open” surgical procedures as the current standard of care. Similarly, since minimal invasive procedures proved to be technically feasible with adequate training and development, MIS techniques have evolved in veterinary surgery over the past 20 years. Various clinical studies comparing open and minimal invasive approaches have identified the significant benefits of MIS in different species similar to that in human. MIS techniques provide significant reduction in postoperative pain, hospitalization time, and wound complications. In addition, it leads to faster recovery time and improve cosmesis. MIS also provide significant advantages for the surgeon by improving the visibility, magnification, and illumination of areas that are normally difficult to access.

III. MIS Equipments
The specialized equipments needed for laparoscopy and thoracoscopy are similar. The most basic video endoscopy imaging system consists of a light source, light-transmitting cable, endoscope, camera, and monitor. Each component is essential, and the resulting endoscopic image can only be as good as the weakest link in the chain. The light generated by the light source is transmitted by the fiberoptic light cable, and farther down the telescope, by fiberoptics to illuminate the anatomy being observed. The image is transmitted through a series of lenses from the distal end of the telescope to the eyepiece, where the chip in the video camera head senses the image and transmits it to the camera control unit (CCU), which processes the endoscopic image and transmits it to a monitor for viewing. This video projection enables the surgeon to maintain an ergonomic posture and to share the visual information with observers. Furthermore, video imaging facilitates documentation of procedures, in several formats and enables remote access to a live procedure via streaming video.

Laparoscopes are rigid telescopes similar in design and construction to an arthroscope. Most telescope employ Hopkins rod-lens system which optimize light transmission and provide wide field of view. Telescopes with various viewing angle and physical dimensions are available. The selection is based on the targeted specie, cavity, and procedure. The most common used angles of view are 0° and 30°. The length varies widely between 6.5 up to 60 cm; while the diameter can vary between 1.9 up to 10 mm.

The power and type of light sources are two of the main factors determining the brightness, clarity, and color accuracy of an endoscopic image. Condition and quality of light transmitting cables, cleanliness of lens surfaces, light sensitivity of the camera, and monitor type also contribute to image brightness and quality. Xenon and LED are the most common types of high-quality light sources used today, ranging in power from 50 to 300 W. Although Xenon light source is the most popular because it offers excellent tissue color reproduction with light closely approximating that of pure sunlight, LED technology is increasingly being adapted because of greater efficiency, long lifetime, small size, real cold light fountain and light weight.

The fiberoptic light guide cable is the weakest part of the image chain, consisting of a bundle of thousands of optical glass that transmit the light from the light source to the telescope. Light cables are available in various styles and diameters, depending on the diameter of the telescope. Correct matching prevents overheating or underillumination.

The video camera system consists of the camera head, CCU, and monitor. The developments in charge-coupled device technology have led to the availability of compact, easily sterilized, robust cameras. These cameras act as electrical-optical interface which then permit through camera processor signal modification to display the image on the monitor. The recent technological evolution led to the production of different camera type with different image quality; however, a multidisciplinary and versatile system that is compatible with all types of scopes should be considered since permit a broad endoscopy service at a reasonable cost. In addition to the main components of the camera system, digital capture systems could be required since it offer a high image quality and easy export of data to the hospital network or patient files. Most units also have an internal storage of limited volume, including patient-related information. Still images and videos are captured and stored on the unit’s hard drive or alternatively recorded onto USB flash drives or external devices.

Other units could be required depending on the endoscopy procedure performed including a CO2 insufflator, electrosurgical unit and fluid irrigation and suction pump.
Finally, there is a wide variety of hand instruments used laparoscopy and thoracoscopy similar to that used in open surgeries but with longer and narrower shaft to be inserted through the cannulae. The dimensions also vary depending on the targeted specie and procedure. The trocar-cannula units and endoscopic tools may be disposable or reusable. Most of the reusable tools are stainless steel, and many veterinarians prefer them for their cost-effectiveness. In addition, some energy and stapling instruments are useful and sometimes essential in advanced MIS procedures to reduce hemorrhage and permit rapid anastomosis. Clinical studies comparing open and minimally invasive approaches have identified significant benefits of MIS techniques in a variety of species. Similar to humans, reductions in postoperative pain, hospitalization time, and wound complications, as well as faster return to normal function and improved cosmesis exist for veterinary patients. 4–11 MIS techniques also provide significant advances for the surgeon including improved visibility, magnification, and illumination in areas that are typically very difficult to access such as small joints or deep body cavities.

IV. Laparoscopy applications in veterinary field
a. Fundamental laparoscopic skills and principles
The basic skills required for laparoscopic surgery include ambidexterity, hand–eye coordination, instrument targeting accuracy, and recognition of cues to provide a sense of depth. All these skills could be only acquired through training; therefore different types of simulation training models were developed and have been implemented in the curricula of surgery resident programs in USA and used in basic international endoscopy courses. Although box trainers and surgical simulators are obvious training modalities, video games are an underused modality that is inexpensive and has been shown to directly correlate with box trainers, surgical simulators, and OR performance. Basic principles should be followed during any MIS procedures. The basic fundamental requirement is the orientation of the telescope-camera unit in an aligned with upright camera head which will ease the use of the tip angulations for the vision of different perspective and permit precise manipulation of the telescope in order to optimize the vision of a targeted tissue. In addition, it will reduce risk of interference and collisions between the instruments and telescopes which is also avoided by the triangulation and the optical-coaxial alignment of the instrument ports and the telescope.
Moreover for an ergonomic manual performance, the optimal height of the surgical table/animal should be adjusted so that the instruments’ handles are positioned lower than the elbows of the surgeon. For maximum comfort during any procedure, the monitor should be placed in a slight angled position below the eye level with a distance of 1.5 meters away.

b. Diagnostic techniques
Biopsies are till today the gold standard for the diagnosis of some disease processes. MIS allows direct observation of the targeted tissue thus reducing trauma to other organs and tissues and allowing a direct monitoring of immediate post-biopsy hemorrhage. Although laparoscopic guided biopsies are more expensive and need more preparations, biopsy forceps generally leads to a larger biopsy specimen providing more accurate diagnosis than other conventional techniques as ultrasound guided needle biopsies.
In equine, laparoscopic guided biopsies could be performed on a sedated standing animal or on an anesthetized horse in dorsal recumbency depending on the targeted tissue. It is mainly performed in horses with suspected liver, kidney, or splenic diseases where histopathologic diagnosis would be...
helpful in the treatment of the disease. In addition, laparoscopic bowel biopsy is indicated when an accurate diagnosis, prognosis and therapy could be achieved with histopathology as in chronic inflammatory bowel disease (IBD).

Diagnostic laparoscopy is also commonly used in small animals as a method for obtaining liver, pancreas, kidney, splenic, intestinal, and tumor biopsy specimens. Moreover, it is used in oncology to diagnose and stage the extent of malignancy, either primary or metastatic, since it may reveal small (0.5 cm or less) metastatic lesions, peritoneal metastases, or organ involvement not easily observed by other techniques. Full thickness intestinal biopsies can also be performed using laparoscopic assistance.

Exploratory laparoscopy is commonly used in small and large animals’ practices when the extracorporeal diagnostic tools are inconclusive. Since laparoscopy gives the surgeon a direct view inside the abdominal cavity, it could provide more information regarding the location and nature of the affection and the overall prognosis of the patient case. In horses, exploratory laparoscopy is mainly indicated in cases of abdominal pain and in horses with signs of chronic weight loss related to problems in the abdominal cavity. In small animal practices, exploratory laparoscopy is mainly used for gastrointestinal examination. Other ancillary diagnostic techniques used in small animals include reproductive evaluation of the ovaries and uterus with the capability for direct intrauterine insemination, gallbladder aspiration, splenic pulp pressure measurements, laparoscopic directed splenoportography and urinary bladder evaluation. Unexplained abdominal effusion is an additional indication for laparoscopy when other diagnostics to determine the cause are unsuccessful.

c. Interventional Laparoscopy

Interventional laparoscopy is becoming more frequent over the past decade with regularly new techniques and indications being evaluated and implemented. Different laparoscopic interventional procedures are being performed in horses. Cryptorchidectomy and adhesiolysis can be performed in either standing or dorsal recumbent positioning. Nephroplenic space ablation as treatment for left dorsal colonic displacement and entrapment could be performed laparoscopically on a standing sedated horse. Standing laparoscopic peritoneal flap hernioplasty surgery is an effective and safe technique to prevent recurrence of acquired strangulating inguinal herniation in stallions when unilateral castration is not desired. In addition, laparoscopic inguinal herniorrhaphy can be conducted in foals with congenital scrotal hernia. Unilateral or bilateral laparoscopic ovariectomy through ventral and standing lateral approaches has been commonly performed for the removal of both normal and large pathologic ovaries in mares. Moreover, laparoscopic gonadectomy is an effective treatment for the rare cases of intersex horses. Other laparoscopic genital surgeries as mesometrium imbrication are reported in few case reports. Laparoscopy is also beneficial in the surgeries of urinary system. Laparoscopic and laparoscopic assisted unilateral nephrectomy on horses in standing position offers several advantages over conventional surgical removal including avoidance of rib resection and large incision, securing a better homeostasis and dissection, shortening the recovery period with reduction of analgesic requirements. Laparoscopic surgery has been reported to provide an excellent operative viewing and repair of a ruptured bladder. In addition, laparoscopic and laparoscopic-assisted cystotomies permit safe and effective removal of cystic calculi in horses. Laparoscopic assisted equine splenectomy, reported only in 1 case report by Ortved et al. in 2008, is a promising treatment for
conditions of the equine spleen refractory to medical management including splenic rupture and idiopathic splenomegaly causing clinical signs of colic. In small animals, laparoscopy is commonly used for the placement of feeding tubes. Several techniques are described which are generally endoscopic-assisted procedures performed by using laparoscopy to exteriorize the section of the bowel selected and then placing the tube externally. Similarly, gastropexy is typically performed as laparoscopic-assisted procedure. Laparoscopic-assisted gastrointestinal (GI) surgery is ideal for a subset of dogs and cats suspected of IBD or alimentary neoplasia and in cases of jejunal segment obstruction caused by a foreign body. Other laparoscopic-assisted procedures performed in small animals include ovariohysterectomy, cystotomy, cystopexy and cryptorchid castration. On the other hand, numerous procedures are being performed in small animal under laparoscopy most commonly ovarioectomy and ovarian remnant removal. Laparoscopic splenectomy may provide improved patient outcomes compared with open splenectomy for a subset of patients with certain forms of splenic disease. Laparoscopic cholecystectomy is an advanced laparoscopic procedure that requires experience and highly selective instrumentations to be performed successfully. Modestly sized adrenal tumors are usually very amenable to non-invasive resection using a laparoscopic approach. Other procedures that are reported to be performed laparoscopically include extrahepatic portosystemic shunt attenuation, ureteronephrectomy and diaphragmatic and inguinal herniorrhaphy.

V. Thoracoscopy applications in veterinary field
Thoracoscopy provides the opportunity for exploratory and interventional procedures within the chest, all performed through multiple 5-mm or 10-mm incisions. It vastly extends the range of diagnostic and therapeutic techniques beyond the ability of other imaging techniques. It is better tolerated than traditional thoracotomy procedure since significant spreading of the ribs and sternum is avoided, thus significantly decreases the perioperative morbidity. Complete evaluation of the parietal pleura, mediastinum, lungs, lymph nodes, diaphragm and pericardium can be followed by sample collection for histopathologic examination and aerobic, anaerobic and fungal culture. The use of video-assisted thoracoscopic surgery was initially limited to diagnostic exploration of the structures. However, with more advanced instrumentation, experimentation and experience, many more surgical procedures have become feasible. Interventional procedures in small animals may be done for the treatment of pericardial effusion, restrictive pericarditis, patent ductus arteriosus, and chylothorax as well as spontaneous pneumothorax, lung lobe neoplasia, megaesophagus associated with persistent right aortic arch and pyothorax. On the other hand, thoracoscopy is less commonly practiced in equine. It is mainly indicated for exploring the thorax of horses afflicted by trauma, infection and neoplasia. This allows a confirmative diagnosis and a significant management of the clinical cases.

VI. Conclusion
MIS is the new stream surgical application that requires highly specialized instrumentations and skills providing more effective results and prognosis. Recent studies have shown promising results for more advanced procedures that could be applied minimal invasively. As MIS being more commonly applied, some MIS procedure will become the treatment of choice for specific affections.
References:

STAPLERS IN VETERINARY SURGERY

Introduction:
Recent advances and acceptance of various medical devices have clearly helped in the efficiency, simplicity, and effectiveness of veterinary surgery. The goals of surgery include efficient methods and minimal surgical times, delicate tissue handling techniques, confidence with tissue reconstruction, and minimizing contamination, leakage and complications. Mechanical means of suturing, cutting, and hemostasis assist with accomplishing these goals. Most recently, stapling instrumentation and vascular sealing devices have become common instruments on all levels of surgery because of their ease of use and increase in surgical efficiency. Surgical stapling methods have been explored widely and used in veterinary surgery. Relationships between surgical goals and their use have been shown and their development has been enhanced by modifications for ease of the early 1980s, the use of stapling instrumentation was being recognized and used in the United States based on clinical studies and greater availability. The use of surgical stapling requires the knowledge of use for each stapling device. In no situation, however, should the use of a stapler compensate for poor surgical practice. Attention to principles of soft tissue surgery (Halstead’s principles), as well as proper use of each surgical stapler must be followed to ensure surgical success.

Principles that have been reported include:
1. Do not staple tissues that are inflamed, edematous, or lack a vascular supply.
2. Every staple must penetrate all tissue layers.
3. Staple size should be accurate; tissues should not be too thick to be penetrated or too thin to support the staple.
4. Tissues should be inspected thoroughly before stapler application to ensure proper alignment and no capturing of inadvertent tissues.
5. Stapling devices should be removed carefully to avoid disrupting the staples.
6. Tissues should be grasped gently before removal of the stapler to check for hemorrhage, leakage, or loose staples.(1)

A large number and variety of disposable staplers are available for use in surgery. All of the self-contained disposable staplers have a plastic casing and are lightweight, weighing 100 g or less, which is important in avoiding operator hand and arm fatigue. The staplers contain a variable number of regular or wide staples and are designed for onetime use; however ethylene oxide sterilization or cold-tray sterilization performed according to manufacturer's instructions may allow limited reuse.(2)

Conventional Stapling Devices
Thoracoabdominal stapler: The thoracoabdominal (TA) stapler is a versatile stapler that applies staggered rows of B-shaped, titanium or stainless steel staples into tissue or across vascular pedicles. The instrument consists of a handle with a handle and trigger configuration and a “U-shaped” end that accepts the vascular tissues or pedicle to be ligated. The noncrushing nature of the B-shaped staples allows for normal capillary blood flow between the staggered rows of staples, but adequately provides hemostasis at the border of excised tissues or vascular structures. Reusable and disposable TA staplers are available and come in various widths for multiple tissue types. Reusable TA staple instruments have staple cartridge widths that are color-coded and are available in 30 mm (white), 55 mm (blue), and 90 mm (green). Disposable staplers come in 30, 45, 60, and 90 mm widths.

Gastrointestinal anastomosis and intestinal linear anastomosis staplers: The GIA stapler is a linear stapling instrument that consists of 2 interlocking halves that form a flat handle with 2 straight limbs. One-half of the instrument holds a stapling cartridge that delivers 4 rows of B-shaped titanium staples and the other half holds an anvil. Typically, the device has an embedded cutting blade that divides the tissue between the second and third row of staples. The reusable form of this instrument comes in lengths of 50 and 90 mm and accepts stapling cartridges that deliver 4.0 mm wide B-shaped staples that begin at a height of 3.8 mm and compress to a final height of 1.5 mm. Disposable staplers come in a variety of lengths (50, 60, 80, and 90 mm) and have color-coded cartridges (green and blue) that deliver B-shaped staples 4.0 mm in width.

End-to-end anastomotic staplers: End-to-end anastomotic (EEA) staplers are tubular instruments that apply a circumferential double row of staples. The result of this staple configuration is a double row of B-shaped, titanium staples that create a double layer inverting anastomosis of tissues of the alimentary canal. The 2-piece instrument consists of a dome-shaped anvil and a long tubular portion that holds the staple cartridge. The cartridges of the stapler have an outer diameter of 31, 28, and 25 mm and produce an anastomosis inner diameter of 21, 18, and 15 mm. The staples have
a width of 4.0 mm and a height of 4.8 mm and compress to a height of 2.0 mm. Disposable EEA instruments are available in similar and smaller sizes for use in smaller dogs and cats.(6)

EEA stapler

Vascular clips: Vascular clips are individual hemostatic V-shaped staples that can be applied quickly and accurately in areas that are difficult to reach. Application of the staples can be done with a single-clip applicator or with an automatic instrument loaded with multiple staples. These clips are an alternative to individual ligatures for small vessels and may serve as a radiopaque boundary to a surgical area or tumor excision. They are most commonly composed of stainless steel, titanium, or an absorbable material. A variety of clip lengths are available; however, regardless of the manufacturer notations, the vessel size should fill only one-third to two-thirds of the length of the clip.(8)

Vascular clips

Skin staplers: Surgical skin staples are used to accurately oppose tissue edges after tissue incision or trauma. Skin staples have a straight cross member with 2 shorter legs. Upon firing of the instrument, the cross member lies flat across the tissue to be opposed, the tissue is penetrated, and the legs are brought together to form an incomplete rectangular shape that is slightly smaller than its original width. Typically, surgical skin staples are made of 316L stainless steel and are available in regular (4.8–6.1 mm width) and wide sizes (6.5–7.0 mm width) and have a wire diameter of just greater than 0.5 mm. The staple leg length is variable, but the wide staples have longer legs, which may be beneficial in edematous tissue, but a disadvantage if deep tissue penetration by the staples is not desired. Staples should be placed 0.5 to 1.0 cm apart.(9)
Endoscopic Stapling Devices: With the recent advances in minimally invasive procedures, stapling equipment designed specifically for laparoscopic procedures has been developed and adapted for veterinary surgery. Thoracoscopic and laparoscopic procedures provide a magnified view and increased visualization of vital structures. With advances in these procedures and the improvement of minimally invasive stapling and vascular sealing instrumentation, vascular structures can be occluded confidently and diseased tissues can be removed safely. Most endoscopic stapling instruments have an articulating head and use staple cartridges that simultaneously place 6 rows of staples. An embedded cutting blade incises through the middle of the stapled line, leaving 3 rows of staples on each side and providing a seal to each sides of the excised tissues. EndoGIA stapling cartridges (Covidien, Norwalk, CT) are able to deliver 30, 45, and 60 mm length staples. The staple leg lengths are available in sizes of 2.0, 2.5, 3.5, and 4.8 mm. Of these cartridges, the 30 and 60 mm length staples have 3.5 mm leg length. Many open and minimally invasive procedures using EndoGIA staples have been described and include lung lobectomy right auricular mass removal and other procedures to remove diseased tissues and provide vessel occlusion.

REFERENCES:
Lameness detection in dairy cows, a multidisciplinary approach

A.R. Mohamadnia¹, M. Faezi², V. Zojaji², A. Nejati², F. Mohamadi², H. Zeinali², S. Mokhtarnazif², P. Nadi², M. Mohammaddoust²

1: Department of Clinical Sciences, Faculty of Veterinary Medicine, Ferdowsi University of Mashhad, Iran.
2: Lameness group, Mashhad, Iran.

Lameness classified as an orthopedic condition belongs to the most common and economically relevant production diseases of dairy cattle. The main causes of lameness are hoof lesions especially in lateral claws of the hind feet. The annual incidence of major hoof lesions (Sole ulcer, White line disease, Interdigital necrobacillosis and Digital dermatitis) reported between 12-62% with average of 30-32% among dairy farms in Iran. However, the prevalence of bovine lameness in European countries and the United States ranges between 5 and 48%. Lameness besides infertility, some infectious diseases (like Paratuberculosis) and mastitis are the most important causes of culling in Iran’s dairy farms. Iran dairy farming is growing in herd level as most farms are increasing in number, otherwise because of financial problems they have to end up their work. Increasing in number and production also affect health status of the cows and lots of production diseases including lameness potentially increase in the farm. Reduced milk yield and fertility, increased risk of culling, treatment costs, and additional expenditure for extra labor cause considerable economic loss. Labor and treatment expenses nowadays are considerable cost of lameness in Iran. However no significant effect of lameness recorded on the rate of culling in Iranian dairy farms. Lameness notification in the herds is a constant problem and different investigators try to find proper indices for detection of lameness. Validation of different ways of lameness detection is very important; lots of these indices are subjective and can easily change during time and between herds. Finding a standard protocol for lameness detection may lead to misinterpretation of the results and finally making wrong decisions about lameness concepts. Unfortunately still many farmers are not aware of the financial consequences caused by lame animals and did not realize how the lameness problem affected the productivity and profitability of their dairy farm. In an investigation of 222 English dairy farms, 90% of the farmers did not judge lameness as being a big issue, although the average prevalence of lameness was 36%. Digital dermatitis, heel horn erosion, sole ulcers, and white line disease were shown to be the predominant claw lesions of dairy cows. Cows seldom show signs of pain until the stimulus is severe and in first steps of lameness lowering BCS proceed milk reduction and other economic important loses.

In practice, lame cows are often insufficiently identified and treated and the mean time from the onset of Lameness to clinical recognition by the farm personnel recorded as 27 days.
In general, veterinary treatments and management decisions are more effective in earlier stages of the disease. A decrease in milk yield lasted from 4 month before individual cows were diagnosed clinically lame until 5 month after this point in time. An increase in locomotion scores 3 month before start of sole ulcer were recorded that lasts till 3 month after treatment of the disease. Generally, lying bouts of lame cows lasted longer than those of nonlame cows. Acute locomotion disorders lead to a decrease in (1) feed intake, (2) number of meals, (3) visits to the feeders, and (4) a considerable decrease in eating time.

Diagnosis of lame cows in Iran based on the practical procedures in the farm. What are the main findings in a lame cow? As previously described a lame cow have lower bouts of feeding, lower rumination, longer lying time between bouts of standing, higher locomotion score, lower body condition score, lower fertility, possibly higher mastitis etc. Each of these findings may appear with different causes and necessarily are not a result of lameness. For example lameness is not the only cause of infertility and a long list of problems in a herd may cause infertility. This is the case for other above mentioned problems.

Lameness is a herd problem and lots of these findings are obvious in herd level not in a single animal. In a stepwise plan we may be able to approach the level of lameness in the herd and finding what we should do for it.

Increasing diseases among the herd
Generally a lame cow may lose lots of her normal functions. As a retrospective look lame cows are more prone to infertility so if you consider lameness as a very important finding in a herd, logically you should see lower fertility rate in such a herd.

This is the case for other disease or conditions like mastitis. Lots of papers show higher prevalence of SCC among lame cows. I’ve visited a herd that separate high SCC cows for increasing times of milking, the average of locomotion score were highly significant higher than counter sound cows, that means by using a criteria (SCC) the lame cows were selected and separated from other cows. Some metabolic markers like increasing in NEEFA or BHBA in transition period and higher level of abomasal disorders in the herd also can be considered as a predictive value for lameness that needs further investigation.

Cow Comfort indices:
Lying time and time budgeting: As a rule of thumb a cow needs a clean and comfortable bedding in a well ventilated weather with reasonable ambient temperature to be able to rest and doing her normal physiological actions.
Cows in high producer herds should rest at least 12 hours a day that by increasing an hour in their resting time, the milk production also may increase about a liter. However cows needs standing up and feeding among these 12 hours resting and should be divided to about 12 bouts. Lame cows normally have longer bouts of resting than normal cows. Also lame cows may have less resting time in comparison to sound counterparts.

Hygiene scoring: Most infectious agents of digital lesions transmitted through bedding of the cows. It is obvious that reducing the infectious agent to zero is impossible but by using good hygienic materials it can be reduced to minimal level so immunity of the body besides good trimming in making normal shape of the hooves, can make good dam against infectious agents. Assessing hygienic condition of the cows is possible by using hygiene scoring system. This scoring system like other scoring systems needs to be done on a regular basis to evaluate changes during time.
Heat stress: Consider as one of the most important predisposing factors in lameness occurrence, different effects of heat stress like more standing time, less lying time, saliva drooling and possible ruminal acidosis, endotoxin absorption and possible problems besides consequences of cooling cows like making ponds of mud and manure are the most important roles of heat stress in making cows lame.

Cow behavior
Locomotion scoring (LS): Normal walking of the cows measured or qualified by locomotion scoring. Different scoring systems have been used and a five point scale scoring system normally used in our field. By using LS we try to quantify a quality of the animal so it will have a very tiny margin of changes and some basics should be considered for doing reliable LS.
- On a monthly basis by a person, don’t change during time as much as possible.
- In a flat area any slope can change the outcome of LS.
- In a normal weather condition, in very hot or very cold conditions or under storms, high speed winds results may be unreliable.
- The surface for doing LS should be clean without gravels or other particles that may affect the scoring; the slippery surfaces may increase the scoring.

Interpretation results of LS are very important in finding and estimating lameness status of the herd. Higher locomotion score maybe consider as the first finding in a lame herd. In five point scale locomotion scoring system we can consider scores one and two as non-lame and 3-5 as lame cows. In our local situation I always use scores 4-5 as lame cows and 1-3 as non-lame cows. Locomotion scoring (mostly 5 point scale, Sprecher method) used in Iran but there are not enough data available on the result of these locomotion scorings and its accuracy or possible sensitivity and specificity of the tests.

Leg scoring: Most of the dutch hoof trimmers believe in this scoring system. The basis of the leg scoring system is outward rotation of the hooves and making an angle with the vertebral column. In this scoring system the score one refers to the most normal hoof that doesn’t have any deviation from vertebral column line or less than 7 degree deviation and score three with more than 24 degree deviation consider the worst score. Our local investigations show that usage of this scoring system is not successful in all dairies and stage of lactation and milk production affect this system. However this system believes that outward rotation is a result of hoof growing.

Hock scoring: this scoring was done on hock of the cows as the score one gives to a normal hock without any lesion and score 4 to a wounded hock. Wounds or other problem in hocks maybe a result of bedding and also an indicator of comfort of the cows.

Hoof trimming
Data of hoof trimming are very important for understanding what happened in the herd in past time. The first step is to know what was done in the herd, is there any recorded data? Are people in the herd have proper knowledge of digital disorders? Do they know when these disorders happens? Do they know the extent of the lesions? If there is any recorded data, it should be analyzed, otherwise some animals in different stages of lactation and ages should be evaluated for possible lesions. For getting reasonable analysis at least ten cows in each of the following categories should be evaluated:
- Ten fresh first parity cows with DIM less than 50
- Ten fresh older than 2 parity cows with DIM less than 50
- Ten cows with DIM between 120-150
- Ten cows with DIM more than 300
The results can give some clues about the possibility of infectious and noninfectious lesions in the herd. However, a reasonable sampling strategy may be to observe up to 100 cows from the middle of the milking order. Also, presence of severely lame cows at the end of milking may be useful for identifying lame farms. In data recording, data recorded in a separate sheet on excel software on daily basis and its total outcome easily extracted from recorded data. Since in some herds, diagnosis of the lesions as white line disease or sole ulcers may controversial, the data recording should be done on a zonary basis that hooves divided into 12 zones.

References from local lameness group team:
Evidence-Based Stem Cell Therapy in Equine Orthopedics: Is It Safe and Effective?

Mohammad Mehdi Dehghan1, 2*, Saeed Farzad Mohajeri1

1Department of Surgery and Radiology, Faculty of Veterinary Medicine, University of Tehran, Tehran, Iran
2Institute of Biomedical Research, University of Tehran, Tehran, Iran.

*mddehghan@ut.ac.ir

The management of orthopedic problems in horses presents many clinical challenges. Despite great advances in field of veterinary orthopedics, there are some injuries that cannot be treated successfully or prognosis is considered as hopeless. Musculoskeletal disorders and injuries have a huge unfavorable effect on equine industry. Although death-dealing orthopedic injuries have a low prevalence, many lameness conditions including tendon and ligament injuries, osteoarthritis, laminitis and chip fractures have a high prevalence. Some of these lameness conditions occur over weeks to months, making the problem chronic and their treatment difficult. Others may subside with current available therapies in equine practice field, but recur and re-injure when the horse take back to previous activity.

Osteoarthritis, Flexor tendons injuries, suspensory apparatus problems, small chip fractures and many other conditions are among the most frequently injured structures of horses. They are not catastrophic injuries in horses, but re-injury rate of them after common treatments make them as main study field of many researchers. Consequently, Novel therapeutic techniques and strategies like regenerative medicine are applied by practitioners for better outcomes and to decrease economical and financial aspects of treatment. Regenerative medicine is on the cutting edge of medical science today, but it is still in its infancy and needs to be promoted scientifically and practically. There is a growing interest in equine regenerative medicine, which can be applied as two main categories: cell therapy, where cells directly injected into the blood or into tissues, and tissue engineering, where cell-scaffold constructions are implanted to tissues. This proceeding, which focuses on stem cell therapy in orthopedic conditions of horses, describes fundamental topics of cell-therapy and systematically reviewed literature and summarizes outcomes and results.

What are Stem Cells?

Briefly, stem cells are cells that have the ability to divide and replicate themselves or develop and differentiate into different cell types. They can be classified as pluripotent stem cells which often harvested from embryonic sources and can differentiate into any cell types and multipotent stem...
cells which can develop just into a more limited type of cells. Mesenchymal stem cells are a form of multipotent stem cells which could be retrieved from most tissues of adults without donor site morbidity. Stem cells can also categorized based on donors as autogenous, allogenic (same species) and xenogenic (different species).

The application of mesenchymal stem cells attracts more efforts to bring it on bench-to-bedside pathway. To date, the most common clinical applications of stem cells in veterinary medicine include autogenous and allogenic transplants of stormal vascular fraction or mesenchymal cells (bone marrow derived and adipose derived). Among them, Bone marrow derived mesenchymal stem cells have been investigated for a longer time and have gained a pronounced presence in equine clinical practice.

Current Stem Cell Researches and Therapies in Equine Orthopedics

The starting point of stem cell therapy was set in 2001, when a clinical retrospective study was published in AAEP proceedings reporting promising results in treatment of 100 horses with suspensory ligament desmitis after intralesional injections of bone marrow concentrates. Current therapeutic approaches try to decrease the interval between injury and cell therapy, reduce costs and increase quality of cells with optimizing of protocols. A large number of in vitro and in vivo studies published every year for this purpose. The scientists try to find more sources of stem cells enabled them to have cells as an off-the-shelf product, because some orthopedic conditions occurred acutely. Since stem cells are employed to regenerate the tissue, they should be in place before scar formation. Tendons, ligaments and joints are the current hot topic of equine stem cell communities and many clinicians focused on these structures. Superficial digital flexor tendinitis is one of the most common orthopedic injuries in performance horses. Joint disease in the form of osteoarthritis is a common cause of lameness in horses. The nature of tissues and organs direct cell based therapies among variety of methods and techniques. For example, since the lesion occurs within the central core of tendons and ligaments, there are natural surroundings for injection of cells and usually there is no need to use scaffold. It is true about joint, unless an osteochondral defect is present. In this situation scaffolds should act as a matrix for stem cells.

Genetic modification of mesenchymal stem cells to express specific proteins and enhance organ repair is currently at the level of experimental and trial research and is not available in clinical setting yet.

Safety Consideration of Stem cell therapy

There is a historical concern about neoplastic transformation of stem cell due to their capability of self-renewal. However histopathologic examination of 18 studies from horses that had undergone stem cell injection did not reveal any abnormality or neoplastic tissue in our systematic review. Another historical concern is exposure to any xenogenic products (e.g. fetal bovine serum that is commonly used in cultured products) so there is little risk of stimulating an immune response. Reported adverse reactions after the treatment of cases have been extremely rare. Additionally, these adverse effects may have not been related to cell injection and can be considered as manipulations during treatment procedure.

Effectiveness of stem cells in equine orthopedic conditions

Stem cell have been injected or implanted into different defects or lesions including collagenase-induced tendinitis, osteochondral cartilage defects, naturally-occurred strains, surgically created tendon defects in multiple in vivo experiments using horses, with almost universally positive
outcomes (see below systematic review). Although many studies stated there is no significant change in histopathologic and ultrasonographic short-term periods, long term performance follow ups revealed greater improvement of horses treated with stem cell in comparison with traditional and current therapies.

**Systematic review of Published literature from 2001 to 2017**

This systematic review includes original research studies published between 2001 to November 2017. All review and non-English studies were excluded. Finally, 41 original articles were eligible and included for analysis. These articles present 936 horses (124 male, 88 female and 596 not mentioned) ranging in age from 2 to 18 years, which have different orthopedic conditions. Distribution of studies based on region of work and type of article is shown in table 1 and 2.

**Table 1 Distribution of articles based on region of work. / Table 2 distribution of articles based on type of study**

<table>
<thead>
<tr>
<th>Region</th>
<th>Number of articles</th>
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<tbody>
<tr>
<td>EU</td>
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<tr>
<td>North America</td>
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<tr>
<td>Japan</td>
<td>4</td>
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<tr>
<td>Brazil</td>
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</tr>
<tr>
<td>Australia</td>
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<table>
<thead>
<tr>
<th>Type of study</th>
<th>Number of articles</th>
</tr>
</thead>
<tbody>
<tr>
<td>Retrospective study</td>
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</tr>
<tr>
<td>Prospective Study</td>
<td>2</td>
</tr>
<tr>
<td>Case report</td>
<td>5</td>
</tr>
<tr>
<td>Case series</td>
<td>5</td>
</tr>
<tr>
<td>Clinical trial</td>
<td>6</td>
</tr>
<tr>
<td>Experimental study</td>
<td>21</td>
</tr>
</tbody>
</table>

**Diseased organ or tissue**

Tendon injury was used in 18 studies (43.9%). Six studies (14.63%) work on tendons and ligaments simultaneously whereas only 2 studies (4.87%) work on ligament alone. Superficial digital flexor tendon is the most studied structure (58%) whereas suspensory ligament is the second common (19.51%). Six articles (14.63%) studied joint problems i.e. DJD and their study was not restricted to specific part of the joint. However, four studies (9.75%) worked on cartilage specifically. Bone Healing was evaluated in three studies (7.31%).

**Stem cell type, source, dose and delivery**

Autogenous stem cells were used in majority of studies (78.04) while allogenic stem cells are used in 7 studies (17.07%). Bone marrow derived mesenchymal stem cell is the most common cell type which were used in 22 studies (53.65%) followed by adipose derived mesenchymal stem cells, blood derived mesenchymal stem cells and amniotic membrane derived stem cell, respectively.
The number of cells applied (cell dose) varied based on many factors including type of lesion, location of lesion, type of stem cell, etc. although the majority of studies (90.24%) delivered cells in a one stage procedure. Only 9.76% of studies repeat injection of cells into the lesion.

**Techniques used for assessment**

The majority of experimental studies (85.71) euthanized horses at the end of study for more evaluations. Diagnostic imaging tools especially ultrasonography, clinical examination histopathology and performance results are the most common techniques used for assessments, respectively (Table 3).

### Table 3 types of techniques used to assess improvement in equine orthopedic conditions

<table>
<thead>
<tr>
<th>Type of technique</th>
<th>Number of studies</th>
<th>percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ultrasonography</td>
<td>22</td>
<td>53</td>
</tr>
<tr>
<td>Clinical examination</td>
<td>20</td>
<td>48.78</td>
</tr>
<tr>
<td>Histopathology</td>
<td>18</td>
<td>43.90</td>
</tr>
<tr>
<td>Long-term performance</td>
<td>10</td>
<td>24.39</td>
</tr>
<tr>
<td>Immunohistochemistry</td>
<td>8</td>
<td>19.51</td>
</tr>
<tr>
<td>Radiography</td>
<td>6</td>
<td>14.63</td>
</tr>
<tr>
<td>Biochemical</td>
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<td>12.19</td>
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<tr>
<td>Computed tomography</td>
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<td>9.75</td>
</tr>
<tr>
<td>Biomechanical</td>
<td>3</td>
<td>7.31</td>
</tr>
<tr>
<td>Gene expressions</td>
<td>3</td>
<td>7.31</td>
</tr>
<tr>
<td>Macroscopic grading</td>
<td>2</td>
<td>4.87</td>
</tr>
<tr>
<td>Scintigraphy</td>
<td>2</td>
<td>4.87</td>
</tr>
</tbody>
</table>
Outcome
Only 3 studies (7.31%) mentioned stem cell treatment has not significant difference with control groups. The majority of studies (92.68%) stated significant difference and favorable results after application of stem cells. Fifteen articles published long-term follow ups and they reported prevalence of re-injury from 4% to 32%. The re-injury percentage of all horses with follow up undergoing stem cell treatment (688 horses) was 16.62%. Some studies follow-up the horses up to 6 years but the majority followed until 2 years.

Adverse effect
No worsening of the injury was observed. None of studies reported any severe or long-term adverse effects related to the stem cells treatment. Twelve studies (29.26%) emphasized “no adverse effect” during observations and follow ups while others not mentioned. Only one study reported minor adverse reactions including swelling around injection sites in 3 horses (9.09%), which resolved after several days.

Conclusion
There is a growing attraction with the role of mesenchymal stem cells in equine tissue repair. Today Intralesional injections of stem cells are widely used as a treatment of orthopedic problems. This approach is effective, beneficial and safe. There are lots of successful high-quality clinical trial and experimental studies in the horse that support this idea. This systematic review is the first of its kind to explore the full spectrum of evidences from experimental studies to case series.

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Ferris, Dora J et al. “Clinical Outcome after Intra-Articular Administration of Bone Marrow Derived


Comparison of Autogenic Costal Cartilage with Chitosan Scaffold in Canine Humeral Defect Healing

Siavash Sharifi1, Iraj Karimi2, Saeed Soltani1, Amin Bigham Sadegh1, Farzaneh Hosseini1

1Department of clinical sciences, Faculty of Veterinary Medicine, University of Shahrekord, Shahrekord, Iran
2Department of Pathobiology sciences, Faculty of Veterinary Medicine, University of Shahrekord, Shahrekord, Iran

E-mail address: drsharifisiavash94@gmail.com

Objective - The present study aims to compare autogenic costal cartilage with Chitosan scaffold in canine humeral defect healing. Current trends emphasize the acceleration of fracture healing on the ground that in doing so, the limitation of mobility and complications associated with recovery period are reduced.

Design - Experimental

Animals - Fifteen adult male dogs weighing about 20 kg and aged 2-3 years were prepared for surgery

Procedures - Dogs were divided into three groups of five. Humerus window shaped defect was created in their right hands. In the first group (controls), the defect was left untreated. In the second and third groups, Chitosan and autogenic costal cartilage were placed into the defects, respectively. Radiographs of the defects were prepared at weeks 2, 4, 6 and 8 and finally the dogs were euthanized after 70 days. Histological sections were also obtained from the defect sites.

Conclusion and Clinical Relevance - Taking into account the results and other recent reports, it can be concluded that chitosan scaffolds with greater capabilities can be used in canine bone defect healing, however, for ideal bone tissue regeneration, chitosan as a base has to be combined with other materials including those mentioned above. The present study results showed that cartilage cannot serve as a proper alternative for grafting

Key words - Autogenic Costal cartilage, Chitosan Scaffold, Bone Defect, Canine

References:
Assessment of polycaprolacton (PCL) nanocomposite scaffold compared with β-tricalcium Phosphate (HA+ β-TCP) on healing femur bone defect in rabbits

Hadi Eftekhari¹, Alireza Jahandideh¹*, Ahmad Asghari¹, Abolfazl Akbarzadeh²-⁴, Saeed Hesaraki³

¹. Department of Clinical Science, Faculty of Specialized Veterinary Sciences, Science and Research Branch, Islamic Azad University, Tehran, Iran.
². Universal Scientific Education and Research Network (USERN), Tabriz, Iran.
³. Department of Pathobiology, Faculty of Specialized Veterinary Sciences, Science and Research Branch, Islamic Azad University, Tehran, Iran.
⁴. Drug Applied Research Center, Tabriz University of Medical Sciences, Tabriz, Iran.

Abstract
Over the decades of bone tissue engineering (TE), the use of scaffold-based strategies grafts has become more popular as to overcome the problems of autograft. Recently, in order to try and overcome the disadvantages of autograft and allograft, attempts have been made to find adequate supporting material such as Hydroxyapatite, β-tricalcium phosphate or combination of both. New bone tissue engineering methodologies and progress in nanotechnology have triggered the use of nanostructures as scaffolds for the purpose of tissue engineering. In this study 60 mature male New Zealand white rabbits 6-8 months and weighting 3-3.5 kg were examined. Rabbits were divided into four groups. Surgical procedures were done after an intramuscular injection of Ketamine 10% (ketamine hydrochloride, 50 mg/kg), Rompun 5% (xylazine, 5 mg/kg). Then an approximately 6 _ mm diameter bone defect was created in the femur of one of the hind limbs. After inducing the surgical wound, all rabbits were colored and randomly divided into four experimental groups of five animals each: Group 1 was a control group with no treatment, group 2 received hydroxyapatite, group 3 received β-tricalcium Phosphate (HA+ β-TCP) and group 4 received medical pure nanocomposite polycaprolactone (PCL) granules. Histopathological evaluation was performed on days 15, 30 and 45 after surgery. On day 45 after surgery, the quantity of newly formed lamellar bone in the healing site in PCL group was better than onward compared to other groups. In conclusion, nanocomposite polycaprolactone granules (PCL) granules exhibited a reproducible bone-healing potential.

Key words: Bone healing, Nanocomposite polycaprolactone granules, β-tricalcium Phosphate (HA+ β-TCP), Hydroxyapatite, Histopathological evaluation, Rabbits
The Use of Fascia Lata as an Autograft for Permanent Treatment of Anterior Cruciate Ligament Ruptures With Extra Capsular Technique in Dogs; New Surgical Technique

Hadi Naddaf, Alireza Ghdiri, Amireza Imani *
Department of Clinical Sciences, Faculty of Veterinary Medicine, Shahid Chamran University of Ahvaz, Ahvaz, Iran

Email: hdnaddaf@scu.ac.ir

Objective – Cruciate ligament rupture is one of the main reasons for lameness in dogs. Standard techniques based on differences in patient selection criteria have not been determined yet and is still in question. The aim of this study is to provide a new technique that uses the strength of the fascia lata, passing it through the regular isometric knee and creating mutual stability.

Design- Randomized, controlled, experimental study

Animals- A total of 10 adult male dogs weighing between 14-20 kg of mixed breeds were randomly divided into control and treatment groups.

Procedures Under general anesthesia, cruciate ligament was resected in both groups. In control group, MRIT technique was used to stabilize. In treatment group, after the preparation of the roll of the thickest part of the fascia lata and two canals creation in the proximal tibia and distal femur, with cross bar of the fascia lata grafts into canals and suturing to the lateral side of the joint capsule, stabilization of the cruciate ligament tear was done. Following parameters were evaluated in 16 consecutive weeks: drawer movement, lameness, pain, range of motion (ROM), thigh circumference, joint effusion and osteoarthritis in radiographic findings.

Results Scoring to drawer movements and lameness in treatment group was not significant compared to control group (p>0.05). In control group, ROM is closer to base line when compared to treatment group. A decreasing trend of joint effusion in both groups was observed during studied times after surgery. No signs of osteoarthritis were observed in both groups (p<0.05).

Conclusion and Clinical Relevance- This technique is a new method for permanent treatment of anterior cruciate ligament ruptures as it has many features of other restorative techniques and comparability to MRIT method. It However, to provide for clinical usage, more studies are needed.

Key words- Cruciate ligament, Fascia lata, New technique, Dog

References
The Role of Decellularized Fish Scale Derived Scaffold with Platelet rich plasma in Healing of Tibial Bone Defect in Rabbit: An Experimental Study

Nikta Mansouri¹, Hamidreza Fattahian¹, Pargol Ghavam Mostafavi², Abdolmohammad kajbafzadeh³

1) Department of Clinical Science, Faculty of Specialized Veterinary Sciences, Science and Research Branch, Islamic Azad University, Tehran-Iran. Niktamansouri2014@gmail .com
2) Department of Marine Biology, Graduate School of Marine Science and Technology, Science and Research Branch, Islamic Azad University
3) Pediatric Urology Research Center, Department of Pediatric Urology, Pediatrics Center of Excellence, Tehran University of Medical Sciences, Tehran, Iran.

Email:niktamansouri2014@gmail.com

Objective: Nowadays marine biomaterials has attracted scientist attention as bone substitutes because they don’t have limitations of grafting methods such as unavailability, zoonotic diseases transmission and high expense. The aim of this study was to evaluate fish scale In-vivo potential and possible synergistic effect of platelet rich plasma with this scaffold in bone healing.

Design: Fish scale is an available and cost effective biomaterial rich in collagen type I and hydroxyapatite therefore resembles bone structure. Furthermore promising results has been reported from application of platelet rich plasma with hydroxyapatite previously. Since fish scale role as a bone substitute and its possible synergistic effect with platelet rich plasma has not been studied heretofore this study was designed.

Animals: 15 male white New Zealand rabbits with similar average weight and age.

Procedures: In order to increase biocompatibility and reduce immunity reactions fresh fish scales were decellularized. Decellularization was confirmed with DAPI staining (4’,6-diamidino-2-phenylindole). Microstructure and surface characteristics of fish scales were assessed by Scanning electron microscopy. Animals were randomly divided to 6 groups each containing 5 limbs. Full thickness bicortical defects were created bilaterally in proximal tibia of both pelvic limbs of rabbits. The defect was left untreated in negative control group. In experimental group I to V the defect was filled with platelet rich plasma, cellular fish scale, combination of cellular fish scale and platelet rich plasma, acellular fish scale and combination of acellular fish scale and platelet rich plasma respectively. Histopathological evaluation was performed on specimens received on day 56 after euthanasia.

Results: Our histological results revealed that fish scale is a biocompatible scaffold with high regenerative potential. Acellular groups were superior to cellular groups in spongiosa and cortex formation. Furthermore platelet rich plasma was able to promote bone marrow formation as a growth factor. There was no significant difference in bone union between experimental groups but union was superior in all experimental groups in comparison with negative control group. Conclusion and clinical relevance: Although several studies focused on finding ideal bone substitute none of them were completely successful and searching for an ideal substitute is still an active research area. Decellularized fish scale showed prominent regenerative potential in healing of tibial bone defect. In addition platelet rich plasma has synergistic effect in association with fish scale scaffolds, when the main goal is enhancing bone marrow regeneration.

Keywords: Bone defect, Fish scale, Decellularization, Platelet rich plasma, Rabbit
Total Vertebrectomy of L1 and Vertebral Stabilization with Dorsal Tension Band Wire Technique in a Paraplegic Dog

Hamidreza Fattahian*, Roozbeh Moridpour2, Mahya Jazini Dorcheh1, Kimia Mansouri1, Nikta Mansouri1, Zohreh Mostahsan3

1 Department of Clinical Sciences, Faculty of Specialized Veterinary Sciences, Science and Research Branch, Islamic Azad University, Tehran-IRAN
2 Division of Surgery, Hamidreza Fattahian Pet Hospital, Tehran-IRAN
3 Department of Surgery and Diagnostic, Imaging Faculty of Veterinary Medicine, Urmia University, Urmia, Iran

Email: Hamidrezafattahian@yahoo.com

Case Description- A 2-year-old male mixed breed dog with 20 kg body weighting after hit by car and non-ambulatory condition on pelvic limbs was referred to private hospital.

Clinical Findings- After clinical examination significant curvature was palpated and observed in thoracolumbar region. Positive patellar reflex in both hindlimb, positive cutaneous trunci reflex, urinary incontinence and deep pain sensation in left hindlimb and absent of that in other one were observed in neurological examination. Survey radiography of affected site in dorsoventral and lateral views was shown a comminuted fracture in first lumbar vertebra.

Treatment and Outcome- In order to type of fracture and impossibility of fixation vertebrectomy was performed. After reduction dorsal tension band wire was placed as fixation. Range of motion, massage and hydrotherapy with under water treadmill were suggested for two months. However, spinal cord was not completely intact, the patient ambulate with wheelchair after rehabilitation period. According to published articles, the second patient treated by total vertebrectomy due to severe traumatized vertebrae. Therefore vertebrectomy is a appropriate technique that prevent, progression spinal cord injury as increase quality of life.

Clinical Relevance- Vertebrectomy and vertebral shortening were performed because of difficulties in reducing lumbar luxation. Management of congenital, tumoural, infectious, deformity, degenerative and traumatic disorders were treated with vertebral resection for first time in human. Dorsal laminectomy and total resection of the vertebral body with implantation of a cortical bone graft and subsequent stabilisation with bone plates were performed for treatment of fibrosarcoma in a dog for first time in veterinary medicine too.

Key Words: Total vertebrectomy, vertebral stabilization, dorsal tension band wire technique, paraplegic dog

References
Combination of mesenchymal stem cells and platelet rich fibrin: a novel method for articular cartilage repair and regeneration

Davoud Kazemi, Karim Shams Asenjan, Nima Dehdilani, Hamed Parsa

1 Department of Veterinary Clinical Sciences, Tabriz Branch, Islamic Azad University, Tabriz, Iran
2 Haematology and Oncology Research Center, Tabriz University of Medical Sciences, Tabriz, Iran

Email: dkazemi@iaut.ac.ir

Objective- Mesenchymal stem cells (MSCs) have emerged as promising tools in cell-based cartilage repair methods due to their ability to differentiate into various cell types including chondrocytes. Growth factors are among the bioactive molecules that can induce chondrogenic differentiation of MSCs. Platelet-rich fibrin (PRF) is a platelet concentrate containing a multitude of growth factors. The effects of MSCs combined with PRF on cartilage repair have not previously been studied. This experimental study aimed to investigate the effect of bone marrow derived mesenchymal stem cells combined with platelet rich fibrin on osteochondral defect repair and articular cartilage regeneration in a canine model.

Design- Experimental study.

Animals- Twelve adult male mixed breed dogs.

Procedures- Osteochondral defects were created on the medial femoral condyles of 12 adult male mixed breed dogs. They were either treated with stem cells seeded on platelet rich fibrin or left empty. Macroscopic and histological evaluation of the repair tissue was conducted after four, 16 and 24 weeks using the International cartilage Repair society macroscopic and the O’Driscoll histological grading systems. Results were reported as mean ± standard deviation and compared at different time points between the two groups using the Mann-Whitney U test, with p< 0.05 considered statistically significant.

Results- Higher cumulative macroscopic and histological scores were observed in stem cell treated defects throughout the study period with significant differences noted at four and 24 weeks (9.25 ± 0.5 vs 7.25 ± 0.95 and 10 ± 0.81 vs 7.5 ± 0.57) and 16 weeks (16.5 ± 4.04 vs 11 ± 1.15), respectively. Superior gross and histological characteristics were also observed in stem cell treated defects.

Conclusion and Clinical Relevance- The use of autologous culture expanded bone marrow derived mesenchymal stem cells on platelet rich fibrin is a novel method for articular cartilage regeneration. It is postulated that platelet rich fibrin creates a suitable environment for proliferation and differentiation of stem cells by releasing endogenous growth factors resulting in creation of a hyaline-like reparative tissue.

Key words- Mesenchymal stem cells, platelet rich fibrin, articular cartilage

References
Gelatin, Fibrin-platelet Glue and Their Combination on Healing of Critical Bone Defect in Rat
Hojjat Gholipour1, Ahmad Oryan2, Abdolhamid Meimandi-Parizi1*
1 Department of Clinical Sciences, School of Veterinary Medicine, Shiraz University, Shiraz, Iran.
2 Department of Pathology, School of Veterinary Medicine, Shiraz University, Shiraz, Iran.
meimandi@shirazu.ac.ir

Abstract
Objective: This study examined the effects of Gel, FPG and their combinations as bone scaffold on the healing of surgically created critical-size defects in rat radius.
Design: Experimental
Animals: 25 Rats
Procedure: Critical size defects of 5 mm long were bilaterally created in the radial diaphysis of rats. The animals were divided into five groups as empty defect, autograft, Gel, FPG and Gel-FPG groups (n = 10 in each group). Radiographs of each forelimb were taken postoperatively on the 1st day and then at the 28th and 56th days. After 56 days, the rats were euthanized and their harvested healing bone samples were evaluated by histopathology, scanning electron microscopy.
Results: The results of present study showed that the Gel alone did not significantly affect bone healing and regeneration. The FPG-enhanced grafts provided a good scaffold containing numerous growth factors for proliferation of osteoinduction and was effective in improving the structural and functional properties of the newly formed bone more than that of the untreated and also the Gel treated groups. Incorporation of Gel into the FPG scaffold improved healing potential of the FPG scaffold.
Conclusion: Although combination of Gelatin and FPG as scaffolds had best effectiveness during bone regeneration, it still needs to be further enhanced possibly by incorporation of the ceramic and osteoinductive biomaterials
Clinical relevance: Gelatin and FPG can applicable for accelerating bone healing.
Keywords: Fibrin-platelet glue - Gelatin - Radius - Bone healing – Rat

References:
Effect of Chitosan-Zinc Oxide Nanocomposite Conduit on Transected Sciatic Nerve: An Animal Model Study

Mostafa Araghi*1, Toktam Heidari2, Rahim Mohammadi1

1 Department of Surgery and Diagnostic Imaging, Faculty of Veterinary Medicine, Urmia University, Urmia, Iran.

2 Department of Midwifery and Poultry, Faculty of Veterinary Medicine, Urmia University, Urmia, Iran.

Email: araghi77@yahoo.com

Objective- Effects of chitosan-zinc oxide nanocomposite conduit on transected sciatic nerve was assessed.

Design- In this experimental study, a 10-mm sciatic nerve defect was created in sciatic nerve of rats and different treatments were evaluated in various treatment groups.

Animals- Sixty male White Wistar rats were used in this study.

Procedures- In chitosan-zinc oxide group, the defect was bridged using a chitosan-zinc oxide nanocomposite conduit filled with phosphate buffered saline. In chitosan group the chitosan conduit was filled with phosphate buffered saline solution. In sham-operated group, sciatic nerve was exposed and manipulated. In transected group, left sciatic nerve was transected and nerve cut ends were fixed in the adjacent muscle. The regenerated fibers were studied within 12 weeks after surgery.

Results- The behavioral and functional tests confirmed faster recovery of the regenerated axons in chitosan-zinc oxide group compared to Chitosan group (p<0.05). The mean ratios of gastrocnemius muscles weight were measured. There was statistically significant difference between the muscle weight ratios of chitosan-zinc oxide and Chitosan groups (p<0.05). Morphometric indices of regenerated fibers showed number and diameter of the myelinated fibers were significantly higher in chitosan-zinc oxide group than in Chitosan group. In immunochemistry, the location of reactions to S-100 in chitosan-zinc oxide group was clearly more positive than Chitosan group.

Conclusion and Clinical Relevance- Chitosan-zinc oxide nanocomposite conduit resulted in acceleration of functional recovery and quantitative morphometric indices of sciatic nerve.

Key words- Peripheral nerve repair; Sciatic; Chitosan-zinc oxide nanocomposite.

References


GUIDELINES FOR BASIC EQUINE DENTAL CARE

David O. Klugh, DVM, FAVD / Equine

Equine dentistry is constantly changing. Old ideas are being re-evaluated and thought of in different ways. As part of this ongoing process, principles relating to basic dental care are reconsidered. Yet while all these dynamics are occurring, guidelines for basic dental care are proposed only in bits and parts, with no overall guiding concepts or principles in place that are applied and evaluated in practice. The purpose of this paper is to consider specific guidelines that can be put into practice every day for the patient requiring basic dental care.

What is “Normal?”

The concept of ‘normal’ provides a basis for treatment. If ‘normal’ cannot be defined, then appropriate treatment cannot be administered. The concept of an ‘overlong tooth’ carries with it the assumption of some normal condition where the offending tooth doesn’t conform. This begs the question, ‘How do you know it’s overlong?’ Many assertions are made in the literature that this or that condition is ‘normal.’ For example, it is asserted that sharp enamel points are normal. The need for their removal is questioned. The idea is that their removal has no effect on feed digestion and could potentially cause harm. This suggestion is limited to the concept of feed digestion only and does not consider what happens when a horse gets a rider on its back and a bit inserted in its mouth. This exemplifies one of the limitations of considering a particular set of data as ‘evidence,’ even of the lowest level. In an attempt to evaluate performance, results in one study demonstrated no effect. However, accurate methods for determining results are challenging to develop, and making epic conclusions questioning the value of dental care based on the method used in that study are very likely erroneous.

It is proposed that measurement of crown to gingival height would reveal the normal condition as it relates to potential reduction of a wave malocclusion. While it is ‘opinion of experts’ and as such has value, it is of the lowest level of ‘evidence.’ Assumptions are made as to the effects of this concept, but no actual data is available in patients reflecting effects and results of this method of measurement.

It is also suggested that remodeling of the alveolar ridge in compensation for support of an overlong tooth is a normal process and that reduction of the wave malocclusion or changing the angle of occlusion will result in dramatic changes in occlusal forces. The compensated dental equilibrium is to be perceived as ‘normal.’ While the reasoning is clear and likely to be partially correct, the conclusion that this is ‘normal’ is unsupported. Intellectual reasoning is valuable in the process of growth of the logical, academic progression of equine dentistry. However, it remains the
lowest level of evidence, and as such should be further evaluated as it actually happens in the horse’s mouth, and not left to stand alone as a conclusion. It can certainly stand as a proposal or theory that has value and should be tested.

In summary, we are left with assertions that sharp enamel points are normal, crown height measurements reveal correctness, and alveolar ridge remodeling creates a ‘new’ or compensated normal. All of these conclusions develop from the concept that the compensating or adapting horse would be considered to be normal. As the mouth adapts to the effects of its diet and environment, and new normal is created. None of these assertions is backed up with data, and as such are valuable as theories that should be evaluated in the live patient.

In this paper, guiding principles are suggested for a different view of the ‘normal’ mouth. These guidelines result from observations of the horse’s dental conformation and tooth characteristics in a natural environment where grazing is the chosen method of feed assimilation. This assumes that the wild horse, the African zebra and other such are normal in their customary grazing state. The use of the wild horse as normal is supported in part by data that shows that free ranging horses grazing on grass have fewer dental abnormalities than stabled horses fed hay and grain.

Specific observations can be made of the dental characteristics of a large percentage of these animals in their natural environment:

1. Occlusal angle is the same on both sides and is consistent from front to back.
2. Chewing surfaces are parallel.
3. All cheek teeth come in contact at the same time.
4. Occlusal surfaces are even.
5. Point of occlusal contact is half to two-thirds the distance across the maxillary surface.

Each of these parameters deserves further discussion. The relation of chewing surfaces develops as the tooth undergoes attrition (tooth to tooth contact) and abrasion (tooth to feed contact). Numerous papers describe the occlusal angle. Results vary and methods to generate accurate results are challenging to construct. Methods for measuring the tooth directly and indirectly by calculating the angle by angle of incisor separation have been used. Measurements range from 3° to 31.5°.

A very accurate, repeatable method of measurement describes the angle of occlusion as 15.1° to 20.2° moving from Triadan 6’s to 11’s. Importantly, the angles were the same for maxillary and mandibular teeth. These angles were measured in dried skulls with the teeth in their natural position. Such measurement might be thought of as measuring the ‘angle of incidence’ of occlusion, while measurements of the actual tooth angle might be thought of as just that: ‘tooth occlusal angle’ or ‘dental occlusal angle’. Measuring the angle of the tooth only excludes the angle of the tooth within the bone.

Occlusal angle can be altered in a single tooth. These can be referred to as ‘orthodontic’ changes. Alternatively, the angle of the entire arcade may be shifted. These changes could be ‘orthopedic’ changes, since the underlying cause is often a change or developmental asymmetry in the conformation of the bone holding the teeth. Any alteration of angle occurs as the tooth responds to asymmetric abrasion and attrition forces when encountering feed material. Alterations of the entire arcade’s angle, such as in sheared occlusion, occur from time to time. These orthopedic changes are often developmental and generally cannot be corrected by routine dental care. Bilaterally asymmetric occlusal angles, or, ‘offset arcades’, where one side is steeper than the other, or where the maxillary arcade is lower on one side, are other examples of orthopedic changes. These angles remain the same after treatment as before in this method.
Orthodontic changes are more easily corrected. Examples include reversed angle of the lower 6, commonly seen in stabled horses. In the anisognathic condition of our patients, it is very common to see a reversed angle of occlusion of the lower 6’s in horses with particularly narrow mandibles. The result of this conformation is incomplete occlusion, and consequently, uneven attrition. In the parameters of this paper, these common conditions are considered abnormal. Other alterations of angle of single teeth occur. In those that can be corrected, the occlusal angle of the affected teeth is returned to normal.

**Chewing surfaces are parallel.** This observation is supported by Listman et alix who measured the same angles on both maxillary and mandibular arcades. The importance of the principle of parallel chewing surfaces, is that after treatment, surfaces should remain parallel. Contiguous contact of all cheek teeth seems very logical. One can reason that the necessity of all teeth contacting together would lead to maximal efficiency of mastication. The importance of this concept is that after treatment, the condition should be the same: all teeth in contact together when the mandible is moved laterally. Premature contact of a single tooth is anecdotally reported to lead to mastication difficulties. While real evidence is lacking for this concept, observations by many would lead one to find some degree of confidence in this theory. Anecdotal supporting reports that dyssmastication is corrected with reduction of the single offending tooth lends a small degree of support to this notion. In this method, all teeth are made to meet together.

Even, not flat, occlusal surfaces are a frequent characteristic of grazing horses. As previously noted, information exists that says that grazing horses have fewer dental abnormalities, including focal overgrowths, than stabled horses.i, iv While each tooth may respond in a different way to the feed it encounters, the result is an uneven chewing surface. Left without intervention, this condition gets worse over time. Uneven wear means also that one tooth has undergone greater wear than its counterpart. The result of this condition continuing uninterrupted would be premature expiration, and loss of function. For the purposes of this paper, the even arcade condition commonly observed in grazing horses is considered to be the baseline for ‘normal.’

Much is made in the literature of mandibular excursion as a method for evaluating molar contact. In this paper, a different, yet similar, condition is evaluated. This point of occlusal contact is demonstrated when the mandible is moved in a direction reversed from the normal mastication process. It is the point on the maxillary occlusal surface where the lateral margin of the mandibular occlusal surface initially comes into contact. It is easily evaluated in all patients, and is most readily observed on the Triadan 9’s or 10’s. It is seen in a closed mouth with the sedated patient at rest. That is to say, with the jaws centered and the normal interdenal space viewed, the mandible is moved from medial to lateral and the point of contact is determined. The commonly observed point of occlusal contact was half to two-thirds the distance across the maxillary occlusal surface measuring from palatal to buccal. Its value lies in the fact that this location, i.e., cheek tooth contact, is where the work of mastication is being done. As such, and for the purposes of this paper, it is considered more reflective of the actual event of mastication function than incisor measurement of lateral excursion. Critically, it also is another key parameter that, within the confines of this paper and its assertions, must remain the same after dental treatment as prior.

Data will be presented to support these ideas in the following paper.

**Basic Dental Treatment**

Examination of the patient determined the nature, frequency, variety and severity of dental abnormalities. All patients received annual dental care. All patients were sedated for treatment.
This discussion will be limited to routine treatment of occlusal surfaces, or odontoplasty, floating, bit seats, wolf teeth and deciduous teeth. Each of these aspects of dentistry is performed frequently by the majority of equine practitioners. It comprises the vast majority of dental care provided by veterinarians and as such, it is valuable if consistent, reproducible, simple guidelines can be developed for practitioners to follow.

Odontoplasty is reduction of crown height. Enthusiastic discussions of this process occur. Guidelines for what to do, or more appropriately, what not to do, exist, but no goal is demonstrated, nor are the effects evaluated. Exemplifying the problem, the question might be asked, ‘If a tooth is determined by whatever method to be too long, and whether it is reduced all at once or in steps, how do you know when you are done?’ Furthermore, if the assumption is that it should be the same length as its adjacent neighbor, where is the evidence that this conclusion is right? Where is it demonstrated to be wrong? The discussion continues without the actual data of results.

In this paper, as stated earlier, the assumption of normal is that occlusal surfaces are even. As such, the procedure for reduction of crown height is to make the surface of a tooth even in comparison to its neighbors. Most conditions involve a single tooth that is overlong. However, in conditions such as wave malocclusions, it can be challenging to determine the ‘normal’ crown height. Most commonly, the examiner can identify an occlusal pair of teeth that require no reduction. These teeth would serve as a starting point. But variations occur and the practitioner must continually re-evaluate patients in order to gain experience in determination of normal.

In odontoplasty, there are important considerations. If a crown is overlong, then the opposing tooth is likely to be too short. Much is made of the resulting potential gap between teeth. Orthodontic and occlusal forces are thought to potentially cause shifting; or mastication efficiency will be compromised, or other disastrous effect. These are assumptions without actual measured results. If having a gap between occluding teeth was as significant as feared, most horses would never live to see their 5th birthday! A counter assertion is that it is more likely that abnormally positioned and angled chewing surfaces will cause orthodontic disturbances of tooth position, inefficient mastication and tooth disease.

Recent data suggests that small amounts of tooth should be removed at any one time. This is based on the nature and thickness of subocclusal dentin. It has been calculated that reduction of more than a few mm would potentially result in vital pulp exposure of approximately 50% of teeth. For the purposes of this paper, and for the purpose of evaluation of the method used here, all dental overgrowths were completely reduced in a single step.

Pulp thermal damage can result from prolonged grinding on a tooth. These studies are done in vitro. The attenuating effects of saliva and blood circulation of the living pulp are not considered. Yet they certainly have a significant beneficial effect. Water cooling also significantly reduces heat buildup. These data generally suggest that a grinding apparatus should remain on the tooth for no more than 30 seconds, or it should be water cooled. Furthermore, and not evaluated in these studies, there should be a significant difference in time and thermal effect of a sharp versus dull instruments. In this study, large protuberances were reduced most commonly with a reciprocating file, where the time involved in complete reduction of some especially long teeth ranged from 14 to 35 seconds. These reductions varied from 6 to 14 mm. Interestingly, no pulps were exposed in any of 12 teeth in this small group where the event was timed.

Floating teeth is a very old procedure. It refers to the reduction of sharp enamel points. In the method discussed here, these prominences were slightly reduced, but a better description of their...
treatment would be that they were rounded off, not significantly reduced. Over-reduction can lead to pulp exposure. All sharp points were rounded off and slightly reduced. The wisdom of such reduction lies not necessarily in the improved efficiency of mastication, but also in bridling comfort.

Bit seats were applied to all patients. No pulps were exposed, and on follow up examination, no signs of pulp disease were identified. Principles of application of the bit seat included:

1. Rounding edges only. The bit seat is rounding edges for the purpose of comfort when biting causes soft tissue of the cheek, lips or tongue to contact these teeth.
2. It was assured that the brown spot representing the pulp horn remained on the occlusal surface and was not seen on the mesial aspect of the tooth. Thereby direct and indirect pulp exposures were prevented.

Wolf teeth were removed when present. Local infiltration anesthesia was followed by elevation and extraction. While there is no evidence supporting their removal, the idea that they should not be removed is not supported by real life. The percentage of wolf teeth that can be directly linked to biting discomfort is probably not statistically significant. However, and as in the case of bit seats, clients and patients don’t care about statistics. If only one of 30 shows improved biting after either a bit seat is applied or after removal of a wolf tooth, that client is happy, and the patient is relieved of pain. The catch is that there is no way of predicting which horses will respond to a bit seat or to wolf tooth removal. In the author’s clinical practice, and in the method discussed here, all wolf teeth were removed.

Deciduous tooth removal followed specific guidelines in this method. They were removed only when one of two conditions were met: either the deciduous tooth was loose or the adult tooth was visible. Correlation to the calendar was not considered.

In conclusion, specific guidelines were followed for basic dental care which resulted from evaluation of the horse in its natural environment. Guidelines for odontoplasty were developed. Floating rounded and slightly reduced sharp enamel points. Bit seats were created following specific guidelines. Wolf teeth were removed when present. Deciduous teeth were removed when meeting specific guidelines. Annual dental care was delivered to each patient. The effects and results of this method will be discussed in the following paper.

References available on request.


### Table 1: Occlusal Angles

<table>
<thead>
<tr>
<th>Author</th>
<th>Year</th>
<th>Angle Range</th>
<th>Measurement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ralston</td>
<td>307</td>
<td>3 to 18</td>
<td>Direct measurement</td>
</tr>
<tr>
<td>Carmalt</td>
<td>2004</td>
<td>All 10.15 ± 6</td>
<td>Direct Measurement</td>
</tr>
<tr>
<td>Carmalt</td>
<td>2005</td>
<td>4066.3 to 19</td>
<td>Direct Measurement</td>
</tr>
<tr>
<td>Rucker</td>
<td></td>
<td>10 to 15</td>
<td>Indirect measurement</td>
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<tr>
<td>Brown</td>
<td></td>
<td>All 11.8 to 19.1</td>
<td>Direct measurement</td>
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<td>maxillary; 18.4 to 31.5</td>
<td>Direct measurement</td>
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Computerised tomography in veterinary dentistry and oral surgery

Cedric Tutt BVSc, MMedVet(Med), Diplomate EVDC

Computerised tomography (CT) is not available to all veterinary practices but the enhanced diagnostic skills which it brings makes this modality a “wish list” item for all of us. The physics behind and functionality of CT devices are beyond the scope of this lecture. We will look at the use of CTs in veterinary dentistry and oral surgery and how they can be of benefit to us in diagnoses, treatment planning and follow-up.

Lang et al (2016) looked at the sensitivity and specificity of CT for the diagnosis of tooth resorptive lesions in cats and concluded that CT sensitivity was between 42.2-57.7% and specificity 92.8-96.3% when compared to clinical examination and intra-oral dental radiography, which are considered the gold standard. (Lang, Wilkinson, White, Farnsworth, & Potter, 2016). Campbell et al (2016) showed that intra-oral radiography resulted in more periodontal lesions affecting the incisors being detected than CT. They also found that CT delineates the alveolar margin height more accurately than intra-oral radiography, but that using the latter modality, periodontitis was detected more frequently in other teeth in the maxilla and mandibles than CT. (Campbell, Peralta, Fiani, & Scrivani, 2016).

de Paula-Silva, et al (2009) compared Cone-beam CT (CBCT), intra-oral radiography and histology of the periapical tissues of teeth which underwent endodontic treatment. They showed that CBCT and histology showed similar results and that the periapical lesions were underestimated by intra-oral radiography. It was also shown the CBCT gave a better representation of the spatial arrangement of structures that might have been superimposed on each other when view using two-dimensional intra-oral radiography. The superimposition of the mandibular canal on an apex is also eliminated using the CBCT modality. (de Paula-Silva, Júnior, Leonardo, Consolaro, & Bezerra da Silva, 2009).

Esmans et al (2014) concluded that a sequential mode 1mm slice thickness protocol with a high frequency image reconstruction algorithm and moderate edge enhancement filter was the optimal imaging protocol for teeth. (Esmans, Soukup, & Schwarz, 2014).

The course of the mandibular canal from the mandibular foramen to the middle mental foramen, is variable. Martinez et al (2009) showed that the canal was initially closer to the lingual aspect except in the region of the molar teeth. At the level of the third and fourth mandibular premolars, the canal is ventral in the body - equidistant from both lingual and vestibular surfaces. At premolar two the canal moves in a dorso-vestibular direction to open at the middle mental foramen. However, the position of the canal varies depending on the individual. Using the CT modality, the exact position of the mandibular canal can be determined when planning jaw surgery, including: oral tumour surgery, apicoectomy and placement of jaw fracture stabilisation devices (including external
fixators and plates and screws). (Martinez, Gioso, Lobos, & Pinto, 2009). Meyers et al (2007), in their description of an odontogenic myxoma in a dog, found that CT imaging clearly showed invasion of the mandibular canal by the tumour. (Meyers, Boy, & Steenkamp, 2007)

The size and CT characteristics of acanthomatous ameloblastoma tumours in dogs were variable, but, all lesions were found to affect numerous teeth. CT of intra-osseous acanthomatous ameloblastomas (also known in the literature as “central ameloblastomas”) showed that these lesions were associated with cyst-like structures within the tumours. This, according to Amory et al 2013 had not previously been described in CT examinations of acanthomatous ameloblastomas (radiographic and histologic descriptions have previously been published. (Amory, et al., 2013)

Amory et al (2013) suggest in their conclusion, that tooth specific changes are more readily seen on intra-oral radiography, while extra-osseous bone extension associated with oral masses are more readily appreciated on CT of the affected areas. They also concluded that given the CT protocols used in all cases were not standardised, this may account for tooth-associated lesions being less evident on CT images in this reported series.

Open jaw locking, a condition shown to occur in cats and in which Red Setter dogs are over represented, is confirmed on CT images obtained of affected patients. Although lack of tooth contact as a cause of open mouth locking is usually indicative of the problem, the displaced coronoid process lateral to the ventral zygomatic arch border is clearly seen in patients with this condition. Ref Open mouth locking usually results from over extension of the TMJ during yawning. During wide opening of the mouth, the coronary process becomes displaced beneath the ventral margin of the zygomatic arch and when the mouth is closed the coronary process does not shift back medial to the zygoma and therefore causes the mouth to the locked in the open position. This can cause major distress to the animal which continually tries to close the jaws, aggravating the situation.

Masticatory muscle myositis (MMM) may present as enlargement or atrophy of the temporal muscles – either way there is usually dissymmetry of the masticatory muscles. Until recently the condition was confirmed on histological examination of muscle tissue biopsy submitted to the laboratory on ice. CT is now used to diagnose this condition. Ref

The temporomandibular joint is comprised of the condylar process of the mandible (the mobile part) and the mandibular fossa/retroarticular process – part of the squamous part of the temporal bone (the fixed part). The joint space is curved in both the latero-medial and dorso-ventral planes, making obtaining radiographs of this structure complex. DV images taken of the TMJ are most informative and easiest to obtain. However lateral-oblique views are extremely difficult to obtain and they often do not add information provided by the DV image. The DV image may show signs of joint surface incongruency or arthritic changes and if present dislocation – but the direction of the dislocation is not confirmed.

CT imaging of the TMJ has brought a better understanding of pathology that is present and that there is often more than one lesion present. Arzi et al (2013) showed that the majority of dogs (78%) with TMJ disorders were suffering from osteoarthritis of the TMJ and more than 80% of these animals had lesions in both TMJs. 36.6% of dogs had osteoarthritis as the only TMJ lesion, the rest of the dogs also had at least 1 other TMJ abnormality. All of the dogs which had osteoarthritis and dysplasia of the joints, showed pain on clinical examination of the jaws, whereas only a quarter of the dogs with osteoarthritis only of the TMJs had pain on examination. (Arzi, et al., 2013). Just more than 50% (9/17) cats with TMJ disorders had TMJ fractures, the majority of which affected the condylar process. The remaining 8/17 cats with TMJ disorders had osteoarthritis. All cats with
TMJ fractures also had fractures of multiple maxillofacial bones and soft tissue trauma. Interestingly, it was found that both dogs and cats with mesaticephalic head shape were over represented in the groups with TMJ osteoarthritis when compare to brachycephalic and dolicocephalic breeds. (Arzi, et al., 2013)

Standard medical x-ray equipment routinely used in veterinary clinics is not an adequate modality for obtaining diagnostic images of jaw fractures. Although intra-oral dental plates can be used to obtain radiographs of the jaws with less superimposition of structures, they too are not completely adequate for obtaining diagnostic radiographs void of superimposition of structures. CT is being considered the imaging modality most useful in the diagnostic work-up of patients with jaw and head/facial fractures. It is however accepted that where CT is not accessible, intra-oral radiography will be the diagnostic imaging modality of choice.

When comparing standard medical radiographic modalities and intra-oral radiographic techniques to CT investigations, Gomes Carvalho et al (2006) showed that CT was superior to either intra-oral or extra-oral radiographic techniques especially when it came to visualisation of fractures of the caudal mandible and ramus. Lateral and DV projections obtained of the head showed that there were lesions affecting the caudal mandible but due to superimposition of other bony structures, a diagnosis could not be made. On examination of the CT images, fractures of the coronoid process and the caudal mandible were clearly visible. (Gomes Carvalho, Pinto, Gioso, CorreaI, & Cavalcanti, 2006)

Arzi and Verstraete (2014) showed that 3-D reconstruction of the CT images of patients suffering from comminuted fractures of the maxillofacial bones, was beneficial in determining the spatial arrangement of the fractured bones as well as beneficial in the contouring of the reconstruction plates on 3-D prints of the images. The extent of bony and soft tissue trauma is easily determined using CT which assists in treatment planning. (Arzi & Verstraete, Internal Fixation of Severe Maxillofacial Fractures in Dogs, 2014)

References


Bones and muscles are held together by the aptly named connective tissue. Connective tissues are ligaments, which connect bone to bone, and tendons, which connect the bones to muscles. It is also the fascia covering muscles and the joint capsule tissue. Fewer information about tendon in comparison to other musculoskeletal tissues such as bone, cartilage and muscle is available. (1) Tendons transmit force from muscle to bone and act as a buffer by absorbing external forces to limit muscle damage. They exhibit high mechanical strength, good flexibility, and an optimal level of elasticity to perform their unique role. (2) One of the most common orthopedic problems is tendon injury. (3) Tendon injuries are difficult to manage and surgically repaired tendons do not fully restore function. its injuries are slow to heal and healed tendons rarely regain their original strength and elasticity. The inferior healing causes prolonged recovery times and a high rate of re-injury. (4) Tendon healing is associated with fibrovascular scar tissue formation and adhesion formation that has negative effect on rehabilitation and its normal function. Due to the low cellularity and low mitotic activity of the tendon, and because of the collagen fibers tend to line up in random arrangements instead of the stronger linear pattern, healed tendon will generally be weaker than the original. In fact, the injured tendon never regains the structural and biomechanical properties of a normal tendon and due to the insufficient healing response; after healing it is prone to re-injury. (2, 3) Therefore, treatment of tendon injuries is still a great challenge for orthopedic surgeons. Considering the frequency of tendon injuries and increasing cost of conservative and surgical treatments and also the poor results of conservative and surgical treatments, and inconsistency in the results of traditional methods, there is an increasing need for new and alternative treatments methods that will result in faster and more efficient healing of the injured tissue. (2, 3) In this paper I want to described my near to 30 year challenge story with tendon healing that begun from 1990 with evaluation of phenytoin and low current direct electrical stimulation on tendon healing till now.
1. Phenytoin

Phenytoin is an anticonvulsant drug which has been used in treatment of epilepsy for many years. The long term usage of this drug has been associated with gingival hyperplasia which is due to the effect of the drug on the connective tissue.

In this study, the effects of parenteral administration of phenytoin on healing of complete and partial ruptures in the deep digital flexor tendon of rabbits were evaluated. Based on this study results it could be concluded that phenytoin have not any beneficial effects in tendon healing. (5) (Table 1)

2. Electrical stimulation

Electrical stimulation is often assumed to augment regeneration of various tissues. Most reports describe the use of electrical current to stimulate healing of delayed union or nonunion fractures. However little attempts have been made to evaluate the effect of electrical current on the repair of the soft tissues, and there is a controversy in its use in promoting tissue healing.

In this study, the effects of local stimulation by direct electrical current on healing of complete and partial ruptures in the deep digital flexor tendon of rabbits were evaluated. Based on this study results it could be concluded that local stimulation by direct electrical current have not any beneficial effects in tendon healing. (5) (Table 1)

3. Ascorbic acid

Ascorbic acid is required as a co-factor for prolyl hydroxylase and lysyl hydroxylase essential for collagen synthesis. When ascorbic acid is deficient, collagen is malformed. Ascorbic acid plays a vital role as a preeminent water-soluble antioxidant. Ascorbic acid, as one of the non-enzymatic aqueous antioxidants, has been shown to have a positive effect on mesenchymal tissues healing.

The main objective of the presented study was to determine the attributes of collagen fibrils during tendon healing in rabbits supplemented with ascorbic acid compared to unsupplemented rabbits. The results obtained indicated a significant positive effect of ascorbic acid on collagen fibril structural properties and tendon healing. (6) (Table 1)

4. α-tocopherol

α-tocopherol is considered as a very important fat-soluble antioxidant. However, the effect of α-tocopherol on surgical wounds healing is inconclusive. It was shown before that α-tocopherol level may be increased by ascorbic acid by reducing α-tocopherol metabolism.

The main objective of the presented study was to determine the attributes of collagen fibrils during tendon healing in rabbits supplemented with α-tocopherol alone and its combination with ascorbic acid in comparison with unsupplemented rabbits. The results obtained indicated a significant positive effect of α-tocopherol on collagen fibril structural properties and tendon healing. However, combination of both vitamins had no synergistic effect on tendon healing and even significantly decreased the effect in comparison to each individual vitamin. (6) (Table 1)
5. Flunixin meglumine

Flunixin meglumine is a member of nonsteroidal anti-inflammatory drugs (NSAIDs) that have been shown to influence wound healing in several tissues. These agents have been shown to diminish pain and inflammation and, therefore, improve the patient’s recovery and return to function. Based on various controversy results, this study was designed to determine the effects of flunixin meglumine, a non-selective COX inhibitor, on histological and mechanical properties of the healed tendon in an experimentally induced tendon injury in rabbits. The present study showed that intramuscular injection of flunixin meglumine resulted in improved structural and mechanical properties of tendon repairs and it could be an effective treatment for acute tendon injuries like severance and laceration. (7) (Table 1)

6. Bone marrow stem cells (bMSCs)

Tissue engineered cell therapies offer many new treatment options for repair of diseased and damaged tissue. Tissue engineers add cells to various delivery vehicles and introduce mechanical and chemical stimuli in culture to try and create safe and functional repair tissues. Bone marrow stem cells (bMSCs) are nucleated mesenchymal cells that would differentiate into fibroblast-like cells once transplanted into healing connective tissue. The main object of this study was to investigate the effect of intratendinous injection of bMSCs on the rate and extent of tendon healing after primary repair (suturing) in a rabbit model. Intratendinous application of bone marrow-derived mesenchymal stem cells following primary tendon repair can significantly improve the histological parameters in the early stage of tendon healing. (8, 9) (Table 1)

7. Stromal vascular fraction (SVF) of adipose tissue

Stromal vascular fraction (SVF) of adipose tissue is a rich source of preadipocytes, mesenchymal stem cells (MSC), endothelial progenitor cell, T cells, B cells, mast cells as well as adipose tissue macrophages and is derived from enzymatic digestion of adipose tissue. The freshly isolated SVF actually contains a heterogeneous mixture of cells, including endothelial cells, smooth muscle cells, pericytes, fibroblasts, mast cells, pre-adipocytes, and a rich source of adipose-derived stromal cells. SVF has been successfully used for repair of skeletal muscle. The adipose tissue SVF cells are suggested as an alternative source of progenitor cells since known sources of such cells suitable for therapeutic usage are limited

8. Ascorbic acid

Ascorbic acid is required as a co-factor for prolyl hydroxylase and lysyl hydroxylase essential for collagen synthesis. When ascorbic acid is deficient, collagen is malformed. Ascorbic acid plays a vital role as a preeminent water-soluble antioxidant. Ascorbic acid, as one of the non-enzymatic aqueous antioxidants, has been shown to have a positive effect on mesenchymal tissues healing. The main objective of the presented study was to determine the attributes of collagen fibrils during tendon healing in rabbits supplemented with ascorbic acid compared to unsupplemented rabbits. The results obtained indicated a significant positive effect of ascorbic acid on collagen fibril structural properties and tendon healing. (6) (Table 1)
<table>
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<th>Study Plan</th>
<th>Phenyltin</th>
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<th>Ascorbic acid</th>
<th>α-tocopherol</th>
<th>Flumilus meglumine</th>
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<th>Bone marrow stroma cells (i.e. BMSCs)</th>
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<td>A piece of the DIA was removed from the skin of a rat.</td>
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</table>
9. α-tocopherol

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SVF has been successfully used for repair of skeletal muscle. The adipose tissue SVF cells are suggested as an alternative source of progenitor cells since known sources of such cells suitable for therapeutic usage are limited.

In the present study we hypothesized whether a single intratendinous injection of SVF immediately after surgically induced complete transection of flexor tendon would influence structural and mechanical repair compared with placebo-treated controls. The present study shows that intratendinous injection of uncultured SVF results in improved structural and mechanical properties of tendon repairs and it could be an effective modality for treating tendon injury. (2, 4, 10-12) (Table 2)

13. Fibroblast-like synoviocytes (FLSs)

Fibroblast-like synoviocytes (FLS) represent a specialised cell type located inside joints in the synovium. Mesenchymal stem cells derived from synovium have higher proliferation and differentiation potentials than the other MSCs. It was believed that the structure of the synovial membrane in the tendon sheath is similar to that in the joint. Recent studies have shown that synovial cells in the synovial sheath have the potential to migrate to the injury site and accelerate connective tissue healing.

The present study was conducted to evaluate the hypothesis that whether fibroblast like synoviocytes (FLSs) would improve biomechanical properties of tendon repairs in rabbits. Results of study showed that, there was no significant differences in biomechanical parameters values between FLSs treated and control groups. In conclusion, intratendinous injection of FLSs did not improve biomechanical properties during eight weeks in rabbit. (1, 13) (Table 2)

14. Blastema

A blastema is a mass of cells capable of growth and regeneration into organs or body parts. Blastema were thought to be composed of undifferentiated pluripotent cells and are typically found in the early stages of an organism's development such as in embryos, and in the regeneration of tissues, organs and bone. In rabbits blastema tissue is group that exist circularly in the pinna holes punched region, which are of mesenchymal stem cell-like population, and they represent alternative source of multipotent cells that could be used in regenerative medicine.

The present study aimed to investigate effects of blastema cells derived from rabbit pinna on the recovery of surgical model of acute tendon injury in rabbits. The use of blastema cells as an adjunct in tendon repair, demonstrates superior biomechanical properties which would due to improve remodeling phase of tendon. (3) (Table 2)

15. Chitosan

Chitosan induces proliferation of cells and its stability facilitates its integration with the host tissue. Moreover, Chitosan was also utilized as a barrier membrane and evaluated for guided tissue regeneration (GTR) application. The present study was conducted to test the hypothesis that the chitosan wrapping would significantly improve the histological, properties of experimentally-induced tendon injury.

In view of histopathological analysis, despite of no significant differences with regards to
angiogenesis and collagen fiber arrangements in restored tendon, the quality and quantity of post operation tendon adhesion to surrounding tissues was significantly lesser in chitosan used groups in 3 and 8 weeks post operation. (14) (Table 2)

16. Fibroblast-like synoviocytes (FLSs) & Chitosan

Due to high potential in regeneration, synovium is studied as a cell source to be used in tissue engineering. Chitosan is a linear polysaccharide which is being studied in tissue engineering and its bioactive, biodegradable, and biocompatible nature makes it a suitable alternative. In vitro studies indicate that chitosan is a desirable material which can be utilized as a substrate for the growth of many cells.

The present study was conducted to test the hypothesis that the intratendinous injection of fibroblast-like synoviocytes (FLSs) with or without chitosan wrapping would significantly improve the histological, biochemical, and biomechanical properties of experimentally-induced tendon injury. The present study revealed that intratendinous injection of FLSs with chitosan wrapping resulted in improved structural and biomechanical properties of the repaired tendons in rabbits. (1, 13) (Table 2)

17. Chitosan & Zn nanoparticles

Chitosan has numerous properties, such as biocompatibility, biodegradability and non-toxicity, which make it suitable for use in biomedical field. Zinc is required for proliferation of fibroblasts and collagen synthesis, the essential elements for wound healing. Also, Zn nanoparticles are well known for their capability to enhance wound healing by improving cell adhesion and cell migration through growth factor mediated pathways.

Histopathologically, the effects of novel fabricated scaffold with chitosan alone and in combination with Zn nanoparticles were evaluated on the healing of experimentally induced tendon injuries and compared with chitosan and zinc oxide combination scaffold.

The biocompatibility and biodegradability of the novel fabricated scaffold, reduced adhesion formation and therefore improved gliding function of the repaired tendons. (15)(Table 2)

Conclusion

Tendon is a structurally and compositionally complex tissue with unique structure, function, and mechanics. For this reason, tendon healing and repair are topics of considerable research. The appropriate treatment for DDF tendon ruptures and chronic tendinopathies remains a clinical challenge. Unfortunately, tendon injuries are common and 1 of every 10 people and 1 of every 2 runners are afflicted with tendinopathy. When a tendon is injured, its structure is disrupted, and proper function can be compromised. In spite of the success of studies focused on tendon healing, much remains to be clarified regarding this complex process. The in vivo animal models and recently in vitro cell-culture, have facilitated tendon research will continue to play a critical role in future experimental activities. Through an improved understanding of tendon healing, enhanced techniques for tendon repair and regeneration may be developed.
Table 2

<table>
<thead>
<tr>
<th>Study Plan</th>
<th>Treatment Modality</th>
<th>Stromal vascular fraction (SVF)</th>
<th>Fibroblast like synoviocytes (FLS)</th>
<th>Blasema cells</th>
<th>Chitosan</th>
<th>Fibroblast like synoviocytes (FLS) &amp; Chitosan nanoparticles</th>
<th>Chitosan &amp; Zn nanoparticles</th>
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<tbody>
<tr>
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<td>4×10^6 SVF in 0.2 ml PBS solution</td>
<td>1×10^6 FLS in 0.1 ml PBS solution</td>
<td>1×10^6 Blasema cells in 0.1 ml PBS solution</td>
<td>1×10^6 FLS &amp; Chitosan nanoparticles in 0.1 ml PBS solution</td>
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<td>21 days &amp; 56 days</td>
<td>36 days</td>
<td>Positive effects on minimal adhesion formation at 4 &amp; 8 weeks</td>
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<td>Conclusion</td>
<td>Positive effect in the SVF treated group</td>
<td>No significant differences at 8 weeks in biomechanical properties</td>
<td>Positive effects on minimal adhesion formation at 3 &amp; 8 weeks</td>
<td>Positive effects on structural, biomechanical &amp; biomechanical</td>
<td>Positive effects at 8 weeks in structural, biomechanical &amp; biomechanical</td>
<td>No significant differences at 4 &amp; 8 weeks between treatment groups</td>
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References:


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Colic, a term used to describe abdominal pain in the equines, can be caused by a plethora of pathological processes, and manifest itself in many forms. It is an important cause of mortalities in domesticated horses and considered as an emergency condition in equine practices (Reeves 1997). Acute cases often need immediate surgical treatment which is expensive with high mortality rate. Before starting with treatment, the clinician must provide the owner with a clear view of possible complications and prognoses, thus reducing the unnecessary suffering and economic losses associated with equine colic.

Prognosticating survival in horses with colic is challenging because of the number of diseases and patho-physiologic processes that can cause the behaviour. (Dukti and White 2009). In different sporadic studies, many single or combinations of parameters viz. clinical and laboratory variables such as heart rate, capillary refill time, colour of mucous membrane, anion gap, total protein and acute phase proteins (APP) have been reported as valuable prognostic markers in equines with abdominal pain.

Physiological markers
Colour of mucous membrane and degree of pain have been found to be the important prognostic predictors in colicky equines (Orsini 2011, Bassan 2017). Congested mucous membrane in colicky equines could be due to dehydration, shock and endotoxemia (Gay et al. 1979). Ihler et al. (2004) also reported that colour of mucous membrane was the important predictor for the outcome in hospitalized colic cases. Gastrointestinal pain has an inhibitory effect on the normal gastrointestinal function causing a feedback loop in which the pain inhibits normal gut motility and function, allowing accumulation of ingesta and fluid, resulting in distension and stretching of the mesentery, intestinal spasm, mucosal irritation or pressure ischemic necrosis by the foreign impacted mass and further pain. (Radostitis et al. 2007). Intensity of pain proved to be a significant variable in discriminating between horses which survived and those which died (Anu Puotunen-Reinert 1986, Thoefner et al. 2000, Van der Linden et al. 2003).
Clinical markers
Heart rate, respiration rate and capillary refill time are the important clinical prognostic markers (Thoefer et al. 2000, Van der Linden 2003, Ihler et al. 2004, Bassan 2017). The increase in heart rate and respiration rate could be due to pain, excitation or hypovolemic shock leading to the stimulation of sympathetic nervous system which causes release of catecholamine into circulation and thus causing tachycardia and tachypnoea. Further, respiration rate also increases as a compensatory response to the metabolic acidosis so that to expel maximum carbon dioxide. Prolonged capillary refill time (CRT) results due to poor perfusion in peripheral circulatory system, hypovolemia, loss of water from the vascular space and endotoxemia leading to dehydration and cardiovascular dysfunction (Zbanszsek et al. 2004). The heart rate increases with both pain severity and cardiopulmonary (CP) compromise and survivability drops significantly at HR > 80 beats/min and CRT > 3 seconds as CP function worsens (Orsini 2011).

Biochemical markers
Blood glucose is an important prognostic variable in equine colic (Hollis et al. 2007, Hassel et al. 2009, Enbavelan et al. 2015, Bassan, 2017). The hyperglycemia could results due to dysregulation of glucose homeostasis caused by action of endotoxin which is absorbed across compromised intestinal mucosa (Vanhoorebeek et al. 2007). Orsini (2011) reported that blood glucose values > 200 mg/dl carry a poor prognosis; a return to normoglycemia during hospitalization is a good sign, but persistent hyperglycemia signals a poor outcome.

Anion gap is an important prognostic indicator in colicky equines (Gossett et al. 1987, Reeves et al. 1989, Bassan 2017). The increase in anion gap might be due to increased level of blood lactate in colic cases reflecting the anaerobic glycolysis, most often subsequent to tissue hypoxia from hypoperfusion or ischemia of the intestine (Walton, 2013). The probability of survival has been found decreased as the anion gap progressively increased above 20 mmol/l (Bristol 1982).

Acute phase proteins markers
Acute phase proteins (APPs) are of clinical interest as they can be identified in serum and used to detect and characterize inflammation. Therefore, APP measurement has a high clinical diagnostic and prognostic abilities for veterinary practitioners. Serum amyloid A (SAA) is a major APP with fibrinogen and haptoglobin being moderate APPs in horses. Westerman et al. (2016) have reported that horses requiring surgical intervention for colic typically have an elevated SAA and were more likely to be euthanized due to poor prognosis despite treatment. Whereas, Bassan (2017) reported haptoglobin and fibrinogen as important prognostic markers in colicky equines.

Peritoneal fluid markers
Colour of peritoneal fluid has been found to be the important prognostic indicator in colicky equines and red peritoneal fluid being associated with an increased risk of death (Van den boom et al. 2010, Van der Linden 2003, Orsini 2011, Bassan, 2017). Red/orange colour of peritoneal fluid might be because of vascular compromise of the gastrointestinal tract as obstruction of gut results in gut distension leading to serum exudation and lymph leakage initially and as the process continued there was diapedesis of red and white blood cells due to capillary break down giving red/orange colour to peritoneal fluid.

Among biochemical parameters of peritoneal fluid, total protein and pH have been reported as the important prognostic variables in colicky equines (Reeves et al. 1989, Orsini 2011, Bassan 2017). Increase in protein might be because of increased permeability of the capillaries of intestines due to inflammation and thus release of inflammatory mediators at the site of obstruction. Over distension
of the bowel causes changes in the hydrostatic pressure of the capillaries and exudation of serum and lymph exudates. Van Hoogmoed et al. (1999) reported that horses with septic peritonitis had significantly lower peritoneal fluid pH.

References
Arthroscopy in the horse
Indications and advantages

Arthroscopy has revolutionized joint surgery in the horse over the last 20 years. It has lead to dramatically improved outcomes, with lower morbidity and shorter rehabilitation times. Its principle uses in Europe have been in the treatment of synovial infection and the treatment of structural disruption of intra-synovial structures such as joint surfaces and tendons. It has also been used extensively to guide repair of fractures with an intra-articular component.

Synovial infection
Infections of joints, tendon sheaths and bursae traditionally carried a relatively poor prognosis for survival and return to soundness. The synovial environment has many factors that make successful eradication of bacteria problematic, and the massive inflammatory response that they elicit creates immense pain and is highly destructive to cartilage. It also leads to thrombosis in the small blood vessels that course through the synovial villi causing necrosis of their tips. The resultant dead tissue is an ideal environment for bacteria to invade, potentially creating a glycocalyx, which renders them less susceptible to antimicrobials. Penetration of the joint by systemically administered antimicrobials is often poor and concentrations below the minimum inhibitory concentration (MIC) are common.

This is a problem that is further compounded by the proteinaceous nature of synovial fluid. The protein can envelop bacteria; making them less susceptible to antimicrobials than laboratory based culture and sensitivity testing might suggest. An example of this is that bacteria, known to be sensitive to amikacin, when cultured in the presence of synovial fluid for 24 hours, remained viable in the face of amikacin administered at one hundred times MIC. Infection of a synovial environment also leads to the production of fibrin clots, which provide another favourable environment for bacteria to establish themselves. These clots may also adversely affect the cartilage and synovial environment, leading to adhesion formation and reduced mobility of the joint.

In adults, synovial infection almost always results from a penetrating wound. The damaged tissue at the edges of these wounds is often compromised or necrotic (depending on the nature of the insult), which can lead to continued seeding of bacteria into the joint. There is also a risk of foreign material such as wood or soil being driven into the joint, which can further compromise the host’s immune response and increase the bacterial load. Successfully combatting infection in the face of foreign material in the joint is extremely rare.

Arthroscopy gives the best chance of successfully treating an infected joint, tendon or bursa for several reasons. It allows a rapid delivery of a large volume of sterile, polyionic lavage fluid through the joint (Lactated Ringers/Hartmanns solution being the most commonly used). The aim of through and through lavage is to remove as much of the bacterial load as possible but also to dilute the damaging inflammatory mediators and flush any foreign material from the joint. Arthroscopy, performed with a high-pressure pump (delivering 100 – 300mmHg pressure) allows lavage volumes of 20 to 30 litres to be delivered in a timely fashion. The pressure may also have some value in dislodging weakly adherent bacteria.
At least 2 arthroscopic portals should be created to allow through and through lavage and evaluation of the joint from both directions. In all distal limb joints, 2 portals are created dorsally and 2 palmarly/plantarly to allow efficient lavage and evaluation of the entire joint. In the carpal joints, if foreign material or fibrin is not identified then a single portal into the palmar pouch is sufficient for lavage. The first portal is created following distension of the joint in standard positioning and all others under direct visualization. A 20-gauge needle is inserted at the expected location to check positioning, prior to creating the portal with a number 11 blade. This direct visualization is particularly important in digital flexor tendon sheaths where there is limited space around the tendons, which can be easily damaged by inadvertent laceration.

The original penetrating wound can often be used as one of the arthroscopic portals once it has been resected. It is important to remove all damaged/contaminated tissue from the wound to remove a potential ongoing source of infection. Ideally, the first portal is created distant to traumatic wound to allow the lavage to commence while the wound is being resected. If using the wound as a first portal then all of the wound edges and the penetrating tract should be resected prior to introducing the arthroscope.

The view around the joint is vastly superior to arthrotomy and can be maximized by using a 30-degree forward inclined arthroscope that allows some visibility around corners. Lavage of the joint is often made more efficient by introducing lavage cannulae through the portals to facilitate removal of fluid from the joint. The area deep to the original wound should be inspected for any direct damage to the underlying tissues or evidence of foreign material driven into those tissues. All damaged tissue should be removed leaving only healthy tissue that has no evidence of contamination. With cartilage and bone that is best achieved with curettes and rongeurs but with tendon/ligaments, a combination of scissors, blades, rongeurs and motorised resectors are most effective.

With increased chronicity fibrin deposition begins to occur within the joint. Ideally all infected synovial structures would be lavaged within 24 hours of the initial insult so that infection is removed prior to the formation of fibrin, which has been shown to result in poorer prognoses. However, once present, removal is vital for a positive outcome. Whilst some immature fibrin can be removed by lavage alone, most will require removal with rongeurs. This can be time consuming but fibrin provides a great environment for bacterial survival and may dramatically increase their protection against antimicrobial medication. Its removal may also reduce the incidence of intra-articular adhesions and reduce damage to cartilage resulting from the direct application of inflammatory mediators.

The arcuate blood supply to synovial villi makes their tips susceptible to necrosis as a result of a thrombotic state that develops with ongoing sepsis. Microclots form in the central arteriole, causing necrosis at the villous tip. This accumulation of dead tissue provides another excellent environment for bacterial proliferation and survival. It also reduces further, the delivery of antimicrobials to the sites of greatest microbial concentration. This has resulted in partial synovectomy being employed in chronically infected joints. That is most efficiently achieved with judicious use of motorised synovial resectors. These should be set so that fluid egress can occur through the blade, allowing removal of all resected material from the joint. The rate of fluid ingress should be increased to ensure that the joint remains distended during that process and that all contaminated resected material is ejected from the joint. If using a pressure based pump, an ingress pressure of 300mmHg is appropriate or an infusion rate of 500ml/minute if using a fluid pump where flow rate is set.

Once the joint has been lavaged and all infected material removed, the portals and the original penetrating wound should be closed if at all possible. The tissue loss associated with traumatic wounds and their debridement often results in some tension across the wound at closure. My preferred technique of closure in that situation is a combination of 4 metric nylon sutures in a
vertical mattress pattern combined with either skin staples or simple interrupted sutures to aid apposition and wound seal. I tend to avoid sub-cuticular sutures, which can act as a nidus for infection. If a wound is under great tension or cannot be closed completely, then the application of a distal limb cast will result in more rapid clot maturity, resulting in the synovial environment being sealed from the exterior environment more rapidly. It will also speed wound healing and reduce the need for post-operative bandaging.

Once all wounds are closed, 500mg amikacin sulphate can be instilled into the joint to maximize its concentration at the site of infection. This also delivers a high concentration to the periarticular tissues, such as subchondral bone and central areas of tendons. When administered at this level, concentrations of approximately 1000 time MIC are achieved and maintained for 24 to 48 hours. Repeat dosing of intra-articular medication can be useful every 48 hours to provide continued high concentrations of antimicrobials. Parenteral antimicrobials are administered for 5 to 7 days post-operatively as a routine and the horse’s comfort levels should be monitored for evidence of treatment failure.

The distal limb should be bandaged with sterile primary layers for recovery from anaesthesia and bandages changed carried out every 2 to 3 days until suture removal 14 days post-operatively. Sutures should be removed under aseptic conditions to prevent bacteria being drawn into the subcutis during removal or immediately afterwards.

Multiple papers have assessed response to treatment of synovial infection, with arthroscopic lavage and debridement consistently providing better outcomes than those reported with needle lavage, arthrotomy or leaving wounds open to drain. The morbidity of arthroscopic surgery is dramatically lower than arthrotomy and allows a more rapid return to function and mobility. Typically, horses can return to work 4 to 6 weeks after treatment for an uncomplicated joint infection providing that sufficient healing of the original wound has occurred.

**Osteochondral fragmentation**

In European sport horses, osteochondral fragmentation in joints is most commonly seen as a result of osteochondrosis or repetitive cyclical load of peri-articular bone. Each of these leads to fragmentation at predictable sites, most commonly in the carpus, metacarpophalangeal/metatarsophalangeal and tarsal joints. Fragmentation can also result from direct physical trauma, often during jumping events. Fragmentation within joints results in direct trauma to the joint surfaces and release of multiple inflammatory mediators and promoters from subchondral bone and as a result of the traumatic process. The fragments will often remain loosely attached to the underlying parent bone and regular movement results in further release of pro-inflammatory mediators into the joint. Arthroscopic removal is the treatment of choice in most of these instances and, as with treatment of infected arthritis, carries a much lower morbidity and a more rapid return to function than removal by arthrotomy. It also allows a more complete evaluation of the joint surfaces to assess cartilage health and of the associated soft tissues. The process of lavage removes blood clots and inflammatory mediators from the joint also.

Arthroscopic evaluation of the joint is carried out using standard technique, but as much of the joint is assessed as possible, before an instrument portal is created. This initial view around the joint is likely to give the most complete assessment, as it is at that point that the joint is most distended and has least fluid accumulated in the subcutaneous tissues. It may be necessary to insert a needle to lavage some accumulated blood from the joint to give the clearest view at that point.

Instruments portals are often created at standard sites in the joint but needle placement prior to creation of the portal ensures that positioning is optimal. This can be especially important for fragment removal or subchondral bone cyst enucleation where it is possible to check that the trajectory created for the instruments by correct portal positioning facilitates completing the surgery. It is often necessary to introduce elevators, curettes or blades initially to release fragments from their attachments. It is often easiest to leave a small area of attachment that retains the
fragment’s position while rongeurs are introduced to the joint. It is then grasped and removed from the joint. Large fragments may need to be removed in smaller pieces to ensure that they can be exteriorised through small arthroscopic portals. The parent fracture bed is then debrided with bone curettes until hard healthy subchondral bone is encountered and the joint copiously lavaged to ensure removal of any fine bone dust or inflammatory mediators released during the procedure. The small size of the incisions and minimal disruption of the peri-articular anatomy means that horses can usually commence walking exercise on the day following surgery. Early re-mobilisation of the joint is thought to improve long term joint health and foster a rapid return to function. The small incisions and low risk for synovial leakage makes post-operative infection a low risk and reduces hospitalisation times.

**Tearing of intra-synovial tendons, ligaments and menisci**
The tendons of the digital flexor tendon sheath and menisci of the femorotibial joints are most often affected. Tearing of the deep digital flexor tendon, manica flexoria and the medial femorotibial meniscus are most commonly affected in our caseload. Tearing of those structures results in collagen exposure in the synovial environment that stimulates an inflammatory response. That adds to the pain resulting from the initial trauma. There does not appear to be an effective mechanism to remove that torn tissue, consequently it remains in situ, either becoming adherent to adjacent structures, leading to reduced mobility, or it remains unattached at the torn end, being retraumatised as the tendon moves past adjacent structures. Arthroscopic evaluation allows removal of all torn tissue and transection of any adhesions that have formed. Removal of the damaged tissue allows reformation of the smooth gliding surfaces that are necessary for perfect function of the tendons also. Attempts at repair of deep tears in tendons and menisci has been attempted but does not appear to improve the prognosis and may favour post-operative adhesion formation. The palmar/plantar annular ligament of the digital flexor tendon sheath may become fibrosed and restrictive as a result of long-term inflammation within the tendon sheath. That may also occur secondary to traumatic tearing of the ligament. Transecting the ligament can alleviate the pain and constriction of the sesamoid canal. That is performed using a hooked blade through an instrument portal at the proximal part of the annular ligament, with the arthroscopic portal positioned immediately distal to the sesamoid and distal to the ligament. The same advantages of small incisions, reduced collateral damage and early return to mobility apply in that situation as those described above. In summary, arthroscopy allows minimal damage to peri-articular tissues, accurate and controlled debridement of lesions and lavage, with reduced morbidity and early return to function in equids of all types.
Surgical management of colic in horses: A review of some cases operated in Veterinary Referral Hospital of Shahid Bahonar University of Kerman.

Mohammad Mehdi Oloumi
Department of Surgery, Faculty of Veterinary Medicine, Shahid Bahonar University of Kerman, Kerman, IRAN

Abstract
From September 2016 to September 2017, 24 cases of equine colic were referred to the Department of Surgery, Veterinary Referral Hospital, Faculty of Veterinary Medicine, Shahid Bahonar University of Kerman. In this article, surgical management of the cases, from the time of admission until discharge from the hospital are reported.

Introduction
Surgical management of colic in horses is still one of the most challenging practices of equine surgeons. In spite of the original cause of the colic, accurate and on-time decision for referring the case to the surgical departments is of the utmost importance. There are some clinical guidelines which can help a practitioner to decide either the case is surgical or medical: severe pain despite the use of analgesia; recurrence of pain, following the administration of moderate to potent analgesia; heart rate persistently more than 60 bits per minute; net gastric reflux of more than two liters; positive findings in rectal examination; alteration in peritoneal fluid; progressive deterioration in mucous membrane color; progressive reduction in intestinal motility, and progressive abdominal distension are some important clinical signs which necessitate referring the colicky case for surgery.

General Overview
From September 2016 to September 2017, 24 cases of equine colic were referred to the Department of Surgery, Veterinary Referral Hospital, Faculty of Veterinary Medicine, Shahid Bahonar University of Kerman. In this article, surgical management of the cases, from the time of admission until discharge from the hospital are reported.

Fig. 1. Severe damage to the mesocolon vasculature and discoloration of the colon due to ischemia. This case was euthanized.
University of Kerman. Regardless of the time interval between the beginning of clinical signs and the operation, 14 cases out of 24 survived from the operation. Euthanasia was performed for three cases due to severe damage to the large colon observed following laparotomy (fig. 1). Six cases died before the surgical procedure began, and four cases died between 48 to 96 hours following surgery mainly due to systemic inflammatory response syndrome (SIRS). All the cases referred for surgery during the first 12 hours from the beginning of the signs of colic, were recovered from the corrective surgery and are pretty well until the time of writing this article. In one case, subtotal large colon resection due to severe, uncorrectable torsion (fig. 2), and in one case, partial enterectomy due to left dorsal displacement of the large colon, and entrapment of the left dorsal colon over the renosplenic ligament, were performed (fig. 3). In two cases there was a severe impaction of food materials in the small colon, which was removed through an enterotomy. All other cases underwent correction of displacement and/or torsion of the large colon.

Presurgical managements:

Pain, response to the analgesic therapy, and rectal examination findings are the most important criteria we use for determining whether a case is surgical or not.

1. **Pain relief.** Gastric decompression by insertion of a nasogastric tube and administration of analgesic drugs. Felunixin meglumine (0.25-1.1 mg/kg IV); Detomidine hydrochloride (10-40 µg/kg IV); Xylazine hydrochloride (0.2-1.1 mg/kg IV); Ketoprofen (1.1-2.2 mg/kg IV), are drugs available in our country and we use routinely for pain control.

2. **Fluid therapy and cardiovascular support.** Intravenous administration of polyionic balanced electrolyte solutions to maintain fluid volume and improve tissue perfusion which usually deteriorates in colic cases. Normal saline, hypertonic saline, saline/dextrose solution, hypertonic glucose, sodium bicarbonate, are easily available and should be considered for this purpose.

3. **Therapy for ischemia-reperfusion injuries.** Ischemia-reperfusion injuries are inevitable following surgical correction of torsions and displacements. So, decreasing these injuries before, during and after the colic surgery is mandatory. Vitamin C as a potent antioxidant and free radical scavenger, can be administered before the surgery. Lidocaine infusion has also been shown to have a protective role for bowel mucous membrane against the reperfusion injuries (1.3 mg/kg bolus, followed by 0.05 mg/kg/min). Lidocaine also can reduce the heart rate, has anti-inflammatory function and control the pain.

4. **Antibiotic therapy.** Antibiotic therapy begins for all the cases referred for colic surgery, from the time of admission. The antibiotics which are routinely used in our departments are: ceftriaxone (20mg/kg, iv, bid, for 7-9 days), gentamycin (6 mg/kg, iv, sid, for 4 days), metronidazole (10 mg/kg, sid, for 4 days). In the cases which diarrhea happens due to ceftriaxone administration, the drug is replaced by penicillin 5000000 (20000 IU/kg, iv, bid).
Anesthesia:
Xylazine (1 mg/kg, iv) followed by diazepam (0.2 mg/kg, iv) are administered as pre-anesthetics and ketamine HCl (2 mg/kg, iv), as inductive agent. The animals are connected to anesthetic machine, following endotracheal intubation and the anesthesia maintained by a combination of isoflurane and oxygen.

Surgical procedures:
Surgical procedures, described here is mainly practiced for torsion/displacement of the colon. The horses are positioned on the surgical table on dorsal recumbency, and following surgical preparation, the abdomen is approached from ventral midline. The first step in manipulation of the viscera is decompressing the gas-filled loops of bowel by a gauge 20 needle inserted on a 5 ml syringe and connected to the suction tube. The large colon of the animal is then exteriorized form the abdomen at the left side, as much as possible, and put over a disinfected table covered with two layers of impermeable surgical drapes (figure 4). In this stage a thorough examination of the colon.
intestines is performed. In the cases of severe damage to the involved parts of the colon leading to massive vascular engorgement of the mesocolon, and discoloration of the colon, euthanasia is considered following the owner’s agreement. The colon is then opened at the pelvic flexure and the contents evacuated as much as possible (fig. 5). The incision is closed in two inverting layers and the region rinsed thoroughly with warmed normal saline. At this stage correction of the torsion is performed, if any, the colon is well rinsed, and returned to the abdominal cavity in its normal anatomical position. Paying attention to the cecocolic ligament which runs between the lateral cecal band and lateral free band of right ventral colon is very important to make sure that the torsion/displacement is corrected perfectly.

The abdominal cavity is rinsed with copious amount of warmed normal saline several times and fluid removed as much as possible by a Poole suction tip. The abdominal cavity is then closed routinely. The animal is then moved to the recovery room and kept under close observation until the time of complete recovery.

Post-operative cares:
The horses are hospitalized for at least 5 days, under close 24 hours-a-day monitoring. Fluid therapy is continued according to the general condition of the animal and laboratory results. CBC, total protein, and serum fibrinogen of the animals are evaluated every day. Supportive solutions, containing vitamins, electrolytes, and amino-acids (i.e. Duphalyte, Aminosol, etc.) are usually administered. As mentioned above, antibiotic therapy continued for at least 7 to 9 days. Flunixin meglumine and lidocaine infusion are also continued. For ulcer prophylaxis, ranitidine (1.5 mg/kg, iv, qid) and as a prokinetic drug, metoclopramide (0.1-0.5 mg/kg, iv, sid) are also administered. When the animal can tolerates, had walking is performed for 15 to 20 minutes, twice a day.

The animals are discharged from the hospital, only when the food consumption (in small quantity) and defecation becomes normal. Close monitoring of the animal, with special care for the quality and quantity of foods, defecation, and sings of recurrence of colic, are recommended to the owners, at the time of discharging.

There is no doubt that the most important factor in successful colic surgery, is on-time referral of the animal for the surgery. This point should be taken very seriously by the equine practitioners.

Acknowledgments:
It is my sincere duty to appreciate the hardworking surgical team of the Department of Surgery, Faculty of Veterinary Medicine.
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References:
Anesthetic management in trauma patients

Nasser Vesal
Department of Veterinary Clinical Studies, School of Veterinary Medicine, Shiraz University, Shiraz, Iran
Email: nv1340@shirazu.ac.ir

Depending on the severity of the initial traumatic event, many critically ill patients may suffer from significant blood loss, extensive soft tissue injuries, multiple fractures and spinal cord injuries. In addition, vital organs (brain, heart, lung, liver, and kidney) are often involved in the traumatic injury. The best approach to the diagnosis and effective treatment of severely traumatized patients includes preoperative assessment and management of injuries to vital organ systems and shock (Table 1).

The goal of anesthesia is to select agents that do not cause myocardial depression, bradycardia, or vasodilation.

Pain should be assessed in all trauma patients. An aggressive and multimodal approach toward management of acute pain is recommended. Drugs and drug combinations can be administered by constant-rate infusion to enhance intraoperative analgesia. Peripheral nerve blocks and regional blocks can provide very effective analgesia for patients with pain from many causes. Patients should be monitored throughout the postoperative period for adequate analgesia.

Anesthesia induction
Calm handling of the patient and administration of suitable sedative drugs before induction reduces the induction dose of anesthetic, and diminishes the incidence of many common induction problems such as apnea, arrhythmias, and hypotension (Table 2).

The transition from the awake to the anesthetized state has a great impact on the cardiovascular (CV) and respiratory systems and therefore should be accomplished with great care and proper vigilance. A rapid, ‘crash’ induction should be avoided in hypotension-prone patients; rapid induction is, however, desirable in animals with respiratory disorders in order to attain a secure airway and provide oxygen and positive pressure ventilation, as soon as possible.

When inducing a critically ill patient, the induction dose may be as small as 10% of the ‘textbook dose’ or ‘usual dose’. It is not known how close the patient is to the ‘death line’. It is always possible to give more drugs until the desired effect is achieved, but you cannot get it back if you give too much.

Intravenous administration of propofol is associated with rapid induction and recovery, and, because of its rapid redistribution and extensive metabolism, it has minimal cumulative effects in dogs (it is cumulative in cats). Propofol is the most potent myocardial and respiratory depressant, peripheral
vasodilator, and hypotensive injectable agent, and therefore, must be used with caution in critically ill patients. Propofol may cause significant respiratory depression and ventilatory assistance should be available (Table 3). Ketamine, which has sympathomimetic effects, may be helpful in preserving blood pressure. However, larger doses of ketamine can induce hypotension in critically ill patients that are already under maximum sympathetic stress (Table 3). An opioid technique can be used for induction of anesthesia, although anticholinergics may be required to prevent bradycardia. Inhalation anesthetics (isoflurane and sevoflurane) are usually used to maintain anesthesia (Table 4). Regardless of anesthetic technique, it is strongly recommended to use a multimodal approach with careful monitoring and titration of drug effect.

Table 1 - Common conditions that should be corrected prior to anesthesia.
A- Severe dehydration
B- Anemia or hypoproteinemia
1- Packed cell volume <20% with acute blood loss
2- Serum albumin concentration <2.0 g/dL
C- Acid-base and electrolyte disturbances
1- pH <7.2
2- Serum potassium concentration <2.5–3.0 or >6.0 mEq/L
D- Pneumothorax
E- Hypoxia/ Cyanosis
F- Oliguria or anuria
G- Congestive heart failure
H- Severe, life-threatening cardiac arrhythmias
I- Upper airway obstruction
J- Hypoglycemia
K- Hypotension (mean arterial pressure (MAP) <65 mmHg)

Anesthesia Monitoring
Vigilant intraoperative monitoring of anesthesia (including frequent evaluation of anesthetic depth [lack of response to surgery, eyeball position], reflexes [palpebral reflex], cardiovascular function [heart rate and rhythm, mucous membrane color, CRT, peripheral pulse strength and rhythm, invasive/ non-invasive blood pressure measurement] and adequacy of oxygenation and ventilation. [rate and depth of breathing, pulse oximetry, capnography], and body temperature) is a key factor in the successful anesthetic management of trauma patients.

Table 2: Characteristics and precautions of sedatives and anesthetic agents

<table>
<thead>
<tr>
<th>Advantages and uses</th>
<th>Precautions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acepromazine</td>
<td>Unpredictable vasodilation &amp; hypotension</td>
</tr>
<tr>
<td>Good anxiolysis</td>
<td></td>
</tr>
<tr>
<td>No analgesia</td>
<td></td>
</tr>
<tr>
<td>Alpha2-agonists</td>
<td>Initial vasoconstriction &amp; hypertension</td>
</tr>
<tr>
<td>Good muscle relaxation</td>
<td>Subsequent vasodilaton &amp; hypotension</td>
</tr>
<tr>
<td>Reversible</td>
<td></td>
</tr>
</tbody>
</table>
Some analgesia
Benzodiazepines
Minimal cardiovascular effects
Reversible
Opioids
Minimal myocardial depression
Good analgesia
Reversible
Vagal induced bradycardia

Ventricular arrhythmias
Not reliable tranquilizers when used alone
No analgesia
Not complete anesthetics
Slow induction process
Respiratory depression

Chest trauma
Blunt trauma can cause hemothorax or pericardial tamponade (due to intrathoracic vessel rupture), myocardial contusion, papillary muscle rupture, and arrhythmias. Myocardial dysfunction secondary to trauma can be exacerbated by anesthetics drugs. Trauma patients may suffer from myocardial contusions that can lead to arrhythmias and impair cardiac output. Thus, arrhythmias their hemodynamic consequences should be evaluated and treated before induction of anesthesia. Blunt chest trauma may create pulmonary contusion and extra-alveolar air (pneumomediastinum, pneumothorax, and/or subcutaneous emphysema). Thoracic radiography should also be a part of the patient evaluation to diagnose pneumothorax, pulmonary contusions, or diaphragmatic hernia. Supplemental oxygen (by face mask or endotracheal intubation) and positive pressure ventilation should be provided as needed before, during, and after anesthesia. In awake animals, the stress of restraint for oxygen administration should be considered. Diaphragmatic hernia, as a common consequence of blunt chest or abdominal trauma causes lung collapse and impaired ventilation. Supplemental oxygen and positive pressure ventilation should be provided as necessary.

Table 3: Characteristics and precautions of injectable anesthetic agents

<table>
<thead>
<tr>
<th>Ketamine</th>
<th>Propofol</th>
</tr>
</thead>
<tbody>
<tr>
<td>Indirect, sympathomimetic cardiovascular stimulation (heart rate, cardiac output)</td>
<td>Rapid induction and recovery</td>
</tr>
<tr>
<td>Muscle hypertonus</td>
<td>Potent myocardial depression and hypotension</td>
</tr>
<tr>
<td>Potentially seizurogenic</td>
<td>Cumulative in cats</td>
</tr>
<tr>
<td>Direct myocardial depression</td>
<td>Decreases CMRO2, CBF, and ICP</td>
</tr>
<tr>
<td>Intermediate recovery; cumulative</td>
<td>May cause/potentiate bradycardia</td>
</tr>
<tr>
<td>Transient respiratory depression</td>
<td>Anticonvulsant</td>
</tr>
<tr>
<td>Muscle remains open</td>
<td>Potent respiratory depressant</td>
</tr>
<tr>
<td>Increases CBF, ICP and IOP</td>
<td>Bronchodilatation</td>
</tr>
<tr>
<td>Increases CBF, cerebral blood flow; ICP, intracranial pressure; IOP, intra-ocular pressure, CMRO2, cerebral metabolic rate for oxygen.</td>
<td>Not analgesic</td>
</tr>
</tbody>
</table>

CBF, cerebral blood flow; ICP, intracranial pressure; IOP, intra-ocular pressure, CMRO2, cerebral metabolic rate for oxygen.
Patients with respiratory distress
Oxygen supplementation is generally recommended during initial assessment and before anesthesia to increase a patient’s PaO₂ and reduce the risk of hypoxemia. Patients with serious ventilatory compromise respond very well to an oxygen-enriched gas mixture as initial therapy; the increase in inspired oxygen fraction is associated with improved ventilatory function, and the patient stabilizes and becomes more manageable prior to further examination and treatment. Preoxygenation is recommended if the patient will tolerate it. Induction of anesthesia should be rapidly achieved without excitement using an intravenous anesthetic technique (e.g., propofol). For this reason, mask or chamber induction with inhalant anesthetics is not recommended. A preoperative history of dyspnea can be indicative of possible airway obstruction during anesthesia induction, and endotracheal intubation may be difficult. The anesthetist should be prepared to perform tracheostomy available in case orotracheal intubation is not possible. Trauma during insertion or maintenance of an endotracheal tube may cause post-anesthetic airway obstruction. In cats, laryngeal desensitization with lidocaine may help to reduce spasm and trauma associated with endotracheal intubation.

Table 4: Characteristics and precautions of inhalation anesthetics (isoflurane & sevoflurane)
<table>
<thead>
<tr>
<th>Advantages and uses</th>
<th>Precautions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Easy maintenance of anesthesia with rapid recovery</td>
<td>No analgesia</td>
</tr>
<tr>
<td>Retrieveable</td>
<td>Myocardial depression</td>
</tr>
<tr>
<td>No arrhythmias</td>
<td>(Halothane is arrhythmogenic)</td>
</tr>
<tr>
<td>Hypotensive agents (dose-related)</td>
<td>Respiratory depression</td>
</tr>
<tr>
<td>Respiratory depression</td>
<td>minimally metabolized</td>
</tr>
<tr>
<td>minimally metabolized</td>
<td>Need an anesthetic machine and specific vaporizer</td>
</tr>
</tbody>
</table>

Hypovolemia
Trauma patients are often presented in hypovolemic shock due to acute blood loss from the site of injury (e.g., open fracture) or internal bleeding in the abdomen and/or thorax and are usually considered to be at high anesthetic risk. The animal’s state of hydration should be assessed in all trauma patients. Increased skin turgor, reduced moistness of mucus membranes, ‘sunken’ eyes, and increases in total protein (TP) and packed cell volume (PCV) are indicative of interstitial dehydration. Tachycardia, increased capillary refill time, alterations in peripheral pulse strength and rhythm, and collapse of peripheral veins may indicate severe hypovolemia due to ongoing hemorrhage. Insufficient urine output (<0.5-1 mL/kg/hr), extensive blood loss, and hypotension are indications for higher fluid rates, while excessively high fluid rates, especially in patients suffering from oliguric renal failure, cardiac insufficiency, head trauma, pulmonary contusions or decreased colloidal osmotic pressure, may increase the likelihood of fluid accumulation in the lung (pulmonary edema). Since glucose is linked to increased brain injury, use of glucose-containing fluids should also be avoided in patients with head trauma. Corticosteroids are also contraindicated in head trauma as they cause hyperglycemia.
Hypotension
To optimize preload and maintain cardiac filling pressures, intravenous fluids should be administered prior to induction of anesthesia. Small (2–5 mL/kg) boluses of crystalloid or colloids can be given at induction to optimize preload and offset anesthetic-associated vasodilation. Colloid therapy be more appropriate in cases with pre-existing hypoproteinemia. Vasopressors (norepinephrine, epinephrine and phenylephrine) are given when patients remain hypotensive despite adequate fluid resuscitation. Additional cardiovascular support using inotropes (dobutamine and dopamine) may be indicated in order to offset the myocardial depressant effects of inhalants and optimize vital organ perfusion during anesthesia.

Anemia
Anemia secondary to hemorrhage, which is common in the traumatized patients, decreases blood oxygen content and oxygen delivery. Since oxygen delivery is the product of cardiac output and blood oxygen content, anesthetic agents that potentially decrease cardiac output should be avoided. Drugs that cause splenic dilation may further decrease the hemoglobin concentration. In general, it is recommended to maintain hemoglobin concentrations above 8 g/dL (a packed cell volume [PCV] of 24%) during general anesthesia. Patients with a hemoglobin concentration of less than 8 g/dL may require a preoperative or intraoperative blood transfusion. In trauma patients with hemorrhagic hypovolemia, it is not necessary to correct the entire RBC deficit preoperatively; however, normovolemia should be restored and attempts to achieve a PCV of ≥30% in dogs or 20% in cats should be made, as oxygen-carrying capacity is usually adequate above these levels.

Urinary bladder rupture and uroabdomen
Uroabdomen, defined as urine in the peritoneal cavity, can occur in small animals following vehicular trauma. It is important to recognize that uroabdomen is not a surgical emergency and preanesthetic correction of azotemia, acid-base disturbances, and electrolyte imbalances is paramount and surgical intervention can usually be delayed until the patient has been stabilized. In summary, a thorough physical examination, patient assessment and preparation for anesthesia are fundamental principles to successful anesthetic management of trauma patients. Prior to anesthesia and surgery, patients should be stabilized via adequate fluid resuscitation and administration of vasopressors and/ or inotropes as necessary to correct hypotension, improve perfusion, maintain adequate tissue oxygenation, and prevent organ dysfunction.

References:
Diagnostic and therapeutic advantages of endosurgery as a minimal-invasive technique: review of 14 dogs and 3 cats

Hamidreza Fattahian*1, Roozbeh Moridpour2, Mahya Jazini Dorcheh1, Mohammad-Hazhir Alaei3, Sepideh Sadafi Koochehbaghi4

1 Department of Clinical Sciences, Faculty of Specialized Veterinary Sciences, Science and Research Branch, Islamic Azad University, Tehran-IRAN
2 Division of Surgery, Hamidreza Fattahian Pet Hospital, Tehran-IRAN
3 Department of Surgery and Diagnostic, Imaging Faculty of Veterinary Medicine, Urmia University, Urmia, Iran
4 Division of Anesthesia and Critical Cares, Hamidreza Fattahian Pet Hospital, Tehran-IRAN

Email: Hamidrezafattahian@yahoo.com

Case Description- Fourteen female and male mixed breed dogs that weighed about 10-20 kg and three domestic short hair cat that weighed 3-5 kg were underwent diagnosis and treatment with endosurgery devices as a minimal invasive procedure.

Clinical Findings- Ten female dogs were referred to hospital for elective lap-ovariectomy. Normal status was obtained after clinical examination, laboratory tests and chest radiography of all cases were done. Elevated liver enzymes were diagnosed in laboratory study of four dogs that was referred with anorexia, weakness and cachexia. Masses with unknown origin was seen in abdominal radiography and ultrasonography of the above four cases that exploratory laparoscopy was recommended for confirmation of diagnosis. The three cats with dyspnea and stridor was referred that upper respiratory disfunction was diagnosed by internist. Then rhinoscopy and bronchoscopy procedures for diagnosis of problems and their treatments was suggested to owners.

Treatment and Outcome- Ovariectomy with three portal laparoscopic method in 45 minutes was done. An Ovary and cervix in a case, liver in one patient and spleen in two patients were the exact origin of masses. Open procedures from midline for exsecting masses in all four case were done. Nasopharyngeal stenosis in a cat and Nasopharyngeal Polyp in two others were seen in endoscopy of upper respiratory pathway.

Clinical Relevance- As the standard of care in veterinary medicine improves with advancing technology, clients expect a higher level of care and even seek for minimally invasive procedures for their pets. Endoscopy is a versatile tool that provides a nonsurgical option for diagnosis and treatment of a variety of disease conditions. While gastrointestinal endoscopy represents the most common use in veterinary medicine, endoscopes can be utilized to investigate multiple body systems. Further, endoscopy can be therapeutic. This article provides a general overview of benefits of this pioneer method for reduce stress, pain, adhesion, hospitalization, surgical trauma, duration of post operative cares and hemorrhage which are main gols of a surgeon.

Key Words: Endosurgery, Minimal-invasive, practice, Dog, Cat

References
Effect of Phentolamine Mesylate on Regression of Epidural Anesthesia with Lidocaine-Epinephrine in Sheep

Hadi Imani Rastabi, Javad Jamshidian, Ali Baniadam, Fereshteh Alipour*
Department of Clinical Sciences, Faculty of Veterinary Medicine, Shahid Chamran University of Ahvaz, Ahvaz, Iran

Email: h.imani@scu.ac.ir

Objective – To evaluate the effect of epidural application of phentolamine mesylate on the duration of sensory and motor blockade following epidural anesthesia with lidocaine-epinephrine in sheep.

Design- Randomized, blinded, controlled, experimental study
Animals- Twelve lambs weighing 25.7 ± 2.3 kg

Procedures- Epidural administration of lidocaine 2%-epinephrine (5 µg/mL) was performed in all sheep (n = 12). Thirty min later, sheep (n = 6) received one of the treatments of normal saline (SAL), phentolamine 1 mg (PHE1) and phentolamine 2 mg (PHE2) in an epidural manner. Sheep were experimented three times with one week interval. Sheep in group LID (n = 6) did not receive any treatment. The final volume of all administered drugs was adjusted to 5 mL. The time to onset and duration of sensory and motor blockade were evaluated and recorded.

Results- There was no differences with respect to the time to onset of sensory and motor blockade between treatments (p > 0.05). Duration of sensory blockade was significantly shorter in SAL (57.5 ± 6.2 min), PHE1 (60.7 ± 9.0 min) and PHE2 (62.0 ± 16.7 min) in comparison to that of LID (81.7 ± 13.4 min) (p < 0.05). No significant differences were observed in the duration of sensory blockade among SAL, PHE1 and PHE2 (p > 0.05). Duration of motor blockade was significantly shorter in PHE1 (59.4 ± 5.4 min) and PHE2 (54.3 ± 4.0 min) than that of SAL (84.8 ± 7.0 min) and LID (91.5 ± 18.2 min) (p < 0.05).

Conclusion and Clinical Relevance- Epidural administration of normal saline and 1, 2 mg phentolamine with the volume of 5 mL reduced the duration of sensory blockade in sheep received epidural lidocaine-epinephrine. In addition, phentolamine at the tested dose rates decreased the duration of motor blockade following epidural administration of lidocaine-epinephrine in sheep. Further studies needs to determine the safety and potential efficiency of epidural phentolamine in the regression of epidural anesthesia with lidocaine-epinephrine in clinical use.

Key words- Phentolamine mesylate, Lidocaine, Epinephrine, Epidural, Sheep

References
The Effects of Propofol and Propofol-Epidural Anesthesia on Immunological Indices in Dogs Undergoing Ovariohysterectomy

Hadi Imani Rastabi, Mohammad Khosravi, Reza Avizeh, Maryam Moslemi*
Department of Clinical Sciences, Faculty of Veterinary Medicine, Shahid Chamran University of Ahvaz, Ahvaz, Iran
Email: h.imani@scu.ac.ir

Objective – To determine whether propofol and epidural anesthesia combination improves immunological characteristics in comparison to propofol anesthesia in dogs undergoing ovariohysterectomy (OHE)

Design - Randomized, blinded, controlled, experimental study

Animals - Twelve adult mongrel bitches weighing 16.1 ± 1.6 kg and aged 1.5-2.5 years old

Procedures - Dogs received acepromazine (0.025 mg/kg) and morphine (0.25 mg/kg) as sedation. Forty min after sedation, left and right cephalic veins were catheterized. After preoxygenation of 5 min, anesthesia was induced and was maintained by total intravenous anesthesia of propofol (loading dose (LD) 7 mg/kg, CRI 0.4 mg/kg/min). After induction of anesthesia, dogs in group P (p=6) received epidural saline and lumbosacral epidural anesthesia with lidocaine (0.22 mg/kg) was performed in group PE (n=6). After aseptic preparation of surgical site, OHE via ventral midline celiotomy was performed in all dogs. After intubation until the end of surgery, the dogs received normal saline at the rate of 10 mL/kg/h and 100% oxygen via tracheal tube at the rate of 100 mL/kg/min. The innate, humoral and cell-mediated immune responses were evaluated at base and at predetermined intervals.

Results - The bactericidal effects against *Escherichia coli* and *Staphylococcus aureus* and lysozyme activity were significantly lower in group P compared to those of PE (p < 0.05). Myeloperoxidase activity showed higher values in P than PE (p < 0.05). The phytohemagglutinin skin test showed significantly less cellular immunosuppression in group P than PE (p < 0.05). The total antibody titer test (TAM) as well as antibody titers against bovine serum albumin, *Salmonella typhimurium*, and sheep red blood cell showed higher values at several time points in PE; however, the difference was only significant with respect to TAM at 5 and 10 days after surgery (p < 0.05).

Conclusion and Clinical Relevance - The results suggest that induction and maintenance of anesthesia with propofol in combination with epidural anesthesia might have benefit of protection of cellular and humoral immune systems.

Key words - Propofol, Epidural anesthesia, Immune system, Ovariohysterectomy

References
Evaluation of the Sedative Effects of Diazepam, Midazolam, and Xylazine after Intranasal Administration in Juvenile Ostriches (Struthio camelus)

Mostafa Araghi¹, Saeed Azizi¹, Nasser Vesal², and Bahram Dalir-Naghade³

¹Department of Surgery and Diagnostic Imaging, Faculty of Veterinary Medicine, Urmia University, Urmia, Iran.
²Department of Veterinary Clinical Sciences, School of Veterinary Medicine, Shiraz University, Shiraz, Iran.
³Department of Internal Medicine and Clinical Pathology, Faculty of Veterinary Medicine, Urmia University, Urmia, Iran.
Email: araghi77@yahoo.com

Objective- Evaluation of the sedative effects of diazepam, midazolam, and xylazine after intranasal administration in juvenile ostriches (Struthio camelus).

Design- In this experimental study, different sedatives were administered nasally in various treatment groups.

Animals- In the study, 72 (36 male and 36 female) juvenile healthy ostriches (Struthio camelus), weighing 50–61 kg and aged 4–5 months were used.

Procedures- The birds were randomly divided into 3 groups (n=24), then each group was further subdivided to 4 subgroups (n=6). For each drug, 4 different doses were chosen and the total calculated dose was equally administered into either naris of the individual bird. The appropriate dose of each drug to produce standing chemical restraint or sternal recumbency was evaluated based on the onset time, the duration of maximum effect, and the duration of sedation.

Results- Midazolam showed significantly shorter onset time (2.9 ± 1.2 minutes) compared with xylazine (4.4 ± 1 minute) and diazepam (4.3 ± 0.4 minutes). Longer duration of sedation was also achieved with midazolam compared with xylazine and diazepam. Moderate sedation was achieved with diazepam (0.8 mg/kg), midazolam (0.4 mg/kg), and xylazine (2 mg/kg) for standing chemical restraint, with the maximum duration effects of 7.0 ± 1.4, 17.7 ± 4.1, and 9.2 ± 2.5 minutes, respectively. Deep sedation was also achieved with midazolam (0.8 mg/kg) and xylazine (4 mg/kg), with sternal recumbency duration of 21.7 ± 4.9 and 13.5 ± 2.6 minutes, respectively.

Conclusion and Clinical Relevance- The results of the present study show that intranasal administration can be an effective route for delivery of sedatives in juvenile ostriches. Intranasal midazolam and xylazine could be suggested for standing chemical restraint or inducing sternal recumbency in juvenile ostriches.

Key words- Intranasal, sedation, diazepam, midazolam, xylazine, avian, ostrich.

References
The effects of Midazolam-Ketamine on Resistive and Pulsatility indices of aorta in Healthy Domestic Short-Haired cats

Niloufar Ghaahari¹, Shahram Jamshidi², Yasamin Vali³, Mohammad Molazem³.
1. Student of Doctorate Veterinary Medicine, Faculty of Veterinary Medicine, University of Semnan, Semnan, Iran.
2. DVM, DVSc/PhD in Small Animal Internal Medicine, Department of Veterinary Internal Medicine, Faculty of Veterinary Medicine, University of Tehran, Tehran, Iran.
3. DVM, DVSc/PhD in Veterinary Radiology, Department of Veterinary Radiology, Faculty of Veterinary Science, University of Tehran, Tehran, Iran.

Email: Niloufar.ghahari@gmail.com

Objective: Evaluate the effects of Midazolam-Ketamine on Resistive and Pulsatility indices of aorta.

Design: Chemical restraints are required to perform ultrasonography in some aggressive patients that it may alter the vascular indices which may result in misinterpretation. Thus, this study conducted to evaluate the effect of sedation with ketamine-midazolam on aorta's resistive (RI) and pulsatility (PI) indices in cats.

Animals: 20 healthy Domestic Short-Haired cats.

Procedure: For this purpose twenty clinically normal cats were included in the present study in two groups, sedated and non-sedated cats. The sedated group members were undergone general anesthesia with Midazolam-Ketamine injection. Then resistive and pulsatility indices of aorta were measured by pulse wave Doppler. The results have been recorded and evaluated by statistical software.

Results: Mean resistive index in non-sedated group was 0.715±0.048 however, in sedated group was 0.778±0.074 a significant difference was found between values of two groups.
Mean pulsatility index in non-sedated group was 1.343±0.615 however, in sedated group was 2.130±0.631 a significant difference was found between values of two groups.
Mean diastolic velocity in non-sedated cats was 12.862±2.184 however, in sedated group it was 5.910±5.743 it reduced significantly with P=0.006.

Conclusion and Clinical Relevance: According to results of the present study, sedation with Midazolam-Ketamine increase RI and PI indices. It may be due to the reduction of diastolic velocity. It is suggested that if sedation by ketamine-midazolam used during the examination the effect of Midazolam-Ketamine on indices should be considered. Our study describes values for aorta in clinically normal sedated cats. It is recommended to do further study to determine if body weight, gender, age and breed have an effect on these values.

Key words: Pulse wave ultrasonography, Resistive index, Pulsatility index, Midazolam-Ketamine, aorta.

References:
Surgical Treatment of Intraluminal Impaction in a Foal

Zahra Riahi¹, Aboutorab Tabatabaiee naeini², Parham Razavi³, Mohammad Mahmoudifard³

1. Student of Veterinary Medicine, School of Veterinary Medicine, Shiraz University, Shiraz, Iran.
2. Associated Professor of Veterinary Surgery, School of Veterinary Medicine, Shiraz University, Shiraz, Iran.
3. Resident of Veterinary Surgery, School of Veterinary Medicine, Shiraz University, Shiraz, Iran.

Email: Zahra.riahi@shirazu.ac.ir

Case Description-- An eight-month old Arabian filly suffering from colic was presented to the veterinary hospital of Shiraz University.

Clinical Findings - She was presented with a mild to moderate colic with reduced fecal output and she had a noticeable abdominal distension. Trocar was used to evacuate excessive gas which was entrapped in the gut. Also medical therapy was done. But after two days the foal was referred to the hospital with severe abdominal pain. Clinical Treatments did not resolve clinical signs; therefore, she was referred to the department of surgery for surgical intervention. The foal showed severe sign of colic and stopped fecal out-put at presentation with a heart rate of 70 beats per minute and respiratory rate of 24 per minute, CRT of 2s and temperature was 38 degrees centigrade. Ultrasonography examination of abdomen did not reveal any beneficial sign; Therefore, we decided to do an exploratory laparotomy.

Treatment and Outcome - Ventral midline celiotomy revealed two intraluminal impactions involving right dorsal colon and pelvic flexure. They were removed successfully through two enterotomies. Surgical treatment was associated with good prognosis. Following up this case in one month revealed that abdominal distention and sign of colic were resolved and defecation was normal.

Clinical Relevance - Colic in horses happens in a variety of reasons. This report describes surgical treatment of intraluminal impaction in horses which can be beneficial for other impaction surgeries in the future.

Key Words - Foal, Colic surgery, Intraluminal impaction.

References
Diagnostic and Therapeutic Advantages of Endosurgery as a Minimal-Invasive Technique: Review Of 14 Dogs And 3 Cats

Hamidreza Fattahian, Roozbeh Moridpour, Mahya Jazini Dorcheh, Mohammad-Hazhir Alaei, Sepideh Sadafi Koochehbaghi

1 Department of Clinical Sciences, Faculty of Specialized Veterinary Sciences, Science and Research Branch, Islamic Azad University, Tehran-IRAN
2 Division of Surgery, Hamidreza Fattahian Pet Hospital, Tehran-IRAN
3 Department of Surgery and Diagnostic, Imaging Faculty of Veterinary Medicine, Urmia University, Urmia, Iran
4 Division of Anesthesia and Critical Cares, Hamidreza Fattahian Pet Hospital, Tehran-IRAN

Email: Hamidrezafattahian@yahoo.com

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Key Words: Endosurgery, Minimal-invasive, practice, Dog, Cat

References
SINGLE-INCISION LAPAROSCOPY: Overview and Current Place in Veterinary Surgery

Roja Ebrahimi*† Mir Sepehr Pedram‡

1. Assistant Professor, Department of Surgery and Radiology, Faculty of Veterinary Medicine, University of Tehran, Tehran, Iran
2. Resident of Surgery, Department of Surgery and Radiology, Faculty of Veterinary Medicine, University of Tehran, Tehran, Iran.

Objective – This article summarizes the work that has been done so far on field of single incision laparoscopy in veterinary surgery, explores different aspects of their findings and provides an outlook on challenges on its way of progress as well as demonstrating its current applications.

Design - Systematic Review (An analysis of all relevant English language experimental studies of single incision laparoscopic surgeries (SILS) in animals).

Procedures - The search for literature was conducted in PubMed and Google scholar using the keywords “single incision laparoscopy” or “single port laparoscopy” combined with “dog” or “cat” or “small animal”, and the reference lists provided by those articles were also further explored for citations regarding SILS. All relevant English language studies were selected. We considered the following in the review (1) type of surgery, (2) Technique used to perform the operation, (3) Technical demand and complications reported, (3) type of Ports used, (4) duration of the operation, and (5) severity of post-operative pain.

Results - The literature search yielded 18 experimental studies, of which 17 were in English, published during 2009 to 2015. 12 of these experiments concerned castrations, 2 of which combined with Gastropexy. Other operations included splenectomy, intestinal surgery and removal of abdominal foreign body.

Conclusion and Clinical Relevance - Review of the publications shows that the SILS has already found its place in uncomplicated procedures in veterinary surgery specially sterilization procedures. Most of the trials have proved SILS to be feasible and at least comparable in surgical time and complications to conventional laparoscopy, although the obstacle of increased time and technical demand of the procedure can still be noted. More studies should be conducted to significantly prove the superior advantages of SILS especially in reduction of trauma and post-operative pain compared to conventional laparoscopy in veterinary surgery.

Key words - single incision laparoscopic surgery-dog-cat
Treatment of cervical mucocele by Mandibular and sublingual salivary gland excision in a male German Shepherd (a case report)

Alireza Bashiri¹*, Seyed Reza Javadi¹, Davood Sharifi¹, Fatemeh Sadat Hosseini Omshi²
¹Department of Surgery and Radiology, Faculty of Veterinary Medicine, University Of Tehran, Tehran, Iran
²Student of Veterinary Medicine, Faculty of Veterinary Medicine, University Of Tehran, Tehran, Iran

Email: Alirezabashiri@mail.ut.ac.ir

Case Description: A six years old male German Shepherd was referred to the veterinary teaching hospital of the University of Tehran with history of a fluid-filled mass on intermandibular region.

Clinical Findings: In clinical examination a prominent unilateral fluctuant, painless mass on intermandibular space was palpated. Aspiration contents revealed a yellowish mucoid fluid and was sent to the lab. The diagnosis of sialocele was made based upon history and FNA result.

Treatment and Outcome: The patient was anesthetized and a ventral approach was performed. The mandibular and sublingual salivary glands were dissected from the capsule to digastricus muscle. The mandibular and a portion of the monostomatic sublingual gland were excised to allow the remaining salivary glands and ducts to be pulled rostrally dorsal to digastricus by a haemostat. The mylohyoideus muscle was incised. The duct was ligated as rostrally to lingual nerve and transected. A drain placed for three days. The incision was closed in a routine pattern after lavaging surgical site. Redundant skin was resumed its normal appearance within three weeks postoperatively.

Clinical Relevance: A cervical mucocele is a collection of saliva in the deeper structures of the intermandibular space. Mucoceles rarely resolve without surgery. Complete excision of the involved gland-duct complex and drainage of the mucocele are curative. Lateral and ventral approaches have been reported; however, the ventral approach was preferred. Mucoceles recur if the side of mucocele origin was misdiagnosed or if inadequate gland was excised. The surgery result was excellent because of the accurate approach and attention to above mentioned points.

Key Words: Mandibular and sublingual salivary gland excision, Cervical Mucocele, German Shepherd

References:
An introduction to distal Limb lameness in horses

Babak Faramarzi DVM, CVA, MSc, PhD.

Lameness is a very common problem in horses particularly in athletes. Abnormal distribution of applied forces, leads to excessive stress on tissues and catastrophic injuries. It has been reported that upwards of eighty percent of all lamenesses originate from the hoof. Hoof conformation has been linked to catastrophic musculoskeletal injuries. While some levels of structural variations in hoof conformation are considered normal, conformational deviations from optimal configuration will invariably lead to musculoskeletal injuries and lamenesses.

The equine hoof is an extensive unit of interconnected anatomical structures that supply immense biomechanical strength designed for energy dissipation and locomotion for the horse. The hoof is subject to 2 major forces with each footstep: loading from the weight of the animal and ground reaction forces. Such forces generate extensive stress and shock waves within the tissues of the hoof as well as within proximal structures.

The complex anatomy of the hoof plays a crucial role in its ability to absorb and dissipate applied forces. Common injuries of the hoof include: fractures and pathological changes of associated bones e.g. phalanges and sesamoidean bones, injuries of the associated tendon/ligament and laminar junction pathology e.g. laminitis. However, abnormal force distribution affect the proximal structures as well, leading to further injuries of the proximal structures, up to shoulder and back.

The highly keratinized hoof capsule is a challenge for diagnostic imaging. Magnetic Resonance Imaging (MRI) and Computed Tomography (CT) allow for better visualization of the internal structures including soft tissue, however availability and high cost limit their application. Even though MRI and CT may produce superb diagnostic images, some pathologies cannot be visualized and therefore can only be diagnosed via histopathology and microanatomy.

One important structure of the hoof that has not been studied well is digital cushion (DC). It is suggested that DC plays an important role in force distribution; therefore, protecting sensitive internal structures from concussive forces. Nonetheless, the exact mechanism of force distribution and anti-concussive properties of the equine foot is not fully understood. Clinicians previously assumed that the DC merely acts as a fat pad to dampen concussive forces. More recent studies, however, have shown that the DC plays a more complicated role, also contributing to the hemodynamic pump mechanism within the hoof. The digital cushion (Pulvinus digitalis) fills the space between the frog, coffin bone, and deep digital flexor tendon/navicular bone as extends...
between the paired ungual cartilages. Previous reports have divided the equine DC into *pars torica* (between the heels) and *pars cunealis* (overlying the frog) based on its anatomical location. *Pars torica* comprises most of the DC, while the *pars cunealis* is a much smaller section. A recent study examined histological properties of 4 regions of the DC in adult horses and reported significant structural differences among the 4 regions of the DC. The axial distal region contained more collagen bundles and less elastic fiber profiles than the axial proximal region. The axial distal also contained more collagen bundles than the abaxial regions. The authors concluded that the structural differences in the various regions of the DC are presumably related to the different functional properties of those regions. Yet, elucidation of the functional properties of the DC and collateral cartilages warrants further research.

Another approach to evaluate hoof-ground interaction is biomechanical analysis. Biomechanical evaluation and gait analysis allow for more accurate analysis of the limb biomechanics. Recent advances in gait and biomechanical analyses have provided several technologies to objectively evaluate hoof biomechanics, among those, pressure plates are gaining more popularity in veterinary research and clinical setting. Recent studies have shown the effect of routine and therapeutic farriery on force distribution and biomechanics of the hoof. A better understanding of biomechanical changes in the hoof and its impact on stress distribution in proximal structures requires further research.

Selected References:


RESULTS AND EFFECTS OF GUIDELINES FOR BASIC EQUINE DENTAL CARE

David O. Klugh, DVM, FAVD / Equine

When following specific guidelines for dental care, certain results and effects ensue. Guidelines were specified in the previous paper. Several evaluations were done. Measurements were taken of amount of crown reduced. Follow up measurements of eruption were taken and rate of eruption calculated. In patients 15 years of age and older, the frequency and severity of periodontal disease was noted. Coordination of shedding of groups of deciduous teeth was evaluated.

Crown Reduction

The wisdom of crown reduction has been questioned. There certainly are significant risks of doing so, including stress to the patient, exposure of odontoblast processes potentially resulting in pain, pulp damage resulting from excessive heat production, and potential pulp exposure from reduction of more than a few mm of tooth material. These precautions offer guidelines as to avoidance or prevention of problems. No evaluations exist as to clinically observed results of these strategies. Consequently, no guidelines exist for a strategic approach to the dental patient. Furthermore, evidence is lacking of a basis for ‘normal’ and as such, treatments such as odontoplasty are inconsistent, haphazard, and while they may or may not result in any of the above problems, they occasionally result in dysmastication and biting problems by reason of lack of basic, general guidelines. In an effort to develop discussion within the profession, specific observations of dental characteristics suggested as ‘normal’ were identified. From these observations, specific guidelines for basic dental care were created and identified in the previous paper. In an effort to begin the process of evaluating the results and effects of these guidelines, measurements of crown reduction were done on patients.

139 horses were evaluated. Since the upper 10’s and lower 8’s are the most commonly reduced teeth when following this method, they were chosen for measurement. 556 teeth were measured. A Marquis periodontal probe with markings every 3 mm was used to measure crown height before and after reduction. The difference between the two numbers is the amount of crown reduced. In all patients, crown reduction was done so as to make the occlusal surfaces even from the 6’s back to the curvature of Spee, following the previously identified guidelines.

The average crown reduced was 2.08 mm. The range was from 0mm to 7mm on these teeth. 68 teeth, or 12% of the total, were reduced greater than 3 mm. 1 horse was painful after treatment.
This horse had other problems that may have led to the pain observed in mastication. No pulps were exposed. Considering only the lower 8’s and upper 10’s, the number of pulps potentially at risk of exposure was 2780, of which none were exposed. Considering all pulps at risk of exposure in all cheek teeth, none out of 16,680 were exposed when following the five specific guidelines.

**Eruption Rate**

By definition, one principle characteristic of hypsodont teeth is continual eruption, which is a compensatory response to dental attrition. The mechanism of eruption is thought to be a function of the periodontal ligament, as traction of the fibers pulling the tooth occlusally provides the force necessary for movement. Attachment breakdown and renewal are unique features of hypsodont teeth. Other forces may play roles as well, including hydrostatic pressure and fibroblast cell migration. The interaction of mastication forces and the complexities of periodontal ligament compensation create a system that is challenging to evaluate. In its continual state of repair and remodeling it responds to mastication forces and whatever changes occur in them. Ligament attachment surface area decreases with age as the tooth erupts and the reserve crown becomes shorter. Fiber bundles thicken in response to increased force and decreased attachment surface area. On the other hand, if forces decrease over time, fiber bundles may atrophy as stimulation of remodeling decreases. As teeth age and reserve crown becomes shorter, ligament attachment surface area decreases. This means that the amount of abnormal force needed to cause tooth shifting or tooth mobility would probably be reduced as well.

Mastication forces have been measured for the Triadan 6’s and calculated for the remainder of the arcade. They are substantial, with power stroke forces ranging from 875 Newtons to 1956 N going from the 6’s to the 11’s. The biphasic peaks of force distribution increase from a small peak at closing stroke to a large peak at power stroke. Closing forces going from 6 to 11 were calculated at 248 N to 554 N. However, the direction and exact distribution during the mastication cycle of this increasing force is not completely clear. It was acknowledged that forces change with the hardness of different feed materials. It is clear, then, that forces and response are dynamic and complex.

The rate of eruption of equine cheek teeth has been calculated to be between 3 and 4 mm per year. This study reflects measurement of the Triadan 6’s with a Marquis periodontal probe. Measurement was taken on the annual treatment approximately one year following the initial care event. In other words, each patient had at least one prior treatment. In that treatment the cementum on the mesial aspect of the 6 was removed to the gingival margin. On follow up the next year, the distance from the erupted edge of cementum to the gingival margin was measured. This measurement represented the amount of eruption for the intervening time period. Great care was taken to be certain that the cementum was thoroughly removed without damaging the gingiva. Not all patients were amenable to this treatment. Some anatomical conformations precluded thorough treatment. Others simply did not tolerate the treatment well. On follow up measurement, some patients had evidence of gingival swelling or recession. These patients were eliminated from the study. Only patients that held confident certainty of appropriate treatment were included.

The hypothesis for this study was that the rate of attrition of the tooth, and therefore the rate of eruption, would be reduced over time as the patient received dental care following specific guidelines. It was further hypothesized that any change in rate of eruption would only be measurable if the patient was treated for several years. It was somewhat arbitrary to choose to separate the two groups at 3 treatments, meaning that the one group received 3 or fewer treatments.
and the other group received 4 or more treatments. Consequently, this study compared two groups: those receiving follow up treatment for 2 or fewer times (3 treatments total) versus those receiving follow up care for 3 or more times (4 treatments total). Since most patients were not seen at exactly a one year interval, the annual eruption rate was calculated.

- 136 horses were measured. Mares, geldings and stallions were included.
- Ages varied from 3 to 33 years.
- The mean overall rate of eruption was 3.45 mm.
- In group one, 74 horses were treated for the second or third time.
- 62 horses in group 2 were treated for at least the fourth time.
- Group one horses had a mean eruption rate of 4.20 mm.
- Group two horses had a mean eruption rate of 2.50 mm.
- In 28 horses less than 7 years of age the rate was 5.08 mm
- In 14 horses 20 years of age and older, the rate was 2.73 mm.

Statistical analysis revealed the following results:

ERUPTION RATE: the average eruption rate (including all measurements from all of the teeth) is 3.45 mm/year.

ERUPTION RATE: However, it makes sense to calculate those values for upper and lower jaws separately, because the difference between the jaws is statistically significant.

ERUPTION RATE: The mean eruption rate (corrected for factors that have influence on the eruption rate like sex, no. of treatments, age, pasture time, individual differences) in the upper jaw is 3.42 mm/year and in the lower jaw it is 4.2 mm.

AGE: For every year of age, the eruption rate decreases for 0.14 mm (lower jaw) and 0.11 mm (upper jaw).

NO. OF TREATMENTS: For each additional treatment the eruption rate decreases for 0.8 mm (lower jaw) and 0.48 mm (upper jaw).

SEX: If you put all teeth in comparison, the differences between male and female horses are not significant. But the differences between male and female horses are at a high level significant, if you compare the lower jaws of male and female horses: The eruption rate in the lower jaw of male horses (mean ER= 3.57) is 1.26 mm/year lower than in female ones (mean ER= 4.83).\(^1\)

Since eruption is a function of replacement of tooth attrition, the rate of eruption reflects the rate of attrition. These data show that the rate of eruption and therefore attrition slows with age and furthermore, that is can also be slowed when following five specific treatment guidelines, regardless the age the patient. The result is that tooth life can be prolonged. The reasons for this reduction in eruption rate are not clear but may involve altering the distribution of mastication forces.

**Periodontal Disease**

The incidence of periodontal disease has been previously reported. These results are summarized in Table 1. Findings are quite variable. Reasons for the variation could be that many of the papers referring to ‘diastema’ are only seeing periodontal disease as it has advanced to the point of separating the interproximal space. One way this condition develops is that the disease process progresses beyond the initial stage of gingivitis, through the next stage of early attachment loss, to

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\(^1\) Thanks to Dr. Carmen Schroeck at the University of Giessen for statistical analysis.
the more advanced condition where orthodontic effects result in tooth movement. Another cause of ‘diastema’ is developmental malpositioning of adult tooth buds. As a consequence, these reviews may not consider early PD. Additionally, other reviewers may only be looking for more severe conditions. Some papers refer to cadaver surveys. Early PD may be challenging to detect in a cadaver.

Table 1. Incidence of periodontal disease is reported by multiple investigators.

<table>
<thead>
<tr>
<th>Date</th>
<th>Author</th>
<th>Age of subjects</th>
<th># affected</th>
<th>Total %</th>
</tr>
</thead>
<tbody>
<tr>
<td>1905</td>
<td>Colyerxxiv</td>
<td>All ages</td>
<td>166 of 484</td>
<td>34% PD</td>
</tr>
<tr>
<td>1937</td>
<td>Vossxv</td>
<td>All ages</td>
<td>213 of 647</td>
<td>34% PD</td>
</tr>
<tr>
<td>1937</td>
<td>Vossxv</td>
<td>13 and older</td>
<td>87 of 142</td>
<td>61% PD</td>
</tr>
<tr>
<td>1970</td>
<td>Bakervi</td>
<td>15 and older</td>
<td>218 heads all ages</td>
<td>60% PD</td>
</tr>
<tr>
<td>1988</td>
<td>WafaXXvii</td>
<td>&gt;15</td>
<td>186 of 355</td>
<td>52% PD</td>
</tr>
<tr>
<td>2001</td>
<td>Vlaminick et alxviii</td>
<td>All ages</td>
<td>62 of 283</td>
<td>22% Diastema</td>
</tr>
<tr>
<td>2006</td>
<td>Peters et alvix</td>
<td>All ages</td>
<td>34 of 471</td>
<td>7% Diastema</td>
</tr>
<tr>
<td>2008</td>
<td>Simhofer et alxx</td>
<td>All ages</td>
<td>73 of 300</td>
<td>24% Diastema</td>
</tr>
<tr>
<td>2008</td>
<td>Dixon et alxvii</td>
<td>All ages</td>
<td>45 of 60</td>
<td>76% Diastema</td>
</tr>
<tr>
<td>2009</td>
<td>duToit et alxxii</td>
<td>16 and older</td>
<td>49 of 255</td>
<td>19% PD</td>
</tr>
<tr>
<td>2010</td>
<td>Anthonyxxiii</td>
<td>All ages</td>
<td>96 of 556</td>
<td>17% PD</td>
</tr>
<tr>
<td>2012</td>
<td>Ireland et alxxiv</td>
<td>15 +</td>
<td>75 of 175</td>
<td>43% PD</td>
</tr>
<tr>
<td>2012</td>
<td>Walker et alxxv</td>
<td>All ages</td>
<td>235 of 471</td>
<td>44% PD</td>
</tr>
<tr>
<td>2013</td>
<td>Rodrigues et alxxvi</td>
<td>16+</td>
<td>89 of 188</td>
<td>47% PD</td>
</tr>
</tbody>
</table>

In these surveys it is not clear how many patients had received regular dental care. Neither is the method described for treatment of those receiving dental care. In averaging the 5 studies of horses at least 13 years of age, those of horses and not donkeys averaged 53% incidence. The studies of donkeys 16 and older found an incidence of 19% and 47%. It may be that the donkeys were managed differently, fed differently, or just less apt to develop periodontal disease. In all studies, the rate of periodontal disease increased with age. Some studies found an increased rate in young horses subject to eruption and shedding of teeth. The conclusion that may be drawn from these studies is that periodontal disease affects older patients more frequently than younger horses.

The purpose of this study was to evaluate the rate of incidence and severity of periodontal disease in patients aged 15 years and older receiving regular dental care following specific guidelines. These guidelines were followed in treatment of all cases. The working hypothesis was that periodontal disease would be somewhat reduced in either rate of incidence or in severity, or both. Patients were seen and treated on an annual basis. The number of times each patient was treated was recorded. Periodontal disease was recorded on dental charts.

PD was recorded as progressive stages of attachment loss. Guidelines for assessment of percentage of attachment loss have been determined for use in small animals. The Veterinary Periodontal Disease Index adapted for equine anatomy was used for collection of these data (Table 2).xxvii
Normal: No Attachment loss. Probing depth <5 mm.
Gingivitis: No Attachment loss. Probing depth <5 mm.
Early PD: < 25 % attachment loss and/or crestal bone loss around teeth.
Moderate PD: 25 to 50 % attachment loss or bone loss < 50 % around tooth root(s).
Advanced PD: > 50% attachment loss or bone loss > 50% around tooth root(s).

Table 2. Stages of periodontal disease used in this study.

This study evaluated periodontal disease in cheek teeth only, and did not measure incisor or canine periodontal disease; neither did it include any Equine Odontoplastic Tooth Resorption and Hyperplasia (EOTRH). Multiple factors influence the etiology and pathogenesis of periodontal disease including eruption physiology, mastication biomechanics, orthodontic forces, feed packing and putrefaction, bacterial involvement, and host defense mechanisms. Consideration of the principles of anatomy, physiology, etiology, pathogenesis, clinical examination and treatment of periodontal disease in horses leads to recognition of disease and early intervention. The gold standard of all medicine, including periodontal disease is prevention.

This study included 153 horses, all of which were 15 years of age or older. Patients were examined for the presence and severity of PD. Only horses whose previous dental treatment could be verified as following specific guidelines were included. Horses with annual dental care were included. Those with sporadic, or inconsistent care were not included.

Several variables were evaluated. The number of consecutive, annual treatments was noted. These were categorized in four groups: 0 previous treatments; 1 previous treatment; 2 previous treatments; 3 or 4 previous treatments; and 5 or more previous treatments. Presence, number of locations, and stage of periodontal disease for each location were noted. Severity was scored by adding together the stage for each site affected. For example, a horse with stage 2 PD in one site and stage 3 PD in two other sites had a score of 2+3+3=8. In summary, the patient was initially placed in its respective category for frequency of treatment, then after examination, two findings were noted: Presence or absence of PD; and severity score. Results are shown in table 2.

Table 2. Frequency and severity of periodontal disease in various treatment groups in horses aged 15 and older.

<table>
<thead>
<tr>
<th>Frequency</th>
<th>0 Treatments</th>
<th>1 Treatment</th>
<th>2 Treatments</th>
<th>3 or 4 Treatments</th>
<th>5 or more Treatments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number</td>
<td>16 of 28 57%</td>
<td>5 of 9 55%</td>
<td>3 of 6 50%</td>
<td>4 of 20 20%</td>
<td>10 of 85 12%</td>
</tr>
<tr>
<td>Mean Severity</td>
<td>3.6</td>
<td>2.1</td>
<td>1</td>
<td>.45</td>
<td>.36</td>
</tr>
</tbody>
</table>

In summary, by following five specific guidelines, the frequency of PD was reduced from 57% to 12%, almost a five-fold change. The severity score was reduced ten-fold, from 3.6 to .36. From
these data it is evident that by following five specific treatment guidelines for basic dental care, periodontal disease in older patients can be reduced both in frequency and in severity.

**Deciduous Exfoliation**

Deciduous tooth exfoliation was evaluated in 36 two and three year old patients. 21 had no prior dental care. 15 had at least one previous treatment. In 15 of the 21 with no prior care, exfoliation of deciduous teeth was uneven. Most commonly the mandibular pair of the set of four teeth was shed while the maxillary partners were retained. This may be one way that the lower 8 step malocclusion begins. In 13 of 15 with at least one prior treatment, all of the set of four were exfoliated evenly. Rather, it would be better to say that the adult teeth were erupting more evenly. 5 of the 6 that had no prior care and even exfoliation spent at least 12 hours daily on green grass pasture.

It is possible that there is an effect of even force distribution on tooth exfoliation and adult tooth eruption. This is a complex process, with much interaction of the eruption process of adult teeth, exfoliation physiology, and mastication forces. As such, much more work is needed.

**Summary**

Beneficial effects and results occur when following five specific guidelines for basic dental care in equine patients. Attrition and eruption can be slowed, prolonging the life expectancy of the dental arcade. Disease can be prevented. Specifically, periodontal disease can be reduced in incidence and severity. Deciduous tooth exfoliation can be assisted to occur more evenly. All this can be accomplished while removing minimal amounts of crown during basic odontoplasty procedures. These results and effects appear to validate the use of previously identified guidelines for basic dental care for equine patients.

**References available on request.**

NSAIDs are central and peripheral analgesics, antipyretics, and have peripheral and central anti-inflammatory activity. Most act primarily by inhibiting cyclo-oxygenase leading to reduced synthesis of prostaglandins and related compounds. This mechanism probably underlies their principal therapeutic and toxic activities. Studies have also revealed actions of NSAIDs at the spinal level, in particular analgesic actions that reduce the CNS sensitization, which occurs as a result of peripheral inflammation or trauma. Much recent interest has focused on demonstration of the existence of two cyclo-oxygenase isoforms. COX1 is a constitutive enzyme which is thought to subserve a range of physiological roles, inhibition of which accounts for the major toxic effects of NSAIDs. COX2 is predominantly an inducible isoform, produced at inflammatory sites to generate inflammatory mediators, although COX2 is constitutively present in some tissues such as the kidney. Potency ratios for the inhibition of COX1:COX2 vary widely being low for aspirin, naproxen, and piroxicam and higher for carprofen, tolfanamic acid, etodolac, meloxicam, and nabumetone. The development of selective COX2 antagonists has led to the introduction of deracoxib. Selective inhibition of COX2 improves gastro-intestinal tolerance. There is evidence that COX1:COX2 potency ratios may, for several NSAIDs, vary between species. Also limited evidence is available for a proposal that COX1, as well as COX2, may contribute to prostaglandin production at sites of inflammation. There is evidence in laboratory animals that selective COX2 inhibitors do not cause gastro-intestinal ulcers but may delay the healing of existing ulcers. The discovery of a third COX isoform, COX3 (actually a splice variant of COX1) in dog brain, the functional significance of which is yet to be determined but which may be preferentially inhibited by paracetamol, is of interest. Parenteral formulations of some drugs and compound analgesic preparations may be given by subcutaneous, intramuscular, or intravenous injection but phenylbutazone is too irritant for injection by non-vascular routes.

NSAIDs are used for their analgesic and anti oedematous actions in acute inflammatory conditions including postoperative pain and control of joint pain in various arthritides, particularly osteoarthritis. In recent years increasing attention has been given to the peri operative use of NSAIDs to control postoperative pain. Drugs such as flunixin, carprofen, meloxicam,tolfanamic acid and ketoprofen have been shown to provide very effective analgesia comparable to, and sometimes better than, some opioid analgesics. Analgesics (opioids and NSAIDs) have been shown to be more effective if administered prior to the onset of surgery. NSAIDs that are potent cyclo-oxygenase inhibitors, for example flunixin, can occasionally precipitate acute renal failure. NSAIDs that are recommended for use pre-operatively are carprofen and meloxicam.
Differences in anti-inflammatory and analgesic effects between different NSAIDs are small, but there is considerable variation in individual patient tolerance and response. NSAIDs may ameliorate symptoms of endotoxic shock, for example, in peracute mastitis and equine colic. Flunixin, ketoprofen, carprofen, meloxicam, and tolfenamic acid have been used to reduce morbidity and mortality in calf pneumonia by suppressing pulmonary oedema. Meloxicam is authorised for use in the treatment of diarrhoea in calves. NSAIDs are also used to reduce pain in equine colic. Aspirin, unlike other NSAIDs, combines with COX1 covalently to produce irreversible enzyme blockade and thus prevents the production of thromboxane by platelets. Vascular endothelial cells, unlike platelets, are able to regenerate cyclo-oxygenase, and so produce prostacyclin, which has an anti-aggregative effect. This action has been utilized to prevent platelet aggregation in thrombo-embolic disorders. The pharmacokinetics and pharmacodynamics of NSAIDs vary between species, leading to inter-species differences in dosage requirements. In general, the dosage interval should be increased in neonates and aged animals to avoid toxicity.

Toxicity of NSAIDs varies with the species, the individual animal within the species, and the individual drug and is therefore not readily predictable. The main side effects of NSAIDs are gastrointestinal irritation and ulceration, and renal failure. Lesions may occur after parenteral or oral administration and may be more prevalent in patients given NSAIDs in conjunction with corticosteroids. NSAIDs can induce direct renal papillary necrosis, or renal failure if administered in dehydrated, hypovolaemic, or hypotensive animals.
Diagnostic imaging of congenital portosystemic shunts

A. Hartmann¹ (Dr. med. vet., Dipl. ECVDI); S. Schaub² (Dr. med. vet., Dipl. ECVDI); M. A. Schneider² (Prof. Dr. med. vet., Dipl. ECVIM-Cardiology)

¹Radiology Department, Tierklinik Hofheim, Germany; ²Department of Veterinary Clinical Sciences, Small Animal Clinic, Justus-Liebig-University Giessen, Germany

Extrahepatic portosystemic shunts (PSS) represent the most common type of PSS, accounting for 70% to 90% of congenital PSS. They are mainly congenital with only a small portion of approximately 20% being acquired. Extrahepatic PSS mainly affect small breed dogs. A familial relationship is known for the Yorkshire Terrier and the Cairn Terrier. However, a multitude of other small breed dogs like the Pug, the Maltese, the Bichon frises are affected as well (1,2,3,4).

Extrahepatic PSS can be divided into portocaval, portoacysos, portophrenic or portorenal and portocolonic PSS, depending on the vessel into which the shunt vessel enters. The vessel from which the PSS arises – left gastric vein, splenic vein or right gastric vein, can used further to differentiate extrahepatic PSS.

Intrahepatic PSS do affect medium-size to large breed dogs in approximately 90% of cases and are almost always congenital. They account for 10% to 30% of all PSS. An autosomal recessive trait of inheritance is known for the Irish Wolfshound. Other breeds commonly affected are the Australian Cattle dog, the Golden Retriever and the Labrador Retriever (1,2,3,4).

Various imaging modalities are used to diagnose portosystemic shunts. Survey abdominal radiographs are of limited value, they often show microhepatica (60-100% dogs, and 50% cats) and bilateral renomegaly, which are unspecific findings and can occur in other diseases as well (1,2). Ultrasonography is most commonly used to diagnose PSS. The sensitivity for PSS ranges between 95% to 98%, with higher values for intrahepatic PSS then for extrahepatic PSS (1,5). To examine for PSS the animal can either be placed in dorsal recumbency or in left lateral recumbency using a transverse intercostal plane (2,6). Normal portal blood flow is laminar with a velocity of 12 to 17 cm/s. In congenital PSS the pattern of blood flow can become similar to that of the caudal vena cava (CVC) showing increased flow velocities and turbulences (2,7).

Nuclear portal scintigraphy is a highly sensitive diagnostic tool for diagnosing the presence of a PSS. A dose of 5 – 20 mCi (dogs) Tc99m-pertechnetate is administered into the colon. The radiopharmaceutical is absorbed into the portal system in the distal colon. Dynamic acquisitions at
one frame per second for 2 to 3 minutes are performed with the patient in right lateral recumbency using a low-energy general-purpose collimator. In case of a PSS the radionuclid arrives in the heart before it becomes visible in the liver (1,5). It is not possible to distinguish between intra- versus extrahepatic PSS with transcolonic scintigraphy, nor is it possible to differentiate between single or multiple shunts (1). Nondiagnostic or poor quality studies are reported to occur in 3.6% to 35.8% of the cases. They are due to poor absorption of the radiopharmaceutical, the route of administration (rectal) or poor visualisation of heart and liver (5). Transsplenic portal scintigraphy appears to be more sensitive with a sensitivity of up to 100%. Under ultrasound guidance a smaller dose of Tc99m-pertechnetate (2 mCi) is injected into the splenic parenchyma. Image acquisition and diagnosis are identical to per rectal scintigraphy. The specificity is increased compared to transrectal scintigraphy and diagnosis of intra- versus extrahepatic, as well single versus multiple shunts may be possible (5).

Computed tomographic (CT) angiography is the gold standard in human medicine to examine the portal venous system. Also in veterinary medicine CT is increasingly used to diagnose and assess PSS. Examination can either be performed as single or dual phase CT angiography (CTA), imaging only the portal phase or the arterial and the portal phases (1,8,9). Dynamic CT scans using a test bolus are superior compared to fixed delay times to plan the start of either single – or dual phase CT scans (9,10). Using the “bolus tracking” function in which the scan starts automatically after a set density threshold is reached in the portal vein often results in suboptimal image quality in our experience as the time delay between recording the threshold and actually starting the scan often lead to the scan be running to late. Compared to surgery or ultrasound CTA allows more often the determination of origin and insertion of the shunt vessel (9) as well as the evaluation of more complex vascular malformations.

Only few studies examined the value of magnetic resonance imaging (MRI) in the diagnosis of PSS. Sensitivity of MR-angiography (MRA) using no contrast medium ranges from 63% to 79%, with a specificity of 100% (1,11). Contrast-enhanced MRA seems to be superior to non-contrast enhanced Time-of-flight techniques (12).

Portovenography is still the gold standard for imaging PSS in small animals. The most widely used technique is mesenteric vein portography. After aseptic preparation a small laparotomy is performed, an over-the-needle intravenous catheter is placed in a mesenteric vein and secured with a small suture. Iodinated contrast medium is injected through the catheter. Sensitivity has been reported to be between 85% to 100% (1,13,14). Alternative techniques are percutaneous ultrasound-guided splenic venography and transvenous retrograde portography (1,14). Transvenous retrograde portography allows for selective catheterization of the shunt and measurement of portal vein pressure prior during and after intravascular occlusion (14).

After shunt occlusion laboratory testing, e.g. measurement of serum bile acids and blood ammonia, allow for functional assessment of successful shunt occlusion, however it does not allow for assessment of residual blood flow through the shunting vessel. Portovenography is still considered gold standard to identify possible residual blood. In a recent study CTA showed varying results between the different observers in assessing residual blood flow through a shunt vessel after cellophane banding (15). However, CTA appeared to be more valuable in evaluating the portal vein and its branching in the liver due to the good visibility on computed tomography angiography images (15).
Dental radiology in small animal practice

Introduction:
Veterinary dentistry is currently undergoing tremendous modernization and it is not possible to provide good quality dental care without utilizing radiographs. Without radiographs, it is almost impossible to find oral problems in small animal practice that may cause the patient discomfort for years.

Indications of dental radiography include:
- Missing or fractured teeth
- Resorptive lesions
- Periodontal disease
- Oral masses
- Draining tracts on the gums, maxilla, or mandible
- Painful or sensitive teeth
- Nasal discharge.

Equipment:
Dental film detail is much better than using traditional X-ray cassettes and film.
Developing films which are available in a variety of sizes.
Digital Radiography: A newer development in dental radiography is the availability of digital systems.
X-ray machines: using your r X-ray machine, the film-focal distance needs to be modified, and the beam collimated appropriately.
Film Focal distance 40 cm
Time of 0.1 second
MA of 100 (for a total technique of 10 MAS)
Kv of 65-90, depending on the size of the patient

Positioning:
There are two basic positioning techniques: parallel technique and bisecting angle technique; however, it would be impossible for the beam to be perpendicular to both the film and the tooth.

Positioning for the different areas of the mouth
The basic positioning techniques and angulation are the same for both dogs and cats, with the exception of the maxillary premolars and molars. Cats require a slightly modified technique to avoid superimposition of the zygomatic arch over the dental structures.

“Three Simple Rules”:
The three parameters of tube angulation, tube position and film position can be summarized as follows:
If the image is elongated, adjust the tube angle. To make the roots longer, move the tube head more laterally.
If you cut the target off at the edge of the beam move the beam toward the area of cone cut.
If you cut the target off at the edge of the film, move the film over toward the area you cut off.
Interpreting dental films:
Film Orientation
Dental films markers should be on the outside of the film packet.
Place the correct side of the marker toward you. This orients the film as if you were outside the animal’s mouth looking in. Imagine your eye being in the same position that the X-ray tube was in when the film was taken.
Try to rotate the film so upper teeth (maxillary) have the roots point up. Mandibular quadrants are rotated so that the roots point down.
Identify which end of the radiograph is towards the front of the patient.
Pay attention to increasing size of teeth in the premolar region, as well as unique anatomy in the carnassial teeth areas to help you out.
Normal structures visible on dental radiographs:
- Enamel
- Dentine
- Root canal system, consisting of the pulp chamber and root canal
- Periodontal Ligament Space
- Alveolar bone and Alveolar Crest
- Trabecular bone
- Cortical Bone
- Mental foramina
- Infraorbital foramina
- Mandibular Canal
- Mandibular Symphysis
- Nasal Septum
- Nasal Turbinates
- Furcation of the tooth
- Root apices

Radiographic signs of common dental diseases:
- Periodontal disease:
  It is characterized by loss of bony support. The periodontal ligament space may widen exposing the apex of the root to infectious organisms.
Feline Odontoclastic Resorptive Lesions (FORL)
Resorptive lesions occur most commonly in cats, but can also be seen in dogs. Dental radiographs commonly show a lucent area near the gingival margin and degrees of root destruction and bony replacement of root structures.

Endodontic Disease
The hallmark of endodontic disease is the presence of a periapical lucency or “halo” which indicates an area of demineralized bone. Radiographically, loss of continuity of the Lamina Dura, with or without widening of the periodontal ligament space, is suggestive of endodontic disease.

References:
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MRI features of the brain lesions in Zinc deficiency in a dog.

Leila Mohammadyar¹, Fatemeh Aramesh², Mahsa Zangisheh²
1. Assistant professor of Veterinary pharmacology, Islamic Azad University, Garmsar branch, Iran.
2. Residency student of diagnostic imaging, department of Surgery and Radiology, faculty of veterinary medicine, University of Tehran

Case description: A 2 years old male spayed husky was presented with sizuir, gained little weight and became extremely emaciated, debilitated, with dull rough coats, and often vomited.

Clinical findings: It seems that this condition started to happen more frequently and it can be epileptic seizures, although according to his breed and another signs like hairloss, anorexia, pneumonia, depression and dermatosis, MRI was recommended by his vet and zinc deficiency has been diagnosed.

MRI features: There was symmetrical, bilateral, ill-defined lesion in the piriform lobes. The lesions are hyperintense in T2w, FLAIR and T2* and isointense in T1 with mild contrast enhancement. The findings fit to a systemic metabolic or inflammatory disease.

Treatment and outcome: Treatment was stared by correcting the diet in addition to some extera zinc suplementation. After that treatments the dogs would have stopped having seizures usually. in this conditions, the vet start medicating with anti convulsive drugs to control the problem by just addressing the symptomes of what they see, so achieving the accurate diagnosis in such disorders is so difficult.

Clinical relevance: Zinc is a second most abundant trace mineral that involves in a variety of metabolic processes in the body and zinc deficenacy or malabsorbtion has variety of symptoms, but this way may be solve the problem in this metabolic disorder.

Reference:
The diagnosis of quadrigeminal cisterna arachnoid cyst by MRI in a dog

Mohammad Molazem¹, Morteza Hooshyar ², Mahsa Zangisheh³, Fateme Aramesh ³
1 Associate Professor, Department of Radiology, Faculty of Veterinary Medicine, University of Tehran, Tehran, Iran.
2 DVM student, Faculty of Veterinary Medicine, University of Tabriz, Tabriz, Iran
3 Resident of Radiology, Department of Veterinary Radiology, Faculty of Veterinary Medicine, University of Tehran, Tehran, Iran.

Email: Mahsazangishehi.vet@gmail.com

Case Description-A 4-year-old, male dog with 2 episodes of fainting and signs include conscious, transient general paralysis, pale mucosal membrane and tachypnea, was presented to small animal hospital of Tehran university.

Clinical Findings-on examinations, no abnormal sound was found on auscultation of heart and lung and also mucosal membrane and CRT (capillary refill time) were normal. Systolic blood pressure was 13 and mild bradycardia was noted. On MRI, infra tentorial cystic lesions located between the collicular plate and the incisural notch of the tentorium was detected.

Treatment and Outcome-The MRI was performed on the dog using T1-weighted image, sagittal, and transverse of the cervical spinal cord, under general anesthesia. Quadrigeminal cisterna arachnoid cyst was diagnosed based on the following MRI findings: (1) fluid in the cyst similar to that of cerebrospinal fluid. (2) cyst not enhanced by contrast medium (0.1 mmol/kg IV). (3) no hypoplasia or aplasia of the cerebellum. (4) cyst located at the dorsal-median area of the cerebellum. (5) no communication with the fourth ventricle. (6) no rotation of the vermis. (7) compression of the cerebellum ventro-caudally.¹

Clinical Relevance- arachnoid cysts in cranium are benign developmental anomalies that may be clinically asymptomatic.² In veterinary medicine, the increasingly widespread use of diagnostic imaging such as MRI will improve the ability to detect these cysts.

Key Words- arachnoid cyst, MRI, quadrigeminal cisterna

References
Objective: Attention deficit hyperactivity disorder (ADHD) is described as a behavioral abnormality in human children which can be seen in canine as well which results in failure in inhibitory process in various brain locations. This disorder may be result of electromagnetic waves influence on the fetuses during the pregnancy. Resting state functional MRI (fMRI) is a modality to discover the brain functional networks. The aim of present study is to determine changes in brain activities of rats affected by Electromagnetic waves (EM) to check feasibility of the fMRI in following brain activation.

Design Animals: Sixteen 56 days old male rats from offspring of the rats exposed and not exposed by EM during pregnancy.

Procedure: fMRI performed under general anesthesia. All the fMRI images were analyzed by FSL software. Registration and Slice timing have been performed in pre-processing phase. Group Independent Component Analysis (ICA) was done to find out activated voxels. Functional activation locations were labelled on Paxinos coordinates.

Result: Mean evaluation of extracted data using Z-test showed significant activation voxels in Prefrontal and cerebral cortex (somatosensory) of examination group in comparison with control rats.

Conclusion: Higher activation in brains of the rats which their mother exposed by EM waves during pregnancy shows functional effect of EM waves on neurons of fetuses.

Clinical relevance: The authors established the present study as the basic pilot for further studies in canine and human behavioral science.

Keywords: fMRI, rats, ADHD

References:
Comparison of Quantitative Computed Tomography (CT) Analysis of Pulmonary Patterns in Dogs Affected by Pneumonia and Pulmonary Edema, Before and After Intravenous Contrast Medium Administration

Saeideh Eftekharit1, Majid Masoudifard2, Mahdi Nasiri3, Amir Rostami3, Sina Bayat Sarmadi4, Zahra Mohseni5, Mostafa Qalavand6

1 Resident of veterinary radiology, Faculty of Veterinary Medicine, University of Tehran, Tehran-Iran. 2 Department of surgery and radiology, Faculty of Veterinary Medicine, University of Tehran, Tehran-Iran. 3 Department of internal medicine, Faculty of Veterinary Medicine, University of Tehran, Tehran-Iran. 4 Resident of veterinary surgery, Faculty of Veterinary Medicine, Islamic Azad University, Science and Research Branch, Tehran, Iran. 5 Resident of veterinary clinical pathology, Faculty of Veterinary Medicine, University of Tehran, Tehran-Iran. 6 Veterinary student, Faculty of Veterinary Medicine, Islamic Azad University, Karaj Branch, Karaj, Iran.

Email: saeideh.eftekhari@gmail.com

Objective-Alveolar pattern of the lungs is usually caused by several involvements such as edema and pneumonia, but differentiation using radiography is usually impossible. Evaluation and comparison of HU and lung patterns of pulmonary edema and pneumonia before and after intravenous contrast medium administration in dogs using CT-scan was purpose of this study.

Design-Original study

Animals-10 dogs by pulmonary edema, 10 dogs by pneumonia

Procedures-In this study, 10 dogs affected by induced pulmonary edema and 10 dogs affected by pneumonia were selected. Radiography and CBC were done. Before and after contrast medium injection, CT-scans of lungs were achieved. Finally in transverse CT sections, CT-assisted FNA of involved lung lobes was taken for laboratory evaluation. CT-scans reevaluated and pulmonary pattern was described. Also HU of involved regions were measured and compared.

Results-Ventral and dorsal regions of lung lobes especially caudal lobes in pulmonary edema, and ventral regions of cranial and middle lung lobes in pneumonia, were involved. The mean HU of healthy lung was -778.540, mean HU of edematous lung parenchyma before contrast study was -250.5757, and after contrast study was -240.8052. Mean HU of lung parenchyma affected by pneumonia before contrast study was 35/3104 and after contrast study was 54/5649. P-value of mean HUs was less than 0.05 and significant. In FNA samples of edema, fluid droplets and in pneumonia, bacteria and inflammatory cells were detected.

Conclusion and Clinical Relevance-CT-scan of lungs for diagnosis of pulmonary disorders such as pneumonia and edema is practical and difference between mean HUs of pneumonia and edema is significant.

Key words- Dog, Edema, Pneumonia, CT-scan, Iohexol.
Computed Tomographic Sex Determination in Caspian Pond Turtle (Mauremys caspica)

Maryam Mahdipour1*, Mohammad saeed Ahrari khafi2
1 Student of Veterinary Medicine, School of Veterinary Medicine, Shiraz University, Shiraz, Iran.
2 Assistant Professor of Veterinary Radiology, School of Veterinary Medicine, Shiraz University, Shiraz, Iran

Email: mahdipour.maryam@yahoo.com

Objective - The purpose of this study was to investigate ability of computed tomography (CT) in sex determination in Caspian pond turtle (Mauremys caspica).

Design - Experimental study

Animals - Six apparently healthy adult Caspian pond turtles

Procedures - Turtles were anesthetized by Ketamine 10% at a dose of 25 mg/kg and diazepam at a dose of 1 mg/kg body weight. Turtles were positioned dorsoventrally and cross sectional images provided using a16-slice CT scanner. After reconstruction of other planes genital organs were assessed in images.

Results - According to small size of the turtles, testes were not clear in the images, but in female oocytes with different sizes and locations were seen in coelomic cavity.

Conclusion and Clinical Relevance - There are different methods for sex determination in turtles but most of them are not definite. Errors will increase with turtles that are smaller in size. Using diagnostic imaging techniques can help increase rate of certainty. Computed tomography showed that oocytes are clearly visible in female turtles, however testes are not seen clearly in the male turtle, not diagnosing follicle shows that the turtle is male.

Key words - Sex determination, Caspian pond turtle, Computed tomography

References
Intra hepatic Porto-systemic shunt

Mohammad Molazem¹, Fatemeh Aramesh¹*, Mahsa Zangisheh², Atena Salimi², Yashar Rafiei³

1. Assistant professor of diagnostic imaging, department of surgery and radiology, faculty of veterinary medicine, university of Tehran
2. Residency student of diagnostic imaging, department of surgery and radiology, faculty of veterinary medicine, university of Tehran
3. Residency student of surgery and anesthesia, department of surgery and radiology, faculty of veterinary medicine, university of Tehran

Case description: a 5 months old mixed breed terrier puppy with chief complain of stunt growth, anorexia, constipation and neurologic signs such as episodes of seizure and ataxia, was referred to the small animal teaching hospital of university of Tehran.

Clinical findings: poor body condition combined with anorexia, constipation and ataxia were noticed in clinical examination. Abdominal Ultrasonography revealed a large torturous vein in the liver that seemed to be connected with caudal vena cava, the liver size was slightly reduced. Also an abnormal turbulence flow appeared in Doppler study which makes it highly suspected to intrahepatic porto-systemic shunt. Both kidneys were hyperechoic than normal associated with decreased in differentiation between cortex and medulla which can be occur as a result of porto-systemic shunt complications. Plain and post contrast CT scan study revealed short bulbous-divisional intrahepatic shunt origination from an early left portal vein branch with maximum diameter of 4mm at the ventral aspect of T13 associated with abnormal distention of caudal vena cava. Renal vein was also abnormally distended.

Treatment and outcome: treatment of these patients are based on medical and diet management to stabilize the patient before performing the surgery. Surgical methods of choice to close the shunt is partial or complete ligation of the defect zone. In this case due to the progress of the clinical signs and severity of neurologic signs(hepatoencephalopathy), the patient died before performing the surgery.

Clinical relevance: Portal vein anomalies could be congenital or acquired, the congenital forms are the result of persistent fetal connection between portal vascular system and caudal vena cava or azygous and it might be intra or extra hepatic. The acquired form develops as the result of chronic hepatic disorders that cause portal vein hypertension. Most affected animals are less that 1 year old and intrahepatic form is more common in larger breeds and extrahepatic shunts are more common in smaller dog breeds and cats.

Extrahepatic shunts are nearly impossible to identify ultrasonographically and intrahepatic shunts can be identified between portal vein and caudal vena cava. Doppler technique can be useful to to establish directional flow.

Key words: Porto-systemic shunt, hepatoencephalopathy, intrahepatic portocaval shunt
Two-Dimensional Echocardiographic Normal Values in Clinically healthy Ghezel Sheep

Seyed Mohammad Hashemiasl1, Bahram Dalirnagadeh2, Majid Masoudifard3, Ali Roustaei4, Mohammad honarjoo4
1 Department of Surgery and Diagnostic Imaging, Faculty of Veterinary Medicine, University of Urmia, Urmia, Iran
2 Department of Internal Medicine and Clinical Pathology, Faculty of Veterinary Medicine, University of Urmia, Urmia, Iran
3 Department of Surgery and Radiology, Faculty of Veterinary Medicine, University of Teheran, Teheran, Iran
4 Undergraduate student, Faculty of Veterinary Medicine, University of Urmia, Urmia, Iran

Email: mm.hashemi@urmia.ac.ir

Objective - The aims of this study was to obtain of two-dimensional echocardiographic normal values in Ghezel sheep.

Design - Descriptive study

Animals - Fifteen female clinically health Ghezel sheep with 16.41 ± 1.18 months and 42.99 ± 4.73 kg were included in this study.

Procedures - Echocardiographic examinations were performed in the standing unsedated animal from right parasternal position. End Diastolic and end systolic measurements were performed according to the previous study (Boon, 2011) using the leading-edge method technique with the ultrasound machine analysis system. End Diastolic and end systolic diameter of left atrium, mitral annulus valve, left ventricular, end diastolic diameter of aortic and pulmonary artery annulus, ejection fraction, fractional shortening, left atrium ratio to aortic annulus were calculated. Each variable was measured three times on three different nonconsecutive cardiac cycle, and their mean was considered as variable value.

Results - All value are described as mean ± SD, maximum, minimum and 95% Confidence interval. The results were described as a reference value table. The present study showed that sheep echocardiography can be done by physical keeping on standing position without any medical sedation. Right parasternal images were more informative than left side.

Conclusion and Clinical Relevance - The results of this study can be used as echocardiographic reference values for diagnosing of heart diseases and other similar studies in Ghezel sheep.

Key words - sheep, echocardiography, two-dimensional echocardiography, Ghezel sheep

References
Measurement of carotid artery blood flow velocity of camel by pulse wave Doppler ultrasonography

Aboozar Dehghan*1, Mehrdad Hasanvand2
1 department of clinical sciences, school of veterinary medicine, kazeroun branch, Islamic Azad University, kazeroun, Iran
Email: Aboozardehghan@yahoo.com

Objective- Normal blood flow velocity of carotid artery of camel was unknown. In this study, this parameter measured. This parameter is useful to compare with cardiovascular system disorders and several metabolic diseases.

Design- Camel is a very strong and resistant animal in bad weather that present various product such as milk, meat, wool and skin to human. From past camel has peaceful life with human especially in hot and dry area rural and nomadic families. Cardiovascular system is one of most important organs of body that failure of this system makes serious damage to body function. Echocardiography is a non-invasive, safe, particular and available method to heart and large vessels evaluation. Doppler echocardiography can calculate blood velocity and detect blood direction. Carotid artery is a major artery that the central nervous system and the head and neck blood supply separated from this artery. This artery placed in jugular area in neck. Knowing normal blood flow velocity of this artery is very important for contrast with pathologic conditions.

Animals- Five healthy adult camels (camelus dromedarius) in both sexes, 3 male and 2 female. Clinical examination was performed and normal camels were selected for ultrasonography.

Procedures- For this study 5 normal healthy adult camel were selected and clinical examination performed and then ultrasonographic study administrated with BK medical ultrasound machine and linear multi frequency 8-12 MHz transducer. B mode and pulse wave Doppler images evaluated and parameters collected, Statistical study performed too.

Results- Mean velocity of blood velocity of carotid artery was 1.40 cm per second. Internal diameter of carotid artery measured that mean of this parameter was 0.87 centimeter.

Conclusion and Clinical Relevance- Changes of this parameter present in pathologic conditions and several metabolic diseases and knowing of normal blood flow velocity is very useful in cardiovascular system examination.

Key words- Camel, carotid artery, blood velocity, pulse wave Doppler

References
The webinar of Dental and Masticatory CT Scan in Small Animals

Dr. Tobias Schwarz
ECVDI Board Member

4th December 2017
Registration Fee: 5,000,000 Rials
2 hours
20 persons

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Veterinary Surgery Association

The 5th International Symposium Of Veterinary Surgery (ISVS)
The 13th Iranian Symposium Of Veterinary Surgery, Anesthesia And Diagnostic Imaging (ISVSAD)
Practical Abdominal Ultrasound Workshop

6th December 2017 9 - 15:30

Workshop Director:
Dr. Antje Hartmann
ECVVDI, MRCVS,
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The Workshop of Equine Arthroscopy

Dr. Oliver Michele Crow
Royal College of Veterinary Surgeons, UK

4th December
8 hours
16 person

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The 5th International Symposium of Veterinary Surgery (ISVS)
and The 13th Iranian Symposium of Veterinary Surgery, Anesthesia and Diagnostic Imaging (ISVSAD)

5-7 December 2017
Faculty of Veterinary Medicine
University of Tehran, Tehran, Iran
Normal Dental Care In Horse

DR. DAVE KLUGH
American Veterinary Medical Association

- December 9, 2017
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- 16 Persons

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VETERINARY DENTAL SURGERY & RADIOLOGY

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- 3rd December 2017
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VIP Registration Fee: 19,000,000 Rials

Iran
5-7 December 2017
Faculty of Veterinary Medicine
University of Tehran, Tehran, Iran