

9th Annual
ESVOT Congress
1998

**European Society of Veterinary
Orthopaedics and Traumatology**

April 16th - 19th, 1998

Munich, Germany

This manuscript is reproduced in the IVIS website with the
permission of [ESVOT www.esvot.org](http://www.esvot.org)

**9th Annual Congress
of the European Society
of Veterinary Orthopaedics and
Traumatology**

Munich April 16th - 19th 1998

April 16th 1998
Precongress short course + wet lab.

April 17th-19th 1998
Main programme

Department of Veterinary Surgery
School of Veterinary Medicine
Ludwig-Maximilians-University
Munich, FRG

Scientific Programme

Abstracts

Contents

Welcome address of the Director Institut fur Tierpathologie Prof. Dr. W. Hermanns	1
Welcome address Dr J F Bardet	2
Overview	3
PreCongress programme	4
Main Programme	6
Free Communications	13
Speakers	16
Abstracts - small animals	1
- equine	78
- cattle	101

On behalf of the Veterinary Faculty of the Ludwig-Maximilians-University, Munich, I would like to welcome you heartily to the 9th ESVOT Congress here in Munich.

Your Congress will deal with topical orthopedic diseases of the axial and appendicular skeleton in dogs, cats, horses and cattle. The lectures will also invite questions concerning traumatology and neurology. The main topics will be modern diagnostic methods, surgical access and therapeutic measures. Experts from numerous European countries and the United States of America are our guests at this international congress. They will report on the latest results of their research in the fields of the expanding sciences of orthopedics and traumatology.

The Congress, which is preceded by three pre-congress seminars, will be framed by the Saki Paatsama lecture, delivered by Dr. De Moor from Ghent and a considerable number of attractive social events.

The Veterinary faculty wishes all participants of the 9th ESVOT Congress fruitful scientific information and some pleasant hours in Munich with its beautiful surroundings.

Professor W. Hermanns

Dear Colleagues

We are most happy and honoured to welcome you to the 9th ESVOT Meeting in Munich, April 16-19th 1998. During the last Meeting in Munich it was decided to use the same facilities and improve what was started at our last Meeting. We would like to acknowledge the generosity of the University of Munich in providing their facilities.

This year the Congress has expanded. There will be three pre-congress seminars and wetlabs prior to the Meeting. These will cover the triple pelvic osteotomy technique, surgery of the elbow and neurosurgical techniques.

On Thursday evening all the delegates will be received in the main auditorium, Grosse Aula of the University of Munich, for the opening ceremony. We will be most honoured to have Professor A. de Moor as the guest speaker for the Saki Paatsama lecture. Immediately after there will be a welcome reception.

The Meeting itself will start on Friday April 17th 1998 with the State of the Art Lecture on osteoarthritis. The programme continues with separate in depth seminars in Small Animal and Equine subjects for two days. On Saturday April 18th 1998 a one day Bovine Orthopaedic seminar will be added to expand our large animal section. We have chosen to limit the free communication session to Sunday morning to allow all the delegates the opportunity to participate in the in depth seminars.

Our social programme will be very attractive too. On Friday evening we will meet at one of the finest Bavarian restaurants in Munich.

The organising committee is proud to thank John Houlton, the scientific committee chairman, assisted by Chris Riggs for their outstanding help in organising the programme.

A great Meeting does not exist as well without a commercial exhibition. We invite you to spend as much time as possible in the exhibition. We will also offer an attractive programme for the spouses and a list of tours will be offered to them by the travel agency of the Meeting.

We sincerely hope many of you will join us for the Meeting. It promises to be a great event. We wish you a pleasant Meeting and we look forward to seeing you in Munich.

Jean-Francois Bardet

Overview

Thursday 16th April 1998

SMALL ANIMALS: pre-congress short courses and wet labs

Friday 17th April 1998

SMALL AND LARGE ANIMALS:

08.45	State of the Art lecture	(Room A)
09.30	Opening of Commercial Exhibition	

SMALL ANIMALS:

10.00	Hip Dysplasia Seminar	(Room A)
	Facial Trauma Seminar	(Room B)

14.30	Immune-mediated Arthritis Seminar (Room A)	
	Polytraumatized Patient Seminar	(Room B)

LARGE ANIMALS:

10.00	Equine Diagnosis Seminar	(Room C)
14.30	Equine Diagnosis Seminar cont.	(Room C)

Saturday 18th April 1998

SMALL AND LARGE ANIMALS:

09.00	State of the Art lecture	(Room B)
09.40	State of the Art lecture	(Room B)

SMALL ANIMALS:

09.00	Critical Care Seminar	(Room A)
11.00	Spine Seminar	(Room B)

14.30	Shoulder Seminar	(Room A)
14.30	Spine Seminar cont.	(Room B)

LARGE ANIMALS:

10.00	External Fixation	(Room C)
	Bovine Lameness	(Room D)

14.30	Orthopaedic trauma in foals	(Room C)
	Orthopaedic problems in calves	(Room D)

Sunday 19th April 1998

SMALL ANIMALS:

9.00	Free Communications	(Room A)
9.00	Free Communications	(Room B)

LARGE ANIMALS:

9.00	Free Communications	(Room C)
------	---------------------	----------

SMALL AND LARGE ANIMALS:

11.45	State of the Art lecture	(Room A)
13.00	End of Meeting	

Thursday 16th April 1998

ROOM E - Small Animal Short Course

Triple Pelvic Osteotomy (T.P.O.) wet lab

H. Hazewinkel, NL; B. Meij, NL; L. Theyse, NL; A. Vezzoni, I

- 08.45 Introduction, H. Hazewinkel, NL
- 09.00 Case selection and surgical planning, H. Hazewinkel, NL
- 09.20 Surgical anatomy, A. Vezzoni, I
- 09.40 Surgical techniques, L. Theyse, NL
- 10.00 After care, B.P. Meij, NL
- 10.30 **Coffee/tea break**
- 11.00 Wet lab
- 13.00 **Lunch**

Thursday 16th April 1998

ROOM E - Small Animal Short Course

Elbow wet lab.

J. Bardet, FR

- 14.30 Anatomy and biomechanics of the elbow
- 14.50 Clinical examination of the elbow
- 15.00 Radiographic examination
- 15.15 Approaches to the elbow
- 15.35 Arthroscopy of the elbow
- 16.00 **Coffee/tea break**
- 16.30 Elbow luxation and collateral ligament reconstruction
- 17.00 Treatment of coronoid process fragmentation
- 17.20 Treatment of ununited anconeal process
- 17.40 Osteoarthritis of the elbow
- 18.00 End

Thursday 16th April 1998

ROOM F - Small Animal Short Course

Neurology wet lab.

M.Fluckiger, CH; N. Jeffery, GB; N. Olby, USA

- 14.30 Cisternal and lumbar myelography - techniques. M. Fluckiger, CH
14.50 Interpretation of myelograms - common errors. M. Fluckiger, CH
15.00 Ventral slot - surgical techniques. N. Olby, USA
15.15 Thoracolumbar hemilaminectomy - surgical technique. N. Jeffery, GB
15.35 Post operative management. N. Jeffery, GB
16.00 **Coffee/tea break**
16.30 Wet Lab
Cervical ventral slot and thoracolumbar hemilaminectomy.
18.30 End

Thursday 16th April - evening

Grosse Aula - University of Munich

Opening Ceremony

19.30 Greetings addresses

19.45 **PAATSAMA LECTURE** - Animals in Art - A. De Moor, B

20.15 Concert

Friday 17th April 1998

ROOM A

08.45 **Small and Large Animals State of the Art Lecture:**

Chairman: C. Riggs

Osteoarthritis S. May, GB

09.30 Opening of the Commercial Exhibition.

Small Animals.

HIP DYSPLASIA SEMINAR

Chairman: J. Houlton

10.00 What's new in Imaging. M. Fluckiger, CH

10.20 Breeding and Hip Dysplasia. G. Ubbink, NL

10.40 Nutritional influence. H. Hazewinkel, NL

11.00 **Commercial Exhibition and Coffee/Tea Break**

11.40 Results and complications of TPO (Triple Pelvic Osteotomy). B. Meij, NL

12.00 Results and complication of THR (total hip replacement.) U. Matis, D.

12.30 Panel Discussion: How I manage the dysplastic dog.
H.Hazewinkel, NL; B. Meij, NL; U. Matis, D

13.00 **Commercial Exhibition and Lunch**

ROOM A

Small Animals.

IMMUNE MEDIATED ARTHRITIS SEMINAR

Chairman: H. Hazelwinkel

14.30 Arthritides: their recognition and treatment. D. Bennett, GB

16.00 **Commercial Exhibition and Coffee/Tea Break**

16.40 Arthritides: their recognition and treatment continued. D. Bennett, GB

17.40 Discussion

18.00 End

Friday April 17th 1998

ROOM B

Small Animals.

FACIAL TRAUMA SEMINAR

Chairman: A. Vezzoni

- 10.00 Stick injuries. R.A.S. White, GB
10.20 Skull and orbital injuries. R. Kostlin, D
10.40 Nasal trauma. R.A.S.White, GB
11.00 **Commercial Exhibition and Coffee/Tea Break**
11.40 Palate injuries. L. Theyse, NL
12.00 Degloving injuries. R.A.S. White, GB
12.20 Mandibular fractures. M. Balligand, B
12.40 Dental emergencies. L. Theyse, NL
13.00 **Commercial Exhibition and Lunch**

ROOM B

Small Animals.

THE POLYTRAUMATIZED PATIENT SEMINAR

Chairman: J. Bardet

- 14.30 The polytraumatized patient. D.T. Crowe, USA
16.00 **Commercial Exhibition and Coffee/Tea Break**
16.40 The polytraumatized patient cont. D.T. Crowe, USA
17.40 Discussion
18.00 End

Friday April 17th 1998

ROOM C

Large Animals.

DIAGNOSIS IN EQUINE ORTHOPAEDICS SEMINAR

Chairman: C. Riggs

10.00 Radiology. S. May, GB; M. Schramme, GB

Gamma Scintigraphy. G. Uelschi, CH; M. Martinelli, GB

11.00 **Commercial Exhibition and Coffee/Tea Break**

11.40 Ultrasonography. D. Stadtbaumer, B; R. Smith, GB

Diagnostic arthroscopy. D. Richardson, USA; K. Boening, D

Participants will rotate through the above groups in turn

13.00 **Commercial Exhibition and Lunch**

ROOM C

Large Animals.

DIAGNOSIS IN EQUINE ORTHOPAEDICS SEMINAR Cont.

Chairman: C. Riggs

14.30 Cont. rotating groups

16.00 **Commercial Exhibition and Coffee/Tea Break**

16.40 Diagnostic Panel

18.00 End

Saturday April 18th 1998

ROOM A

Small Animals.

CRITICAL CARE SEMINAR

Chairman: R. Kostlin

9.00 Critical care. D.T. Crowe, USA

10.20 **Commercial Exhibition and Coffee/Tea Break**

11.00 Critical care continued. D.T. Crowe, USA

12.30 Discussion

13.00 **Commercial Exhibition and Lunch**

ROOM A

Small Animals

SHOULDER SEMINAR

J.F. Bardet, FR

14.30 Anatomy and biomechanics of the shoulder joint.

14.50 Clinical examination of the shoulder.

15.10 Diagnosis of shoulder lameness.

15.30 Biceps tendon rupture: diagnosis and treatment.

16.00 **Commercial Exhibition and Coffee/Tea Break**

16.40 Shoulder luxations.

17.00 Shoulder instability: pathophysiology, diagnosis and treatment.

17.20 Arthroscopy of the shoulder joint.

17.40 Treatment of OCD and other shoulder pathologies.

18.00 End

Saturday April 18th 1998

ROOM B

Small and Large Animals.

NEUROLOGY

Chairman: U. Matis

09.00 Current concepts in spinal cord repair. N. Jeffery, GB & N. Olby, USA

09.40 Peripheral neuropathies, P. Moreau, F

10.20 **Commercial Exhibition and Coffee/Tea Break**

ROOM B

Small Animals

SPINE SEMINAR

Chairman: J. Davies

11.00 Radiographic Diagnosis of Wobblers. M. Fluckiger, CH

11.30 Ventral decompression in cervical spondylopathy. N. Olby, USA

12.00 Distraction fusion in cervical spondylopathy. N. Jeffery, GB

12.30 Discussion panel on cervical spondylopathy
M. Fluckiger, CH; N. Jeffery, GB; N. Olby, USA

13.00 **Commercial Exhibition and Lunch**

ROOM B

SPINE SEMINAR CONTINUED

Chairman: G. Niebaeur

14.30 Ce1 - Ce2 instability. J-P Cabassu, FR

14.50 Cervical fractures. F. Forterre, D

15.10 Thoracolumbar fractures. J. Cabassu, FR

15.30 L7 fractures. K. Johnson, GB

16.00 **Commercial Exhibition and Coffee/Tea Break**

16.40 Imaging the L/S region. B. Meij, NL

17.00 MRI of the cauda equina J. Davies, GB

17.20 Treatment of cauda equina syndrome. N. Jeffery, GB

17.20 Discussion

18.00 End

Saturday April 18th 1998

ROOM C

Equine

EXTERNAL FIXATION IN EQUINE FRACTURE REPAIR

Chairman: S. May

11.00 Principles behind the Ilizarov technique in fracture repair. G. Jukema, D

12.00 External fixation in equine fracture repair. D. Richardson, USA

12.30 Discussion

13.00 **Commercial Exhibition and Lunch**

ROOM C

MANAGEMENT OF ORTHOPAEDIC TRAUMA IN FOALS

Chairman: M. Schramme

14.30 The use of the Ilizarov technique for management of growth deformities in children. G. Jukema, D

15.00 Joint disease and its management in the foal. S. May, GB

15.30 Trauma surgery in the foal 1. D. Richardson, USA

16.00 **Commercial Exhibition and Coffee/Tea Break**

16.40 Anaesthesia of the traumatized foal. F. Gasthuys, B

17.10 Trauma surgery in the foal 2. D. Richardson, USA

17.40 Discussion

18.00 End

Saturday April 18th 1998

ROOM D

Bovine

BOVINE LAMENESS

Chairman: A. De Moor

- 11.00 Diagnosis of bovine lameness. G.B. Edwards, GB
- 12.00 Radiography and Radiology of bovine orthopaedic problems. F. Verschooten, B
- 12.30 Discussion
- 13.00 **Commercial Exhibition and Lunch**

ROOM D

SURGICAL MANAGEMENT OF ORTHOPAEDIC PROBLEMS IN CALVES

Chairman: F. Verschooten

- 14.30 Anaesthesia and intensive care of the young bovine surgical patient. F. Gasthuys, B
- 15.00 Management of metacarpal, metatarsal, radial and tibial fractures. A. Steiner, CH
- 15.30 Management of septic arthritis in calves. K. Nuss, D
- 16.00 **Commercial Exhibition and Coffee/Tea Break**
- 16.40 Flexural deformities in calves: pathogenesis and retrospective analysis of surgical treatment. X. Van Huffel, B
- 17.10 Spastic paresis: pathogenesis and retrospective analysis of treatment by partial tibial neurectomy. A. De Moor & A. Marten, B
- 17.40 Discussion
- 18.00 End

Sunday 19th April 1998

ROOM A

Small Animals

Free Communications.

Chairman H. Hazewinkel

- 09.00 - 09.15 Two cases of axial limb deformity corrected with an Ilizarov technique: decision making and technical choices. G.L. Rovesti, I
- 09.15 - 09.30 Femoral and humeral fracture treatment with an external fixator tie-in configuration in growing dogs and cats. B.Peirone, I
- 09.30 - 09.45 Use of external skeletal fixation in 129 cats. W.McCartney, IRL
- 09.45 - 10.00 Prophylactic and curative use of cephalixin in canine orthopaedic surgery. E. Bousquet, F
- 10.00 - 10.15 Spontaneous iliac fracture after a triple pelvic osteotomy J.P. Zaera, E
- 10.15 - 10.30 Intracranial surgery. G.Niebauer, I
- 10.30 **Commercial Exhibition and Coffee/Tea Break**

Chairman J. Houlton

- 11.00 - 11.15 Enthesiopathy of the origin of the short radial collateral ligament in racing greyhounds. M. Guilliard, GB
- 11.15 - 11.30 Anatomical aspects of the pathogenesis of canine cranial cruciate ligament rupture. S. Reese, D
- 11.30 End of Free Communications

Chairman U. Matis

- 11.45 **Small and Large Animals State of the Art Lecture:**
Myopathies - diagnosis and treatment. N. Olby, USA.
- 12.45 Discussion
- 13.00 End of Meeting

Sunday 19th April 1998.

ROOM B

Small Animals

Free Communications

Chairman A. Vezzoni

- 09.00 - 09.30 Field trial results of quadrisol versus metacam J. Bergman, NL
- 09.30 - 09.45 Post-traumatic hypermetabolic patients - how much energy do they need? B. Dobernecker, D.
- 09.45 - 10.00 CT-Osteoabsorptiometry in the canine shoulder joint - a new method to assess long-term loading J. Maierl, D.
- 10.00 - 10.15 CT in diagnosis of torsional deformities in canine patellar luxation B. Loer, D.
- 10.15 - 10.30 CT myelography in the diagnosis of root avulsions in canine brachial plexus injuries. F. Forterre, D.

10.30 **Commercial Exhibition and Coffee/Tea Break**

Chairman R. Kostlin

- 11.00 - 11.30 Nutritional innovations for companion animal surgeons. R.C. Nap. NL.

ROOM C

Equine

Free Communications

Chairman C. Riggs

- 09.00 - 09.15 Plastic surgery of covered and penetrating penis trauma in the stallion. Birgit Fruhauf, C.P. Bartmann & E. Klug, D
- 09.15 - 09.30 Unusual findings in the navicular bones of two horses B. Wollanke, D
- 09.30 - 09.45 The use of heel wedges in the orthopaedic shoeing of horses. M.A. Willemen, NL
- 09.45 - 10.00 Forging conditions and the use of particle reinforced alloy horseshoes in sport horses. C.H. Stanek, J. Brandstetter, J. Anich & C. Hinterhofer, A
- 10.00 - 10.15 Intra-articular and intravenous use of sodium hyaluronate for the treatment of osteoarthritis in horses. H. Gerhards, & K. Schwenger, D
- 10.15 - 10.30 Long term results of intra-articular treatment with Hyartil/Celestovet in distal interphalangeal and metacarpophalangeal joint disease in horses. J. Brumhard, V. Na Songhkla, P. Stadler, D & B. Loer, D.

10.30 **Commercial Exhibition and Coffee/Tea Break**

Chairman R. Kostlin

- 11.00 - 11.15 Differences in wound healing between ponies and horses J.W. Wilmink, NL
- 11.15 - 11.30 Some biomechanical and diagnostic aspects of back problems in horses. W. Ranner, D
- 11.30 - 11.45 Aetiology of parasagittal fractures of the distal condyles of the third metacarpal bone; a new hypothesis. C.M. Riggs, S. Jones & A. Boyde, GB

OSTEOARTHRITIS - THE CURSE OF ALL FLESH

May S

Articular cartilage is a unique tissue, physically and biochemically adapted to its functional role. To both permit and facilitate movement, vertebrates require an articulated skeleton, and the tissue which lines these joints has two important properties. Articular cartilage provides a low-friction interface between bone ends, which makes movement both energy efficient and also minimises wear-and-tear. This permits tissue repair and homeostasis, despite the constantly changing environmental conditions of the chondrocytes and their extracellular matrix.

Cartilage homeostasis may fail for two main reasons. Either the tissue receives a single insult which exceeds its capacity, and that of the surrounding bone, to absorb and dissipate that force, or repetitive damage, physical or biochemical, leads to an imbalance between catabolic and anabolic processes, increasing the vulnerability of the cartilage to wear-and-tear as its natural lubrication system breaks down. All such damage, if not arrested, leads to the final common pathway of articular failure, which we know as osteoarthritis.

Osteoarthritis has been a problem for vertebrates as long as they have existed. The characteristic bony changes can be recognised in fossilised dinosaur bones and the remains of early man. It can be induced experimentally by the forced overuse of joints, and is recognised in the joints which are tested to their limits in specialist activities, ranging from ballet dancing to the operation of a pneumatic drill. Like bone, cartilage has the capacity to adapt to the static and dynamic demands placed upon it. However, such changes take time, and may not be complete if training regimes are curtailed or inappropriate to the intended activity.

The situation is complicated by the superimposition of ageing processes on articular cartilage. Indeed, some would still advocate that ageing and degenerative changes are synonymous, although there are fundamental biochemical differences between old and degenerate cartilage matrix. It is becoming evident that in the process of normal proteoglycan turnover, the catabolic processes do not continue to completion, making the matrix a graveyard for partially degraded proteoglycan molecules. This, together with an apparent down-regulation of cartilage metabolism as a whole, may be part of the energy-saving compromise of the whole organism which is responsible for ageing, and, ultimately, death. There is now considerable interest in such age changes as the predisposing factors to degenerative change in later life, as an alternative to theories of accumulating, low-grade trauma.

Regarding therapy for osteoarthritis, clearly, the ideal is to avoid cartilage damage by ensuring that the tissue is adequately conditioned for its intended loads. However, if catabolism, for any reason, exceeds anabolism, appropriate therapy involves the use of so-called chondroprotective agents which inhibit proteoglycan and collagen degradation, at the same time as encouraging matrix synthesis. Under certain circumstances, still poorly understood, joints have the capacity to heal, and even regenerate! However, the recreation of such favourable conditions, using, if necessary, chondrocyte or cartilage grafts, supplemented with appropriate growth factor regimes, remains a distant goal of all research workers in this field.

HIP DYSPLASIA; WHAT'S NEW IN IMAGING

Fluckiger M

Current status: CHD is still present in 40% of all purebred dogs despite a 30 year eradication programme. The continued use of dysplastic dogs and their progeny for breeding, is considered to be a major reason for this disappointingly slow progress. Only the use of dogs graded normal (A) and near-normal (B) for breeding with a strict ban on all dysplastic dogs would cause a remarkable decline in the prevalence of CHD. This has been proven in many breeding colonies.

Determination of joint laxity, assumed to be the primary causative factor in CHD is unreliable on a film taken in conventional VD positioning of the patient in dorsal recumbency. The caudal extension of the hind limbs results in a spiral tensioning of the non-elastic joint capsule which itself leads to repositioning of a subluxated femoral head back into the acetabular cup.

Stress studies: Joint laxity or degree of lateral displacement of the femoral head has been evaluated using a variety of stress techniques. In lax hip joints a fulcrum device positioned between the limbs and application of a medially directed force on the stifles results in a lateral displacement of the femoral heads. But with the hind limbs fully extended the fibres in the joint capsule are again twisted and stretched, resulting in an incomplete demonstration of maximal subluxation.

A "half axial view" (Badertscher, 1977) avoided this drawback but the technique was never published. The dog is placed in dorsal recumbency with the femora at a 45° angle to the table top. Placement of a wooden fulcrum on the pelvic symphysis and adduction of the stifle joints resulted in lateral subluxation of the femoral heads in the affected dog. Smith et al (1990) angled the dogs' femora further to 80° off the table top and determined a distraction index (DI) defined as the ratio between the distance between the centre of the femoral head and the centre of the acetabulum divided by the radius of the femoral head. In German Shepherd dogs a DI of less than 0.3 is found with normal hips whereas dogs of this breed with a DI of over 0.4 are considered to carry a disposition for CHD. Virtually all dogs with a DI of over 0.7 will develop CHD. There are differences in disease susceptibility among breeds. Assuming that coxofemoral instability and arthrosis are undesirable findings in breeding dogs, only those CHD-graded A or B, with an upper DI limit of 0.3 should be used for breeding. It must be noted that fraudulent manipulation of the stress techniques is easy to accomplish and could not be detected easily on the resulting radiograph.

Outlook: Neither the conventional radiograph in VD positioning nor the stress radiograph truly reflect the genetic burden of a dog for the disease. Progeny testing and the implementation of a modern breeding value estimation (BVE) programme should be encouraged which would allow a more precise determination of the breeding value of a dog for CHD. Such programmes are highly successful in farm animal breeding and are also successfully used in many dog breeds in Germany. BVE becomes most valuable when many offspring are radiographed, or when randomly selected offspring are evaluated. The remarkable advantage over the current selection mode is that a dog's breeding value is only mildly dependent upon his own conformation and is constantly changing with increasing data information from related dogs.

HIP DYSPLASIA SELECTION: INDIVIDUAL SELECTION AND THE POPULATION DYNAMIC CONSEQUENCES.

Ubbink G J

The overall likelihood that a dog might suffer from hip dysplasia (HD) is partly dependant on genetic risk factors. In dogs, the inheritance of HD is recognised as a polygenetic trait. However polygenetic in dogs, in different breeds different factors might be the most influential. Furthermore, in different individuals within a breed the impact of the genetic factors that determine the HD risk can differ as well. Some alleles will have a major impact while others are just minor influencing factors.

On the level of individuals, HD is seen as a multifactorial disease: the individual combination of both genetic and/or environmental factors might ensure sufficient cause for clinical symptoms of HD. In some dogs the cause is mainly genetic while in others the environmental factors are more prominent. Under the current circumstances the genotype of the likelihood of inheritable risks of breeding stock can not be determined with absolute certainty. Surveyable DNA characteristics or informative quantitative trait loci (QTL) are not yet identified. Probably the practical impact of QTLs varies between breeds. Technically the marker assisted selection might increase the power of selection in one breed but could be virtually useless in other breeds.

Presently, the recurrence of HD can only be deduced by the evaluation of clinical data. An estimate of the genetic value of breeding stock is a derivative of its own phenotype and of related phenotypes.

In man two different clinical predictors are recognised as influences on the individuals HD risk in later years. First, the obviously sex associated clinically defined laxity of joints. Second, the lesser sex related radiologic evaluation of abnormalities in coxofemoral joint conformation. Both entities prove genetic but are regulated by different genes. If generalised to dogs, we can expect that similar clinical definitions are associated with different genetic risk factors.

Currently, selection against HD is mainly based on HD characteristics in overall dogs, irrespective of breed specific features. This selection method is founded on the realisation that the average genotype of dogs with superior hips is better than of dogs with inferior hips. The most applied phenotypic test as predictor of HD is the radiologic hip conformation at 12 or 18 months of age, according to FCI definitions. In recent years, as in man, joint laxity at a much younger age is proposed as a diagnostic alternative to radiological surveys. After screening all potential stud dogs the ones with superior hips are favoured as breeding stock.

In the Netherlands and other countries breeding regulations focus on screening phenotypically.

This approach increases the importance of the screening method used. In general, each method should be (1) reproducible, (2) sensitive and (3) specific as any other diagnostic in medicine. Regrettably limited data are available to evaluate the radiological conformation at 12 to 18 months, as predictor of the risk of clinical HD in later life, nor as the predictor of genotypic likelihood or breeding value. The attribution to a lesser chance of (clinical) HD in progeny, of phenotypic superior hips of both parents still varies between potential stud dogs, despite their similar radiologic description. In general, we must conclude that it is likely that the test and the conclusions of the expected genetic value should be breed specific, and influences the diagnostic accuracy of genotypic determination. However, current veterinary knowledge about the quantified sensitivity and specificity of the phenotypic appearance is limited.

In theory, the use of dogs with superior hips, should decrease the chance of inferior hips in progeny.

But there is no absolute certainty that the overall incidences of HD will decrease in the population as a whole. (1) Realising that the genetic superiority of dogs with superior hips, is only true as a population estimate. Thus that some individual phenotypically superior dogs might still classify as genetically less than the population mean. (2) Furthermore, realising that retrospectively only relatively few dogs (<8%) are screened for breeding purposes (3) and that other criteria than HD determine the preselected screened subgroup the actual mean breeding value of the preselected phenotypically superior dogs can be smaller than the population mean. The result could be a rise in HD incidence despite phenotype selection.

To ensure a decline of HD to lower the risk of accidental choices (1) the current individual selection should coincide with (2) the use of more different stud dogs and (3) control of the representation of the population heterogeneity in the breeding stock.

NUTRITIONAL INFLUENCES ON HIP DYSPLASIA.

Hazewinkel H

The hereditary coefficient for hip dysplasia (HD) varies between 0.2 and 0.5. This implies an important influence of environment, including nutrition, on its phenotype.

Research in Great Danes revealed that raising dogs on a diet with 3.3% calcium (Ca) content instead of the recommended level of 1.1% Ca on dmb, caused a delay in appearance and ossification of several secondary ossification centres(3, 21) Since cartilage is much more plastic than bone, delayed ossification of the skeleton at a given age, weight and activity might stimulate skeletal deformities when compared with dogs with a more advanced stage of skeletal development. In addition, parathyroid hormone activates osteoclasts and calcitonin decreases osteoclastic activity when plasma Ca concentration decreases or increases, respectively. In the case of an excessive Ca intake, hypercalcitoninism might occur causing decreased skeletal modelling (5, 6). The change in position of the collum femoris during growth is the result of bone cell activity (especially osteoclasts) and can thus be hampered in the case of high Ca intake, as was demonstrated by Hedhammar et al (1978) in the Great Dane.

Osteoclastic activity can also be influenced by a change in base excess (2, 16) An excess of cations (Na, K, Ca, Mg) and the resulting compensatory alkalosis lowers bone cell activity and thus skeletal modelling (19) A total of 121 dogs were studied during a feeding trial with diets containing different amounts of cations and anions. Dogs with lower anion-cation gaps (in mEq/L) revealed a better Norberg angle when compared with dogs with a large anion-cation gap (9).

A variety of studies have demonstrated that excessive energy intake causes excessive body weight with negative influences on hip joint development in those dogs which are prone to HD (7). Ad lib fed Labradors developed significantly more severe HD, assessed by Norberg angle measurement, than the restricted fed matched group (8, 10). Subluxation of the femoral head together with overweight encourages the the acetabular rim to deform as is seen in young dogs with severe HD (11). In addition, loading only a small part of the joint surface causes a corresponding increase in pressure on the joint cartilage which might cause irreversible cartilage damage.

Excessive protein per se has not proven to influence hip joint development (12). Excessive fat intake might facilitate excessive food intake, and thus overweight, and essential nutrients might not taken in sufficiently. However feeding an excess of fat to dogs has no influence on

calcium availability and thus on calcium absorption (3a). An excess of vit. A might increase osteoclastic activity together with decreased osteoblastic activity and hypervitaminosis C can cause hypercalcaemia induced hypercalcitonism and thus both might cause disturbance in skeletal modelling (5, 20).

Nutrition can also have a role in the conservative treatment of dogs suffering from osteoarthritis due to HD. In privately owned dogs suffering from HD, a considerable improvement of force plate analysed locomotion after a period of 3 months strict cage rest (4). This clinical improvement might be explained by the regeneration of cartilage lesions due to strict rest. In 8 year old Labradors housed in research wards, significantly overweight dogs had different plasma concentrations of growth hormone and insulin-like growth factor -I (IGF-1) compared to the slim dogs of that group. In addition, the overweight dogs had more severe HD. This demonstrates that adiposity might cause differences in hormones which influence cartilage cell function even without the influence of overloading. There is much interest in the role unsaturated fatty acids can play in directing the synthesis of inflammatory mediators in dogs, as is described in man, but no results of studies in dogs are available yet. Diets restricted in calories might be used in assisting the decrease of excessive body weight, but these should only be fed to adult dogs, since the danger exists that a low-energy but complete dog food, as commercially available fed to a young dog, ends up with normal or increased energy intake together with excessive mineral and vitamin uptake (13) Therefore it is advocated to reduce food intake with 30-50% of the quantity fed during the period over weight developed. Since there is no scientific literature currently available that demonstrates that herbs, food additives or potions have a beneficial effect on the prevention or development of HD, the role of nutrition is limited to prevention of HD by feeding a restricted amount of a high quality complete dog food. Nutritional treatment of osteoarthritis is, until now, limited to a weight reducing programme. In those cases where conservative treatment, including both activity and dietary regimes and analgesics is not sufficient in treating osteoarthritis surgical techniques are indicated.

1. BENNETT, D. (1987). Hip dysplasia and ascorbate therapy: fact or fancy? *Semin.Vet.Med.Surg. (Small Anim)* 2: 152-157.
2. CHING, S.V., FETTMAN, M.J., HAMAR, D.W. et al (1989): The effect of chronic dietary acidification using ammonium chloride on acid-base and mineral metabolism in the adult cat. *J.Nutr.* 119, 902-915.
- 3a. HALLEBEEK, J.M., HAZEWINDEL, H.A.W. Effect of isoenergetic substitution of dietary fat (beef tallow) for carbohydrates (wheat starch) on the calcium absorption in the dog. *J.Anim.Physiol.Anim.Nutr.* 1998 (in press)
3. HAZEWINDEL, H.A.W., VAN DEN BROM, W.E., KLOOSTER, A. et al (1991): Calcium metabolism in Great Dane dogs fed diets with various calcium and phosphorous levels. *J.Nutr.* 121: s99-s106.
4. HAZEWINDEL, H.A.W. (1991): Conservative treatment of canine hip dysplasia, *Proceedings BSAVA/VOK Congress, Wien*, pp 444-446.
5. HAZEWINDEL, H.A.W. (1994): Skeletal disease Ch. 22 in: *The Waltham book of clinical nutrition of the dog and cat* (Will J.M. and Simpson, K.W. eds) Elsevier Science, Oxford, UK pp. 395-423.

6. HEDHAMMER, A., KROOK, F.W. et al (1974): Overnutrition and skeletal disease: an experimental study in growing Great Dane dogs. *Cornell Vet.* 64 (suppl): 1-159.
7. KASSTROM, H. (1975): Nutrition, weight gain and development of hip dysplasia. *Acta Radiol.* 334 (suppl): 135-179.
8. KEALY, R.D., OLSSON, S.E., MONTI, K.L. et al (1992): Effects of limited food consumption on the incidence of hip dysplasia. *J.Am.Vet.Med.Assoc.* 201, 857-863.
9. KEALY, R.D., LAWLER, D.F., MONTI, K.L. et al (1993): Effects of dietary electrolyte balance on subluxation of the femoral heads in growing dogs. *Am.J.Vet.Res.* 54, 555-562.
10. KEALY, R.D., LAWLER, D.F., ALLAM, J.M. et al. (1997): Five-year longitudinal study on limited food consumption and development of osteoarthritis in coxofemoral joints of dogs. *Am.J.Vet.Med.Assoc.* 210, 222-225.
11. LUST, G., GEARY, J.D., SHEFFY, B.E. (1973): Development of hip dysplasia in dogs. *Am.J.Vet.Res* 34, 87-91.
12. NAP, R.C., HAZEWINDEL, H.A.W., VOORHOUT, G. et al. (1993): The influence of the dietary protein content on growth in giant breed dogs. *J.Vet.Comp. Orthop.Traum.*6, 1-8.
13. NAP, R.C., HAZEWINDEL, H.A.W. (1997): Gezond groeien, een andere kijk op de calcium - en energiebehoefte van de hond. In *Praktijk 1*: 32-35.
14. OLSEWSKI, J.M. (1982): Physiologic and pathologic studies on canine diarthroses; polyarticular degenerative joint disease in young and mature animals. Thesis Cornell University, USA pp 1-161.
15. OLSEWSKI, J.M. LUST, G.L. RENDANO, V.T. et al (1983): Degenerative joint disease: multiple joint involvement in young and mature dogs. *Am.J.Vet.Research* 44, 1300-1308.
16. PATIENCE, J.F. (1989): The physiological basis of electrolytes in animal nutrition in: *Recent advances in animal nutrition* (Haresign, W., Cole, D.J.A. eds). Butterworth, London pp. 223-228.
17. RICHARDSON, D.C. (1992): The role of nutrition in canine hip dysplasia. *Veterinary Clinics of North America: Small Animal Practice* 22, 529-540.
18. RICHARDSON, D.C., TOLL, P.W. (1997): Relationship of nutrition to developmental skeletal disease in young dogs. *Veterinary Clinical Nutrition* 4, 6-13.
19. SCHAWALDER, P., SPRENG, D., DIETCHI, E. et al (1996): Die Huftgelenkdysplasie im Umfeld von sekundären Einflüssen und ektopischen Ursachen. *Kleintierpraxis* 41, 625-638.
20. TEARE, J.A., KROOK, L. KALLFELZ, F.A. (1979). Ascorbic acid deficiency and hypertrophic osteodystrophy in the dog. *Cornell Vet* 69, 384-401.
21. VOORHOUT, G., HAZEWINDEL, H.A.W. (1987): A radiographic study on the development of the antebrachium in Great Dane pups on different calcium intakes. *Vet. Radiol.* 28, 152-157.

RESULTS AND COMPLICATIONS OF TRIPLE PELVIC OSTEOTOMY (TPO)

Meij B

The ideal candidate for TPO would be between 6 and 8 months of age, with clinical signs of hip dysplasia, with no or minimal degenerative signs radiographically, and on palpation, and with a positive Ortolani sign indicating there is still sufficient dorsal acetabular rim to support the femoral head after rotation of the acetabulum. When these selection criteria are not strictly met the excellent results after TPO will be compromised. TPO is contraindicated when there are radiographic or palpable signs of advanced degenerative joint disease, breakdown of the dorsal acetabular rim, shallow acetabulum or neurological disease. There are several studies which have reported on the results following TPO.

1. Schrader (1986).

TPO with transplantation of the trochanter major was conducted in 41 dogs (77 hips) with hip dysplasia. The mean age of the dog was 8.7 months. After osteotomy of the pubis and ischium a staircase osteotomy of the ilium was performed and the acetabulum was rotated 70° to 90° and fixed with one screw and cerclage wire. The trochanter major was transplanted distally. After surgery all hip were stable (ortolani sign negative). The percentage coverage of the femoral head by the acetabular rim increased to a mean of 78% (range 38-107%). Loosening of screws or screw breakage was seen in 5.2% but did not affect bony union. The mean long term follow up period was 2.7 years (range 1.0-5.5 years). The function of the pelvic limb, result of orthopaedic and radiographic examination were satisfactory in respectively, 55 (92%), 48 (87%) and 45 (81%) of the hips. Postoperative complications were loss of proprioception during 7 days (2.7%) and osteomyelitis (1.3%).

2. Slocum and Devine (1986 and 1987).

TPO was performed in 119 dogs. In 42% of the cases the age of the dogs was < 1 year and in 31% it was between 1 and 2 years. The osteotomized ilium was fixed using a 30° twisted plate. The osteotomized ischium was fixed using a cerclage wire. Follow-up examination was performed at 6 weeks (119 dogs), at 6 months (115 dogs) and at 1 (113 dogs), 2 (87 dogs), 3 (68 dogs), 4 (57 dogs) 5 (36 dogs), 6 (10 dogs) and 7 years after surgery (7 dogs). At 6 weeks after surgery 19/119 dogs were not sound. Radiographic examination showed loosening of screws in 10% of the cases although bony union had progressed in all dogs. At 6 months after surgery 3/115 dogs were still lame whereas at 1 year after surgery 113/113 dogs showed normal locomotion and activity. In these dogs the hips were stable under anaesthesia, (Ortolani sign negative) and radiographic healing was complete. These results remained unchanged at 2,3,4,5,6 and 7 years for the dogs that were followed up.

Complications included postoperative constipation for 5 days, urethral stenosis (1 dog) pain due to gluteal muscle irritation by the rotated acetabular fragment (1 dog) and transient ischiadic and cranial gluteal neuropraxia in 3.4% of the cases.

3. McLaughlin and Miller (1991)

In 15 dogs, 25 hips underwent TPO for hip dysplasia (10 bilateral) The age of the dogs was between 6 and 13 months. The Ortolani sign and radiographic examination were carried out pre-operatively and at 5,10,15 and 28 weeks after surgery. The Ortolani sign was positive in all dogs before surgery. The Ortolani sign remained positive in 3 rotated hips at 5 weeks and in 2 hips at 10 weeks after surgery. At 15 and 28 weeks after surgery the Ortolani sign was negative in all 25 rotated hips whereas in the 5 hips that were not operated the Ortolani sign remained positive. The mean percentage of covering of the femoral head by the dorsal acetabular rim improved from 18% before surgery to 84% at 28 weeks after surgery. In the hips that were not operated the mean percentage of covering decreased from 29% at the first evaluation to 17% at 28 weeks.

4. Duhautois (1997)

The acetabulum was rotated 30° to 40° using a twisted plate on the osteomized ilium. In 173 dogs that were operated using Slocum's original technique, the results were either good or excellent in 91% of cases. The results were inversely proportional to the stage of development of the dysplasia and the age of the animal at surgery. The weight of the animal had no significant influence on the results. The final result was obtained in 84% of the cases at 8 weeks after surgery. The optimum recovery time was observed in the dogs that were 7 to 10 months of age when the operation took place. A postoperative follow-up period of 2-4 years in 62 dogs, highlighted a significant stabilization of the evolution of the arthrosis.

5. Experiences at the Small Animal Clinic of the Utrecht University.

In 43 dogs, 56 hips underwent TPO (13 bilateral) for hip dysplasia. All dogs underwent an orthopaedic and radiographic examination before surgery. In 39 (91%) dogs bilateral hip dysplasia was present. The age of the dogs at surgery was < 6 months in 7% between 6 months and 1 year in 77% and between 1 and 2 years in 16% of the cases. In 28 dogs an AO/ASIF 2.7 dynamic compression plate (DCP, manually twisted over 30° to 45°) was used and in 26 dogs Slocum's Canine Pelvic Osteotomy Plate (CPOP) with rotation angles of 20° (1 hip), 30° (23 hips) and 45° (2 hips) was used for ilial fixation after acetabular rotation. Clinical and radiographic follow up was available for 48 rotated hips and was performed at 6 weeks, at 3 months and at 1 year after surgery. In 96% of the cases there was a satisfactory clinical result at 1 year after surgery. Close observation of the gait showed circumduction of the pelvic limb in 52% of the dogs but this did not affect activity. All ilial osteotomies were radiographically healed at 3 months after surgery. Acetabular support, Norberg angle and hip

joint congruency improved significantly after TPO. Osteophyte formation was judged to be moderate at 3 months after the operation. Comparison of the two plating methods showed significant post operative advantages for the CPOP group in terms of a higher Norberg angle and a better congruency. There was loosening of 33% of the screws in both groups but this did not interfere with the aim of the TPO procedure. Plate and screws were not removed.

Complications were ischiadic neuropraxia (1 dog), pelvic narrowing due to atechanical error (1 dog) and osteomyelitis of the ilial osteotomy with concurrent lumbosacral discospondylitis (1 dog).

Summary.

When the patient selection criteria are met, TPO gives excellent (>90%) short term (up to 1 year follow up) results for treatment of hip dysplasia. In general the patient is best treated as early as possible (6-10 months of age) to enable remodelling of the hip joint after rotation of the acetabulum. Postponing the surgery will increase the risk that the patient is excluded from TPO for reasons stated above. The most common complication after TPO is radiographic loosening of plate screws (10-30%). This may delay bony union but has no clinical consequences and does not affect the final radiographic outcome (=bony union within 6 months after surgery). Severe complications are rare and include: transient neuropraxia of the ischiadic nerve, pelvic narrowing due to technical error or loosening of screws in the cranial and/or caudal ilial fragment with inward displacement of the acetabulum, urethral stenosis with dysuria due to severe pelvic narrowing after bilateral TPO and pubic osteophyte formation and, osteomyelitis of the ilial osteotomy.

RESULTS AND COMPLICATIONS OF TOTAL HIP REPLACEMENT (THR)

Matis U

STICK INJURIES

White R A S

Injuries resulting from dogs becoming impaled on sticks continue to be an important cause of oropharyngeal trauma and dictate vigorous and early management to ensure a successful outcome.

Aetiology : stick injuries are most commonly encountered as the consequence of dogs running onto the stick or less frequently, in dogs which persistently chew or carry sticks. The condition affects predominantly dogs >20kg and the Collie appears to be especially prone to this injury.

Presentations : dogs are presented as either acute (<7 days of the original injury) or chronic cases (>7 days). Acute cases present with severe and systemic signs including shock, dyspnoea, pyrexia and oral bleeding. Chronic cases are presented for the investigation of discharging sinuses or fluctuating wound located in the ventral midline, cervical, temporal or intrmandibular regions.

Complications : Acutely-injured dogs may have perforations in the tonsillar or pharyngeal areas with associated bleeding, haematoma formation and cellulitis. Airway obstruction and exsanguination are constant dangers in all such cases. More severe lacerations will extend into the oesophagus lacerating this and even leading to fatal mediastinitis.

Chronic cases will suffer periodic eruption of the sinus with resulting systemic signs. In some cases there may be fibrosis of the masticatory muscle preventing normal mandibular function.

Management : Acutely-injured dogs should be vigorously managed for septic and hypovolemic shock as soon as possible. In general, the wound should be explored for management of bleeding and in severe cases ligation of the external carotid artery is warranted. An attempt should be made to remove all residual wooden fragments and appropriate drainage provided. Tube gastrostomy should be performed to manage any dysphagia.

Chronic sinuses should be explored to located migrating foreign bodies. In the absence of foreign material the tissue lining the sinus tract should be excised.

SKULL AND ORBITAL INJURIES

Kostlin D

NASAL TRAUMA

White R A S

Despite its relatively exposed and unprotected position in small animals the nose and its associated structures is relatively immune to trauma as compared with man. Nevertheless, it is a frequent site for foreign body migration and direct trauma is occasionally encountered.

Foreign bodies : The patient's signalment and history are generally sufficiently convincing to warrant a 'foreign body hunt'. Radiography is only rarely helpful in identifying the location of the offending material since most are organic. Endoscopy, using solid lens systems, may be useful in locating the foreign body which is almost always found in the the ventral meatus permitting its migration toward the choanae. Retrieval only rarely requires surgical intervention and although endoscopic removal is perhaps the most satisfactory method for location of the foreign body the 'blind grab' exploration of the ventral sinus is a perfectly acceptable and often successful alternative where endoscopy is not available. Only in cases where the foreign body has lodged away from the ventral meatus is rhinotomy indicated.

Nasomaxillary fractures : direct trauma to the nasal sinuses and the surrounding nasal, maxillary and palatine bones is unusual but may be the consequence of road traffic injuries or occasionally, penetrating or crushing bite wounds. Acute complications include severe epistaxis, obstruction of the upper airway which may require airway bypass and inhalation of debris. Longer term problems include the fixation of unstable maxillary fractures. In general, conservative management using muzzles and supporting tapes is preferable to internal fixation of the sheet-like bones of the nasal sinuses. In severely displaced fractures, however, transfixing pins placed through the sinuses and supported externally may be indicated. The overriding considerations should be maintenance of the airway and management of dysphagia using tube gastrostomy as indicated.

PALATE INJURIES IN COMPANION ANIMALS

Theyse L F H

Traumatic injuries of the palate most frequently occur in domestic cats. Falling from heights (the high-rise syndrome) and vehicle accidents are the most common causes. In dogs, palate injuries are encountered less frequently, with bite trauma and vehicle accidents being the most important aetiologic factors.

The hard palate is formed from rostral to caudal by the incisive, maxillary and palatine bone. On the nasal side, these bones join the nasal bone to form the nasal septum. On the oral side the hard palate is covered with a very firm stratified squamous epithelium which is cornified. This epithelium forms the palatine rugae which extend from the canine teeth to the last molars. Caudally, the hard palate is met by the soft palate.

In cats, the high rise trauma results in a midline fracture of the hard palate with rupture of the soft tissues. This rupture can extend into the soft palate due to the anatomic configuration of the skull and dental occlusion. In cats, this trauma frequently results in palate injury in combination with a fracture-luxation of the mandibular symphysis. Forceful closure of the mouth causes the canines and molars of the mandibula to act as a wedge on the hard palate resulting in a midline fracture and rupture of the soft tissues. At the same time, the canine teeth of the mandibula are rotated outward resulting in a fracture-luxation of the symphysis. Vehicle accidents in cats usually result in extensive injuries of the head with fractures of the hard palate, lacerations of the soft tissues (sub)luxations of the symphysis and/or mandibular joints and dental fractures.

In cats, injuries of the palate are treated by repositioning the wound edges and suturing the hard and, if indicated, the soft palate. Repositioning the hard palate can be achieved by manually compressing both sides of the incisive and maxillary bone towards the midline. The hard palate can be closed with interrupted sutures using PDS while the soft palate can be closed with Vicryl. In some cases additional stability and compression can be achieved using figure of eight cerclage wires round the canine teeth. All co-inciding mandibular trauma should be treated and occlusion should be checked.

In dogs, midline fractures of the hard palate are very rare. Injuries of the hard palate occur as segmental fractures incorporating one or more teeth or as a total bony detachment of the rostral part of the upper jaw. In dogs, stabilisation of the fractures is achieved using interdental fixation with cerclage wires, bone pins, external fixation, plate osteosynthesis or a

combination of these methods. Additional stability can be achieved using a muzzle. Correction of oral occlusion and reconstruction of soft tissues are essential to promote early healing.

In both dogs and cats with extensive trauma to the head, food intake can be very difficult and nutritional support using a gastric or oesophageal tube may be necessary. In general the prognosis for palate injuries in both cats and dogs is favourable.

DEGLOVING INJURIES

White R A S

Aetiology : Although degloving and avulsion injuries have differing aetiologies it is convenient to discuss them together since they are often similar in appearance and have the same complications. A degloving injury describes the tearing off of skin from an extremity, usually a limb, in a manner similar to the removal of a glove. The process of degloving may be either *mechanical*, sometimes described as a stretch laceration, in which the overlying skin is torn from its subdermal attachments. This is most frequently seen in road traffic injuries as a car wheel runs over a limb or as the result of severe abrasive injuries. In other cases the degloving is *physiological* as the consequence of damage to the vascular supply as the skin and subcutaneous tissues are sheared from the deeper fascia leading to subsequent sloughing of the overlying skin over a period of days. The aetiology of either mechanism may be similar.

Avulsion injuries refer to the forcible separation of tissue from its attachments. Avulsions are commonly seen as the sequel to dog fights in which large areas of skin are simply torn from their attachments. Some of the most severe avulsions occur in dog fights and fights with badgers or foxes in which the dog's mandible can be extensively exposed or even removed.

Shear injuries are more complex degloving injuries and tend to be encountered in immature dogs. The medial aspect of the carpus, phalanges and particularly the tarsometatarsal joints are particularly prone to this type of injury.

Complications : Both degloving and avulsion injuries may initially be free of bacterial contamination although there may be complicated by associated orthopaedic injury. In physiological degloving the sloughing process may take several days and secondary infection of the necrotic tissue may become a problem. In addition to the damage to the skin and associated structures shear wounds involve bones and more seriously, joints. Like degloving wound, shearing injuries are heavily contaminated with bacteria and debris from the abrading surface. These wounds are extremely prone to infection and can be expected to require long term open wound care to prevent this. In the case of joint involvement there may be deep penetration of the joint surfaces by the contamination. The bacterial load within the joint is considered to be the

major determinant for primary wound closure and most wounds have to be left to heal secondarily rather than reconstructed or grafted. Joint injuries are further complicated by the damage to their associated soft tissue structures such as ligaments or tendons which allowing instability such as valgus deformity of the carpus or tarsus.

Management : The major management concern is the reconstruction of what is often a large cutaneous deficit over an extremity where spare adjacent skin is at a premium. The degloved skin may remain attached by a pedicle in which case an immediate reconstruction can be considered or totally detached in which case it can be used as free graft. Avulsions involving the mandible represent a considerable reconstructive challenge due the difficulty of attaching skin to bone devoid of a periosteum. Options for closure include secondary healing, direct pedicle flapping and skin grafting. Certainly, degloving injuries represent the single biggest indication for the latter technique.

MANDIBULAR FRACTURES

Balligand M

General Considerations: Mandibular fractures may occur secondary to trauma, severe periodontitis or neoplasia. Head trauma is the most common cause. Concurrent injuries (upper airway obstruction, central nervous system trauma, pneumothorax, pulmonary contusions and/or myocarditis) are often present and should be taken care of.

Biomechanics: The tension side is the alveolar border or tooth side. Knowledge of the relevant biomechanics affects decision making with regard to fracture fixation. Oblique fracture lines from dorsocaudal to ventromesial: muscles forces compress the fracture line. From dorsomesial to ventrocaudal: muscle forces lead to distraction of the mesial fragment.

Antimicrobial therapy. Mandibular fractures are often open to the oral cavity. Ampicillin (25 mg/Kg IV) or Cefazolin (25 mg/Kg IV) may be administered initially. Antibiotics significantly decrease the rate of osteomyelitis in case of open fractures. In case of periodontal diseases use amoxicillin + clavulanic acid, clindamycin or metronidazole.

Perifracture loose teeth. Teeth + periodontal disease marked by bone loss = to be removed regardless of stability. Root exposure + tooth stable = no extraction. Root exposure + tooth mobile = extraction. Crown fracture + tooth stable = pulpotomy or root canal therapy. In case of delayed or non-union; extraction regardless of stability.

Fixation techniques. Mandibular fractures can be dealt with following a clinical fracture assessment: low score = high risk...maximal stability required. high scores = low risk.....mechanical properties of implants need not be extreme. midscale scores = intermediate risk!

Purpose: restoration of occlusion by anatomic reduction + stable fixation. Trauma to tooth roots and neuro-vascular structures **May not result in clinical signs yet complications may occur** making teeth extraction necessary after fracture healing.

Muzzle coaptation technique: Most common treatment technique. Satisfactory for minimally displaced reasonably stable fractures, ramus fractures or pathologic fractures secondary to periodontal disease or in adjunction with other forms of stabilisation. Permanent malocclusion is regularly reported but with little clinical significance. Dermatitis can be severe!

Interarcade wiring: Same indications as muzzle coaptation techniques; avoids the dermatitis problem but damages the periodontal tissue of the upper and lower carnassial teeth.

Interdental fixation/Intra-oral splints: Erich arch bar - Stoot loop - acrylic splints - combination of former - parapulpal pins composite bridge - interdental wires. Interdental wires are positioned securely in the bone around the tooth's neck. Intraoral splints work for fractures mesial to the first molar. They can augment other fixation techniques. An acid etching agent is first applied to the tooth surface.

External skeletal fixation: when possible, pins (smooth or positive threaded ends) penetrate bone ventral to the mandibular canal to avoid neuro-vascular contact; driven with low speed to prevent ring sequestrum (< 300 rpm); predrilling is useful; six cortices engaged in each major fragment; 1-1.5 cm between fracture line and pins. Use of acrylic side bar allows pin placement in different planes.

Internal skeletal fixation: Bone plate and screws applied to the ventro-lateral mandibular surface; Satisfactory also for complex fractures. Intramedullary pins: should be avoided.

Interfragmentary wire: Satisfactory for relatively simple reconstructible fractures. Ideal for stabilization of mandibular symphyseal fractures. Two interrupted wires are recommended for each fracture line. **Avoid** tooth roots when placing the more coronal wire. 18-22 gauge wire, penetrating the bone 5-10 mm from the fracture line.

References:

Umphlet, R., Johnson, A: Mandibular fracture in the cat, a retrospective study, *Veterinary Surgery*: 17: 6: 333; 1998.

Zemer, K: Treatment of jaw fractures in small animal with parapulpal pin composite bridges: *Vet.Clin. of N.Am: SA practice*; *Feline Dentistry*: Nov. 1992.

Umphlet, R., Johnson, A: Mandibular fractures in the dog - A retrospective study of 157 cases: *Veterinary Surgery*, 19: 4: 272; 1990.

Smith, M. Kern D.: Management of Orthopaedic Emergencies - Skull Trauma and Mandibular Fractures: *Vet. Clin. of N.Am: SA Practice*: 1127; Sept. 1995

Maretta, S.M. and Col.: Dentistry: problems associated with the management and treatment of jaw fractures: *Problems in Vet.Med*: 2; 1: 220; March 1990.

Fractures of the mandible: *Manual of Internal Fixation in Small Animals*: 4.9.1: 210.

Welch Fossum T.: Maxillary and mandibular fractures; *Small Animal Surgery*. Chap. 29, 767; 1997.

DENTAL EMERGENCIES IN COMPANION ANIMALS

Theyse L F H

The most common dental emergency is trauma to a tooth. These traumatic dental injuries result in fractures of the tooth or in damage to the periodontium. Tooth fractures can be categorized as crown, crown-root or root fractures and can be complicated or uncomplicated. When the fracture only involves the enamel or the enamel and dentine, without extending into the pulp chamber, the fracture is called uncomplicated. When the pulp is exposed the fracture is defined as complicated.

Fractures of the enamel with intact covering of the dentine do not cause clinical symptoms. In uncomplicated crown fractures involving the dentine, exposed nerve ends and dentine tubules may be sensitive initially but this stops after sclerosis of the tubules and the formation of tertiary dentine in the pulp chamber. Uncomplicated crown fractures weaken the tooth structure and the rough surface promotes plaque and calculus accumulation. In these injuries, sealing of the dentine and restoration of the crown with glass-ionomer or composite is indicated.

Uncomplicated and complicated crown-root fractures involve the gingival attachment, cementum and periodontal ligaments. Restoring the normal anatomy is almost impossible and many of these injuries result in chronic periodontitis and lead to the decision of extracting the tooth.

In complicated crown fractures, the pulp is exposed resulting in pulpitis, and without intervention, necrosis of the pulp, death of the tooth and the formation of a periapical abscess. In these injuries endodontic treatment is indicated and aimed at preserving a viable tooth and restoring function. Acute fractures (< 48 hours in adult dogs) can be treated with a partial pulpectomy and direct pulp capping. In older fractures with chronic pulpitis or pulp necrosis, total pulpectomy is performed removing all the debris from the tooth, sterilization and obturation of the prepared pulp chamber and restoration of the crown.

In root fractures the crown usually is missing leaving an exposed pulp. Treatment consists of extraction of the root or endodontic intervention. With a large root remnant, placement of a dowel and crown can be considered. In some instances, the crown may still be in place with increased mobility and discoloration as clinical signs. Radiography of the root will confirm the diagnosis. Fractures in the coronal third of the root will not heal but fractures in a more apical location can heal by means of a dentino-cemental callus, fibro-oseus union or fibrous union. In these cases splinting of the crown can give additional stability.

Damage to the periodontium can result in subluxation, intrusion, extrusion, lateral luxation and total luxation or avulsion of a tooth. In subluxation increased horizontal movement of the tooth without vertical displacement is present. Treatment consists of soft food for approximately 2 weeks. Damage to the apical blood vessels is the most common complication and pulp vitality should be monitored after 4-6 weeks. Intrusion pushes the tooth into the alveolar socket and wedges the tooth in the bone. This injury typically occurs in the upper canines and is characterized by a decrease in crown height. In extrusion, the tooth is movable in lateral and vertical directions. Treatment of intrusion and extrusion injuries consists of repositioning and splinting of the tooth. Lateral luxations are always associated with fracture of the alveolar bone and repositioning the bone plate and tooth are indicated. Avulsed teeth are totally luxated out of the alveolar socket and need replacement and fixation as soon as possible. Fixation of teeth in periodontal damage can be achieved with cerclage wires and/or bonding using acrylic or composite splints.

The prognosis of traumatic dental emergencies depends strongly on accurate diagnosis and early treatment.

IMMUNE MEDIATED JOINT DISEASE

Bennett D

The immune-based polyarthropathies are a group of inflammatory conditions of unknown aetiology where the immune system plays a major role in their pathogenesis. They are classified into a number of different types and subtypes (table 1) to help with selecting treatment and providing a prognosis. Strict criteria are used to identify the different types of polyarthritis. Clinically they are very similar, often presenting with stiffness and systemic illness; they are a relatively common cause of so-called "pyrexia of unknown origin". There is generally multiple joint inflammation, in a bilaterally symmetrical fashion. Arthrocentesis of selected joints and synovioanalysis is essential to help confirm the diagnosis - there are increased white cell counts with a preponderance of polymorphs. There are two broad categories: the erosive and the non-erosive, according to whether or not there are destructive changes present on joint radiographs (table 1). The two main examples of the erosive immune-based arthropathies are rheumatoid, mainly seen in the dog and periosteal proliferative polyarthritis, mainly seen in the cat. The non-erosive are a much larger group and more likely to show disease of other body systems besides the joints e.g dermatitis, meningitis, myositis, glomerulonephritis, anaemia. Systemic lupus erythematosus is a multisystem disease characterised by the presence of circulating antinuclear-antibody, but is rare. Polyarthritis/polymyositis is commonly seen in the Spaniel breeds and the Polyarthritis/meningitis syndrome is reported mainly in the Weimeraner, German Short haired Pointer, Boxer, Bernese Mountain Dog and the Newfoundland. Other syndromes are recognised in the Japanese Akita and Chinese Shar Pei as breed related conditions. The idiopathic group is an even more obscure group of non-erosive arthropathies. The idiopathic Type 1 probably represents an early form of the erosive rheumatoid group; many of these dogs develop joint destruction if the disease cannot be controlled. The idiopathic type I group is the largest of all the immune-based arthropies. Research into the idiopathic and rheumatoid groups has produced evidence that canine distemper virus may be involved in the aetiopathogenesis. The miscellaneous group includes polyarthritis associated with drug administration, particularly antibiotics and vaccine reactions, particularly arthritis following calicivirus vaccination in kittens. Treatment of these diseases is often difficult and involves antiinflammatory and/or immunosuppressive drugs (Table 2).

Table 1 classification of arthritis

A. DEGENERATIVE

- 1. Osteoarthritis
- 2. Traumatic arthritis
- 3. Haemophilic arthritis
- 4. Neuropathic arthritis

B. INFLAMMATORY

- 1. Infective
 - a. Bacterial
 - c. Endocarditis and arthritis
 - e. Bacterial L forms
 - g. Mycoplasma
 - i. Protozoal
 - b. Discospondylitis
 - d. Borreliosis
 - f. Tubercular
 - h. Fungal
 - j. Viral
- 2. Immune-based.
 - a. Erosive
 - i. Rheumatoid
 - ii. Periosteal proliferative polyarthritis
 - iii. Polyarthritis of Greyhounds
 - iv. Felty's syndrome
 - b. Non-erosive.
 - i. Systemic lupus erythematosus
 - ii. Polyarthritis/polymyositis
 - iii. Polyarthritis/meningitis
 - iv. Arthritis of Japanese Akitas
 - v. Amyloidosis Chinese Shar Pei
 - vi. Polyarteritis nodosa
 - vii. Sjogren's syndrome
 - viii. Idiopathic
 - Type I. (no associations)
 - Type II ('reactive')
 - Type III (enteropathic)
 - Type IV (neoplastic)
 - c. Miscellaneous.
 - i. Drug-induced
 - ii. Vaccination "reactions"
 - iii. Plasmacytic/lymphocytic gonitis
- 3. Crystal-induced.
 - a. Gout
 - b. Pseudogout
 - c. Hydroxyapatite

Table 2: Drugs used to treat Immune-based Polyarthritis

<u>Drug</u>	<u>Dosage and Recommendations for Use.</u>
Presnisolone (prednisone)	Immunosuppressive dose (1-2 mg/kg q.8hrs.PO) for "acute" cases. This dose continued for 2-3 weeks and then gradually reduced over 3-4 months. Anti-inflammatory dose (eg. 0.25 mg/kg q.8hrs. PO). Smallest dose which provides clinical improvement for "chronic" cases.
Cyclophosphamide	1.5 mg/kg dose >30 kg. 2.0 mg/kg dogs 15-30 kg 2.5 mg/kg dogs < 15 kg and cats. Given on 4 consecutive days each week (or similar) for up to 16 weeks. Given in combination with anti-inflammatory dose of prednisolone each day. Haematology every 7-14 days: if wbc <6000/cmm, or platelets count <125,000/cmm, reduce cyclophosphamide by 25% if wbc < 4000/cmm or platelet count < 100,000/cmm discontinue for 2 weeks, then recommence at 50% original dose.
Azathioprine	2.0 mg/kg EOD, PO. Used as an alternative to cyclophosphamide. Given with prednisolone (each drug given on different days). Not to be used for cats. Haematology every 7-14 days (see cyclophosphamide).
Sulphasalazine	25 mg/kg q 12 hrs. PO
Sodium aurothiomalate	0.5 mg/kg by intramuscular injection once a week for 6 weeks. Usually given with daily oral prednisolone (anti-inflammatory doses). Can be repeated after 2-3 months. Given small test dose first. Haematology every 7-14 days.
Auranofin	0.05-2.0 mg/kg twice daily orally (max 9 mg/day). Can be given with prednisolone. Can be given as continuous regime. Haematology every 7-14 days.
Colchicine	0.03 mg/kg orally once daily.
Levamisole	3.7 mg/kg EOD. PO. Max dose of 150 mg per day. Used for up to 4 months. Anti-inflammatory dose of prednisolone used initially.

CARE OF THE POLYTRAUMATIZED PATIENT

Crowe D

Polytrauma, by definition, is injury to more than one major system or body cavity. Mechanisms of injury involve blunt or penetrating force. A third involves crushing. The first and third are the most common in the dog and cat and unfortunately are associated with higher mortality than penetrating due to the bursting and compression forces applied to often multiple organ systems.

Keys to the successful management of the polytraumatized patient are the following:

1. Readiness on the part of the team and facility; this includes ready access to blood.
2. Early recognition, the care provided at the scene and speed of transport
3. Rapid and thorough primary and secondary surveys performed at the receiving hospital
4. Prompt and appropriate treatment of all life-threatening injuries on a priority basis.
5. Appropriate management of the patient's pain.
6. Balanced and careful anaesthesia with full monitoring as required.
7. Timely and technically correct surgical repair of all injuries
8. Adequate supportive care prior to and following surgery including early nutrition
9. Complete communication and documentation (including fees) regarding all care done
10. Retrospective examination and assessment of the patient and the care given; asking the simple question, could we have done a better job or done things differently that could have improved the outcome.

Readiness requires equipping and organizing a 'ready area' where patient assessment and resuscitation is initially performed. Often a practical ready area is where every anaesthetic inductions and surgical preps are completed. Equipment suggested includes oxygen that can be delivered via small bore tubing, resuscitation bag-valve mask (ideally with a PEEP valve that can be attached) assorted endotracheal tubes and NG feeding tubes (sterile) cutdown and tracheotomy tray, emergency drugs and crash cart, pressure or 'slam' bags for the delivery of fluids (particularly colloids) and blood, backboards, radiographic unit and automatic developer, stat lab capability and the operating room and equipment in a state of readiness and technical support required frequently in the evening or weekends via a pager or cellular telephone.

Care provided at the scene of the accident follows the same principles as that required for humans. First-aid includes rapid assessment, scene safety, airway management, rescue breathing, covering with blankets to prevent hypothermia, covering wounds, compression of bleeding sites, and stabilization on a firm object such as a board. Rapid transport should

follow. A phone call made to the veterinary hospital will help them be prepared for the animal's arrival.

The primary survey begins with reception and triage nurse rapid visual assessment. Any patient with a history of recent trauma, or those with altered levels of consciousness should be rushed back to the ready area, owners first approving and then following. Note: I believe it is a very good idea to bring the owners back to the ready area and allow them to observe the initial treatment. This educates owners as to the team work and equipment required and assures them that their pet is getting cared for very well. ABCs are assessed, capsule history obtained, vital signs assessed (RR, HR, BP and pulse quality, mucus membrane colour and refill time, rectal and toe web temperature and jugular and saphenous vein distension time and quality). If problems are detected in the primary surgery they are addressed immediately (as they are discovered). For example if an airway is found disrupted and blocked, a tracheotomy or visual intubation is performed. Rapid venous access and delivery of diazepam-succinylcholine or thiopental will enable endotracheal tube placement and beginning positive pressure ventilation. NOTE: Following intubation the airway and lung sounds bilaterally must be assessed via auscultation.

Secondary survey involves a head to toe examination. A detailed history is obtained. commonly "trauma films" are completed which involve lateral projections from head to tail while the patient is secured to a backboard. Blood is drawn for Hct, total plasma solids, glucose, profile, activate coagulation time, estimate of platelet numbers and blood gases and electrolytes. The blood is obtained as the first intravenous catheter is inserted. Further radiographs and other tests might be indicated (chest radiographs, diagnostic peritoneal lavage, abdominal ultrasound, ECG, Dynamap blood pressure and doppler flow monitoring, infrared thermometry, pulse oximetry and end tidal CO₂ monitoring).

Resuscitation is performed according to priority: The airway is first cleared, oxygen at high flows provided (often by "flow-by" technique, nasal cannula, or hood oxygen initially) Severely altered sensorium patients are either intubated following the administration of a sedative - hypnotic and possibly a neuromuscular blocking agent, or an awake tracheotomy is completed. Positive pressure ventilation with 100% oxygen is provided. Again bilateral "breath" sounds are assessed. At least one large bore short cephalic IV catheter is inserted and fluids (LRS, Plasmalyte) are begun at a moderately speedy rate. If active haemorrhage is suspected a second short cephalic is inserted and a colloid begun (plasma, hetastarch, dextran, gelatin in that order according to their half-life). NOTE: Research indicates that oxygen provided prior to fluid support decreases the level of reperfusion injury. Fluids, including colloids are delivered at a rate only sufficient to provide arterial pressure and flow to prevent critical splanchnic hypoperfusion that involve the kidneys, pancreas and gut. Providing volume support at supra

normal levels at this stage in management might increase the loss of blood. Only after assurance that haemorrhage is not continuing; frequently provided through exploration, can supra normal levels recommended to fully resuscitate the patient, be given.

Surgical repair under carefully controlled anaesthesia is often challenging in the unstable patient. However, it should be emphasized that stabilization in the polytrauma patient REQUIRES surgery and anaesthesia. As an example is the diaphragmatic hernia patient that is having severe difficulty with breathing. He cannot be stabilized until the hernia contents are replaced back into the abdominal cavity and the diaphragm repaired.

Supportive care following the surgery includes litany of items that must be addressed. The list includes: tissue delivery of oxygen (often enhanced by supplemental oxygen, blood replacement and colloid - volume infusion, antiarrhythmics and catacholes) substrate deliver for the manufacture of energy (glucose, fructose, 1.6 diphosphate) early enteral nutrition, acid base and electrolyte balance, physical therapy, respiratory care and therapy as needed, pain control, incision and wound care (bandages and dressings) competent catheter and tube care, nursing - tender loving care. Physical therapy is also a large part of the continuum of care required for this type of patient because they frequently have musculoskeletal injuries that have required repair.

Finally professional care of the polytraumatized patient concludes with careful and thorough communications and medical record documentation. This includes the thorough recording of charges based on the principle, if you don't charge for it you are giving it away; something that can not be done in either academic or private practice as these cases in particular, are notorious for involving some of the most expensive veterinary care required.

Protocols are helpful to provide the entire team of professional work together with act as a guide for treatment to ensure no areas of care are left unattended: An example is provided below:

Blunt Trauma: Patient Presented with Difficult Breathing that is Progressive - Triage Class 1

Priority: Highest Patient (pt) Priority. Ask owner for permission to start oxygen and IV line.

First action: High Flow Oxygen - 15 LPM jet towards face. If open mouth try to jet down mouth (if brought in a box or container - leave there until flood with oxygen using clear plastic bag over the container and gradually toward filling container and bringing pt out with plastic bag over the pt. Continue high flow into the plastic bag where pt is; pull leg out for iv start

Section action: Start IV short cephalic or saphenous catheter, as large a bore as comfortable with

Third action: Assess breath sounds and heart tones ilaterally, examine for SQ emphysema.

IF rapid and much effort breathing and poor or distant lung sounds consider tension pneumothorax and tap chest if very severe struggling STOP, giving succinylcholine 1 mg/kg or thiopental 3-5 mg/kg (third choice that usually works is diazepam 0.2-0.3 mg/kg IVP (push) and then start mask ventilation with AMBU Bag at 100% O₂ ... when relaxed enough INTUBATE and take control of ventilation at 20 BPM... then tap chest or if severe resistance to bagging or pulses are very weak just "crack chest"... No prep. incision into the skin, lateral chest wall 4th-6th ICCS midthorax. Mayo scissors puncture guarding tips, open blades, with sliding action open ICS several inches. IF YOU DON'T THEY WILL DIE IN SECONDS.

Those that respond to high flow oxygen with significant decreases in respiratory effort still need to have chest taped after nasal -pharyngeal oxygen or bilateral nasal cannulas are inserted.

DO NOT TAKE RADIOGRAPHS OF A TRAUMA PATIENT WITH A CLEAR AIRWAY BUT DIFFICULT BREATHING UNTIL HIGH FLOW OXYGEN HAS BEEN PROVIDED FOR SEVERAL MINUTES AND THE CHEST HAS BEEN TAPPED (BY OPEN THORACENTESIS METHOD) BILATERALLY.

TAP CHEST BY OPEN NEEDLE CATHETER METHOD ONLY NOT WITH CLOSED SYSTEM OR BUTTERFLY CATHETER. 1. Fast clip/prep. 2. 18g needle or cath. 3. Insert mid 6th-7th ICS through skin only. 4. Add sterile saline to hub of needle or catheter. 5. Advance the needle catheter into chest slowly until see drop at hub getting aspirated into the pleural space or air flies out - indicating a tension pneumothorax. Attach an extension set, 3-way stopcock and large syringe. Aspirate gently on the syringe and note if air or fluid is aspirated. If so continue until no further material can be aspirated. Consider Chest Tube if any blood or >10 mg/kg air or fluid is aspirated.

CRITICAL CARE MANAGEMENT FOR THE SEVERELY ILL OR INJURED PATIENT

Crowe D

Critical care medicine in humans has made a dramatic difference in the recovery of severely ill or injured patients. This is particularly true in those disease or injury conditions that are acute and in which there is physiological reserve or the potential to recover in the multiple organs involved. As an example: only 25% of the multiple injured human patients recovered in 1965; now over thirty years later over 90% recover and are discharged. Critical care in veterinary medicine, although not as sophisticated is providing similar results. Because pets are considered members of 'the family' by an increasing number of owners, and society in general, is acknowledging the value of companion animals in the provision of human health it appears that veterinary critical care is here to stay. Veterinary critical care has evolved and is now a recognized speciality in the United States by the American Veterinary Medical Association. There are over 70 diplomates practising in both academic and private practice and over 50 veterinarians in residency or alternative residency training programs. It has been stated by many veterinary leaders in both academic and private practice that one of the most rapidly expanding and dynamic specialties in the US is in emergency and critical care. Recently, one professional said " if you provide quality critical care 24 hours a day 365 days a year you probably can now really call the hospital you work out of a hospital. Otherwise they are really only still just clinics".

Currently veterinarians and technicians (nurses) in the critical care and emergency field are commanding some of the highest paid positions in practice. The reason is driven by:

1. This requires some of the most intense work and it can be stressful.
2. Skill level required for both veterinarians and veterinary nurses is high
3. Hours or shifts may require night and weekends;
- 4 The law of supply and demand (few well trained currently to fill all positions available.)

The business and professional leaders in veterinary medicine are or have seen a significant increase in the multiple person private or corporate practice gross income whenever a critical care veterinarian has joined them. However, this is NOT the driving force behind the major demand to provide veterinary critical care in US. It is multifactorial: better care for all patients in the practice is a major result of providing critical care to the most sick and injured; everyone connected with the hospital becomes proud of what can be accomplished; it also sets a certain tone for the practice and lets everyone who is an animal owner who brings a pet to the practice that if such care is required it can be delivered and last but not least, critical care forces the hospital to truly be a hospital - to provide 24 hour around the clock care! Now even the animals simply recovering from uncomplicated surgery have someone who is watching

them. If they show any signs of pain they will get analgesics, anytime and all the time, day or night and their owners appreciate this type of care very much.

With that introduction, what actually constitutes critical care in veterinary medicine will now be summarized. A few case examples will be highlighted to provide illustrations in the seminar. For a Critical Care Unit (CCU) to work and be successful it must be in a practices that has certain key characteristics in my opinion. These are as follows: They must have:

1. A multiple number of veterinarians in the practice. The lowest number of doctors is 3-4.
2. The commitment to provide the highest quality of care in the entire field
3. The 'necessary tools of the trade' (from lab to x-ray to Surgery to the CCU itself).
4. A type and sufficient number of clientele that want and can afford this "intensive" care.
5. The staff that are very well trained and be continuing to provide education to them.
6. Specialty veterinarians or at least veterinarians that provide a form of "specialty care".
7. The willingness to provide care that initially will not be financially lucrative.
8. The willingness to work well with all the surrounding veterinarians and always talking
9. The compassion and fortitude to deal with many very ill animals and their owners
10. A good computerized practice management system for inventory, fee entry recording of patient data, recording all opioids and other controlled drugs used etc.

Keys to successful management of each critical animal can also be listed. These include the following below: The veterinarian and CCU staff must:

1. Know the pathophysiology of the disease processes involved with the seriously or critically ill or injured patient.
2. Anticipate the unexpected as well as the expected and address each problem as they are first noted EARLY in the course of the disease.
3. Monitor all patients seen and prove that they do NOT have this or that complication that is common with this or that disease. Use a check off list once or twice daily (below).
4. Be always in a constant state of readiness or preparedness, just as in emergency care.
5. Provide thorough primary and secondary surveys at least once or twice daily.
6. Provide the most appropriate and up-to-date treatment of all life-threatening problems
7. Provide appropriate management of the patient's pain and anxiety.
8. Provide supportive care including early nutrition, physical therapy, respiratory care.
9. Complete communication and documentation (including fees) regarding all care done.
10. Retrospective examination and assessment of the patient and the care given; asking the simple question; could we have done a better job or done things differently that could have improved outcome. Strive to continue to improve patient care and the compassionate response to the owners that also need care in these difficult times.

The following 24 CONCERNS is constructed and is encouraged to be used daily when assessing each critical care patient. This is required so as to NOT forget any body system or key management area involved with each patient. The list was constructed from many sources to which I give the individuals who provide this information all the credit. First and foremost is Rebecca Kirby, DVM at the Animal Emergency Center, Milwaukee, Wisconsin for her "Rule of 20", second is the late Bill Knerr, DVM, MD Riverside Methodist Hospital, Columbus Ohio and third is Carl Soderstrom MD Shock Trauma Center, Baltimore, Maryland.

CCU list of Concerns.

1. Airways, Lungs, Ventilation (Work of Breathing, Dead Space, SpO₂, ETCO₂, pCO₂).
2. Cardiac Contractility, Relaxation and Rhythm (Upstroke of Art P Wave, ECG, CO)
3. Vascular Volume, Flow, Pressure (Arterial and Central Venous) and Tone
4. Oxygen Delivery including IIB and PaO₂.
5. Substrate Delivery and Utilization (glucose)
6. Fluid Balance (water, albumin, colloid osmotic pressure)
7. Electrolyte Balance (Na, K, Cl, Ca, Mg PO₄)
8. Acid-Base Balance (pH, HCO₃, BE)
9. Renal Function - Urine Output - USG, Sediment
10. Energy - Protein Balance (enteral and parenteral nutrition)
11. Mentation - Level of Consciousness - Cranial and Peripheral Nerve, ICP's
12. Pain and Anxiety Control
13. Gastrointestinal Function, Motility and Integrity
14. Skin, Muscle and Joint Care.
15. Eyes, Ears, Nose, Mouth and Teeth Care.
16. Immune Function (WBCs, small proteins, large proteins).
17. Coagulation (Platelets, BT, ACT, FEPs, Coag. Panels)
18. Drugs (Dosages, Metabolism, Compatibility and Route).
19. Catheter and Tube Sites
20. Surgical Incisions and Bandages/Splints
21. General Nursing Care (Physical Therapy, Mobility, Dangers)
22. Assurances and Communication (Patient and Owner)
23. Charting Complete
24. Charges Entered.

These 24 areas are examined at least at every shift by the veterinarian and the CCU nurse. By using it as a check off list ALL areas of patient care will be accounted for as being addressed. The list is made up and posted in the CCU flow sheet. Each veterinarian and CCU nurse signs off or checks each area when these are completed.

CURRENT CONCEPTS IN SPINAL CORD REPAIR

Jeffery N & Olby N

Spinal cord injury causes reversible and irreversible loss of function in both white and grey matter. In small animal patients, clinical signs predominantly result from dysfunction in white matter tracts, mainly because most injuries occur in the thoracolumbar segment (T3-L3). The clinical signs vary from ataxia to paraparesis to complete loss of all sensory and voluntary motor function below the level of the injury, reflecting the degree of isolation of the distal portion of the cord. Attempts to restore useful function to the animal can be directed towards limiting progression of the secondary metabolic consequences of trauma that eventually result in cell death or promotion of spontaneous recovery processes.

i) neuroprotection.

This strategy relies on administration of drugs designed to interfere with the secondary injury cascade that occurs in the spinal cord after contusion. At present only methylprednisolone sodium succinate has proven effective following trauma and is available for veterinary use. Recently, protection of white matter has received increased attention. Many drugs (eg tirilazad mesylate and TRH) are underling experimental or human clinical trials at present.

ii) salvage.

Neurons that suffer damage to their axons within the spinal cord as a result of trauma will often die - and therefore cannot take part in recovery mechanisms. Recently it has been shown that certain drugs (eg. exogenous growth factors) can prevent death of these neurons.

iii) surgery.

The role of surgery in trauma is limited to elimination of spinal cord compression, thereby aiding restoration of blood flow. Two instances where this may be appropriate include removal of compressive material following disc extrusion and stabilisation of the vertebral column following fracture/luxation. Whether surgical interventions, such as piotomy and myelotomy are useful in animals in which there is only cord swelling (and no extramedullary compression) is not known. Experimental evidence would suggest that durotomy alone is not beneficial.

iv) transplantation.

Two basic types of graft are available - cell suspensions and blocks of tissue (usually foetally derived). Transplantation could aid recovery by four mechanisms: a) provision of a "bridge" to permit axon regeneration; b) neurons within a graft could form a "relay" allowing impulses to be conducted from one side of the lesion to the other; c) provision of a source of growth factors to promote cell survival; d) neuron replacement (eg motoneurons).

Clearly the ability to regenerate axons across the lesion would be the most beneficial therapy in cases of white matter injury assuming that newly regenerated axons are able to make appropriate connections when they arrive at their target sites. Spontaneous regeneration of almost all tracts in the adult CNS is abortive and achieving long range regeneration remains the "holy grail" of spinal cord injury research. Recently there has been encouraging work suggesting that (at least some) tracts in the spinal cord can sometimes be coaxed to regenerate. Usually this has been done by providing growth factors to enhance the innate growth capabilities of the injured axons, but other strategies designed to alter the glial and extracellular substance in the spinal cord have also proven useful.

PERIPHERAL NEUROPATHIES

Moreau P M

Peripheral neuropathies are commonly observed in veterinary clinical practice. These disorders of peripheral nerves and muscles are frequently associated with trauma involving peripheral nerves and/or their roots, and sometimes cranial nerves. The characteristics of these conditions are reduced or absence of reflexes (hypo or areflexia), reduced or absence of muscle tone (hypo or atonia or flaccidity), weakness (paresis) or paralysis of limb or head muscles. After 1-2 weeks, neurogenic muscle atrophy may occur. This syndrome is related to motor nerve dysfunction and so has been called *lower motor neuron disease*. Chronic neurogenic atrophy may result in severe fibrosis and limited joint movement from contractures as seen in polyradiculoneuritis for example. Variable degrees of loss of pain (hypoalgesia) or sensation (hypoesthesia) may be present upon cutaneous (dermatomes) testing, since most nerves contain both motor and sensory components. Tremors and muscle fasciculations are sometimes observed in animals with neuropathic disease (post denervation fasciculation). Animals suffering from sensory neuropathies, the signs may include a complete loss of pain (analgesia) or sensation (anaesthesia) and proprioception. In such cases abnormal sensitivity about the face or about the trunk (paraesthesia), as well as self-mutilation, may occur without muscle atrophy. Peripheral neuropathies commonly involve a single nerve (mononeuropathy) such as seen most often with the peroneal, the radial or the facial nerves. Polyneuropathies involve several nerves and are usually symmetrical and bilateral such as in polyradiculoneuritis (Guillain-Barre syndrome). Some less common degenerative polyneuropathies may have a proximal limb muscle distribution such as hereditary spinal muscle atrophy in Brittany spaniels, or a distal limb muscle distribution such as giant axonal neuropathy in German shepherds or distal polyneuropathy in adult Rottweilers.

Some neuropathies are usually expressed first in the pelvic limbs (generalized polyneuropathies). Some may occur acutely such as traumatic or ischaemic neuropathies, or some other subacutely such as polyradiculoneuritis. Most neuropathies, however have an insidious and chronic clinical onset.

Although signs of autonomic nerve dysfunction (anisocoria, bradycardia, decreased tear secretion) are rarely observed in animals with polyneuropathies, these signs are commonly observed in dogs or cats with dysautonomia. Cranial nerve dysfunction is also uncommon, with the exception of facial paralysis (CN VII). This cranial nerve involvement could be associated with polyradiculoneuritis, or hypothyroid neuropathy. Vagus nerve neuropathy (CN X) may result in dysphagia and megaesophagus in giant axonal neuropathy of German shepherd dogs and in laryngeal paralysis and megaesophagus of young dogs (Dalmations) or in older large breeds with laryngeal paralysis-polyneuropathy complex.

Certain disorders of the neuromuscular junction, namely botulism and myasthenia produce signs similar to those observed in a diffuse polyneuropathy. Metabolic neuropathies, such as diabetic neuropathy are now regularly recognised. Paraneoplastic neuropathies have also been described in dogs and cats.

Finally nerve sheath tumours are a relatively common cause of brachial plexus neuropathy.

RADIOGRAPHIC DIAGNOSIS OF WOBBLERS (cervical spondylopathy, caudal cervical spondylomyelopathy, cervical vertebral malformation-malarticulation).

Fluckiger M

Occurs mainly in (young) Great Danes and (older) Dobermann Pinschers.

Basics: Vertebral malformation, vertebral instability and later disc herniation all result in spinal cord compression with corresponding clinical symptoms.

Plain Films.

Note: not all findings may be present in each dog.

Malformed rhomboid vertebral body with loss of its cranioventral edge resulting in dorsal subluxation and tilting.

Narrowing or shortening of the height of the cranial spinal canal opening resulting in cord compression.

Abnormal size, shape or position (malformation) of the articular processes.

Vertebral malformation and a malarticulation result in vertebral instability which again leads to hypertrophy of the Lig. longitudinale dorsale, Lig. flavum and joint capsule.

Osseous and ligamentous proliferations may compress the spinal cord.

Great Danes: narrowing (occurring in all directions) and flattening (mainly dorsoventral) of the cranial vertebral foramina of C4 to C6.

Dobermanns: Subluxation predominantly at C5 to C7 with C6 being usually most severely affected.

Narrowing and wedge-shaping of disc space cranial to the vertebral body malformation.

Occasionally calcification of affected disc.

In older Dobermanns type II disc degeneration and protrusion.

Osteophyte formation such as spondylosis deformans and spur formation at the articular facets.

End plate sclerosis.

Myelography.

Mandatory for the assessment of site, extension and severity of the cord compression.

Always take lateral and dorsoventral (not ventrodorsal!!) projections

Use lateral extension/flexion and traction myelography to separate static from dynamic compression.

Caution: Manipulation of the cervical vertebrae under general anaesthesia may aggravate the clinical signs. Extending the head and neck may mask minor dynamic compression sites.

VENTRAL DECOMPRESSION IN CERVICAL SPONDYLOMYELOPATHY

Olby N

Cervical spondylomyelopathy is a multifactorial problem, the treatment of which depends on the factors causing spinal cord compression. Possible factors include disc herniation, vertebral instability, ligamentous hypertrophy, vertebral canal stenosis, joint capsule proliferation and osteophyte production. These factors are often related; for example, vertebral instability is frequently associated with disc herniation and ligamentous hypertrophy. Assessment of each case includes CSF analysis, plain spinal radiographs and myelography with traction views. It has been shown that the degree of spinal cord atrophy is correlated with the prognosis for recovery in man and it has been suggested that this is also true in the dog. If a CT scanner is available a CT scan of the affected area may therefore provide extra information as the cross sectional area of the spinal cord can be assessed and the lateralization of the compression is usually clearly delineated. It is also useful to verify that aspirin has not been given within a week of surgery and to check a mucosal bleeding time especially if the patient is a Doberman Pinscher.

Ventral slots are most frequently used to treat static ventral lesions (ventral compressive lesions that are not altered by traction) and less commonly to treat dynamic lesions. The surgical approach is the same as for performing a ventral slot to treat disc disease; however the lesion is frequently in the caudal cervical region. This must be taken into consideration when positioning the dog as the neck must be adequately extended to allow access to the caudal cervical vertebrae. When the spinal canal is reached it is unusual to find a mass of herniated nucleosus pulposus that is easily removed from the canal. Instead, the surgeon has to cut out the fibrous tissue that is compressing the spinal cord until the cord can be clearly visualized. If desired, the two vertebrae can then be fused by filling the defect with cancellous bone harvested from the humerus. Fusion is usually only performed in animals with a single lesion. If there are two adjacent lesions, fusion of one may precipitate the domino effect. Success of this procedure is dependent on appropriate case selection and adequate decompression of the spinal cord. Post operative care, including suitable facilities for managing a tetraparetic patient and appropriate physiotherapy play an important role in the recovery of the animal.

DISTRACTION/FUSION TECHNIQUES IN CERVICAL SPONDYLOMYELOPATHY

Jeffery N

The most commonly encountered form of CCSM is that associated with protrusion of the intervertebral disc between C6 and C7. Myelographic and dynamic myelographic studies frequently demonstrate that cord compression caused by the dorsally directed disc protrusion varies in different neck positions. Compression of the spinal cord worsens with extension (dorsiflexion) of the neck and is alleviated by flexion. The observation that alleviation of cord compression also occurs if linear traction is applied to the cervical spine has led to the development of surgical techniques to mimic this effect permanently.

i) pins (or screws) and methylmethacrylate

In this technique, a partial slot is made in the affected vertebrae to expose cancellous bone and remove the nucleus and ventral annulus of the disc. Screws or pins are then embedded in the vertebral bodies by drilling obliquely from ventral to dorsal across the vertebral bodies of C6 and C7 vertebrae, taking care to avoid the spinal cord, nerve roots and vertebral artery. Traction is then applied to the neck to stretch the affected disc space by an appropriate amount and cancellous bone graft is packed into the partial slot. Liquid polymethylmethacrylate is then moulded around the tips of the pins or screws and left to harden while the neck is in the traction position.

ii) screw and washer (also reported using cortical bone graft).

In this technique a "spacer" is placed between the vertebral bodies of C6 and C7 to stretch the space to a sufficient extent to eliminate spinal cord compression. A large screw (4.5 mm) is placed across the intervertebral disc space directly caudally from C6 into C7 taking care that the screw does not penetrate the vertebral canal. The washer is lodged into the intervertebral disc space while the screw is tightened into position.

Both these techniques have significant rates of failure. Firstly, decompression may not be achieved if the degree of traction applied across the space is insufficient. Secondly, the use of implants is associated with a risk of their failure. For instance, the washer can sink into the end plates of the vertebral bodies or the screws or pins can loosen. Use of PMMA must be accompanied by stringent aseptic precautions since it predisposes to infection.

THE SHOULDER

Bardet J

ATLANTO-AXIAL INSTABILITY

Cabassu J P

The cervical part of the vertebral column can be divided into two sections:

- a cranial section behind the occipital condyles: the atlas articulates on the occipital condyles and permits dorso-ventral movements (yes). The atlanto-axial articulation permits rotation of the head (no). Rotation is centred around the odontoid process. This toothlike projection is attached to the floor of the atlas by a transverse ligament which prevents its protrusion into the medullary canal. Other ligaments attach it to the foramen magnum and to the occipital condyles. On the dorsal surface a large ligament links the arch of the atlas to the spinous process of the axis.

- a caudal portion from C3 to C7 which supports the head. This configuration concentrates the forces at the level of the axis. Excess stress may lead to traumatic lesions of the dorsal compartment, ventral compartment or both. It is the ligaments that give way in the instability of toy breeds.

Several types of congenital or developmental malformations predispose such dogs to these lesions to such an extent that slight trauma may endanger the support mechanisms of the atlantoaxial articulation; the odontoid process may be absent, too small or angular, even unattached to the vertebra. The apical, alar and transverse ligaments may be absent or atrophied. The clinical signs are variable; examination of published cases reveals the presence of pain in 61%, signs of alteration of locomotory function, ranging from paresis to tetraplegia, in 84%. The instability is not in itself responsible for the clinical signs but leads to medullary trauma.

Diagnosis is based on lateral radiographs which exhibit abnormal separation of the dorsal arch of the atlas and the spinous process of the axis. The neck has to be placed in flexion. This must be done with care, with or without anaesthetic, so as not to induce respiratory arrest by medullary compression, but the flexion must be sufficient to exceed the degree of flexion induced by the atlanto-occipital joint alone. The medical treatment consists of corticoids, wearing a brace for six weeks and rest. The results are not known. A high percentage of relapses can however be expected.

One classic treatment is surgical management by dorsal approach. A wire is placed via a sagittal plane approach, between the atlas and the axis, to take the place of the dorsal ligament. The anterior attachment is ensured by passing the wire under the arch of the atlas,

and the posterior attachment by its passage through the spinous process of the axis. The wire may be metallic, synthetic or replaced by a piece of nuchal ligament.

Surgical treatment by a ventral approach consists of arthrodesis of the atlas and axis. Bone fusion is obtained after resection of the articular cartilage, grafting with cancellous bone taken from the humeral head and fixing with pins, screws or pins and cement. Fixing with pins is easier to perform but pin migration may often occur.

CERVICAL FRACTURES

Forterre F

THORACOLUMBAR FRACTURES

Cabassu J P

The aim in the treatment of fractures, dislocations and fracture-dislocations of the vertebral column is their reduction and stabilisation.

The selection of patients for treatment is initially based on neurological criteria. The conservation of deep pain is crucial to potential recovery. The animal owner's determination is highly important, as the treatments are often long and expensive.

There is no recognized rule of choice between conservative and surgical management of thoracolumbar fractures and dislocations. Conservative treatment (rarely applied after attempted reduction) combines rest and hygiene. Splints are of no apparent interest and are more likely to irritate the animal.

Different surgical techniques have been proposed but always in limited series. The overall published results indicate that surgery produces more rapid results and better recovery but is associated with a higher percentage of complications.

Experimental studies have been performed on the resistance of different osteosynthesis assemblies on the vertebral column to ventrodorsal flexion, lateral flexion and torsion. These help to improve our understanding of the stability of such systems in practice and their ability to resist the imposed constraints.

Proposed surgical treatments.

Principles:

- Different parts of the vertebral column and different fractures require different treatments.
- Only a single vertebral unit should be treated to limit stress on the implants and to obtain optimal functional results.
- Association of implants in different planes offers the best mechanical qualities.
- In the dog and cat, only the vertebral bodies provide suitable support for implants.
-

Thoracic region

- Weak mobility. Large spinous processes
- Approach is ventral, intercostal

- Fixation by combination of implants: Kirchner pin and VCP plate.

Thoracolumbar junction

- Zone of maximal mobility. Considerable bending forces.
- Approach is ventral with resection of a rib in most cases (11th or 12th).
- Fixation by a combination of implants: Kirchner pin and VCP plate.

Caudal lumbar region

- Mobility considerably reduced
- Approach inferior retroperitoneal is more complex.
- The use of plates by dorsal approach produces an undesirable rhizotomy.
- Good results by dorsal fixation with pins and cement.

SEVENTH LUMBAR VERTEBRAL FRACTURES

Johnson K A

Seventh lumbar vertebral fractures often result from severe trauma and have a characteristic oblique fracture pattern, extending from the lumbosacral intervertebral foramen cranioventrally through the body of the vertebra. Cranioventral displacement of the caudal segment is considered to be a result of muscular forces acting on the sacrum and pelvis.

These fractures of the seventh lumbar vertebra may involve the cauda equina, and produce neural deficits as well as painful instability. There may be injury to the sixth and seventh lumbar nerves and the sacral and caudal roots that pass through the displaced vertebral canal. Traction or avulsion injury to nerve roots may result in atony of the anus, urinary bladder and rectum, as well as sciatic nerve and tail paralysis. Fractures and luxations of the seventh lumbar vertebra present a challenge for surgical stabilisation because of the potential for iatrogenic damage to the lumbosacral nerve plexus and the complex anatomy of the sacrum and adjacent ilial wings. Techniques that have been described to stabilise these fractures include a single transilial pin, two transilial pins with dorsal spinous process plating, modified segmental fixation, combined Kirschner-Ehmer device and dorsal spinal plate fixation and two transilial pins with two double fixator clamps. This lecture describes a technique for using methylmethacrylate and bone screws to repair fracture luxations of the seventh lumbar vertebra.

Dogs are positioned in ventral recumbency for surgery and a dorsal midline approach is made to expose the fifth, sixth and seventh lumbar and sacral spinous processes. Using periosteal elevators, all muscular attachments are elevated from both sides of the pedicles and retracted laterally to the level of the articular processes. The fracture-luxation is reduced by elevating the sacrum in relation to the lumbar spine using a large curved haemostat as a lever while traction is applied to the head and tail. Fully threaded bone screws are inserted bilaterally to the ilial wing and lumbar vertebral bodies. Screw lengths are chosen so that about 2 cm of screw head and threads protrude above the bone surface while the opposite cortex of the bone is just penetrated. Forty to eight grams of methylmethacrylate is applied in a cylinder to incorporate screws on either side of the dorsal spinous processes. During polymerisation, saline lavage protects tissues from the heat of the exothermic reaction. Muscular, subcutaneous and skin layers are closed in a routine fashion.

Bone screws instead of pins are used because they are more resistant to pullout and are less likely to migrate. Bone screws do not need to be cut therefore loosening and rocking does not

occur as it does when pins are cut. Also, bone screws do not need to be notched because the screw head and threads provide good purchase for the methylmethacrylate.

Since small increases in core diameter dramatically increase the tensile and bending strength of screws cortical screws of relatively large diameter should be used where possible. Previously it has been suggested that 20 g of methylmethacrylate be used for dogs less than 15 kg and 40 - 60 g for large dogs (Blass and Seim 1984). However the diameter of the methylmethacrylate columns is more critical than the absolute quantity used. A 3/4 inch diameter methylmethacrylate cylinder was stronger in bending than a 3/16 inch diameter medium size connecting bar. Since the methylmethacrylate implants can be large, difficulty in closing the surgical incision may be encountered.

References:

Beaver, D.P., MacPherson, G.C., Muir, P. and Johnson, K.A. (1996) Methylmethacrylate and bone screw repair of seventh lumbar vertebral fracture-luxations in dogs. *Journal of Small Animal Practice* 37, 381-386.

Blass, C.E. and Seim, H.B. (1984) Spinal fixation in dogs using Steinmann pins and methylmethacrylate. *Veterinary Surgery* 13, 203-210.

Garcia, J.N.P., Milthorpe, B.K. Russell, D. and Johnson, K.A. (1994) Biomechanical study of canine spinal fracture fixation using pins or bone screws with polymethylmethacrylate. *Veterinary Surgery* 23, 322-329.

Wheeler, S.J. and Sharp, N.J.H. (1994) *Small Animal Spinal Disorders, Diagnosis and Surgery*. Mosby-Wolfe, London pp. 123-134 and 171-191.

IMAGING THE LUMBOSACRAL REGION

Meij B

Anatomy: Caudal to the lumbosacral enlargement (at vertebrae L4 and L5) the spinal cord tapers to an elongate cone (conus medullaris) at vertebra L6. The spinal cord segments appear successively smaller and are surrounded by caudally directed spinal roots. The spinal cord eventually terminates as the ilum terminale but the dural sac and subarachnoid space extends about 2 cm beyond the end of the spinal cord. Within the vertebral canal of L6, L7 and the sacrum the caudal lumbar (Nn.L6 and L7) sacral (Nn.S1-3) and caudal (Nn.Cd 1-5) spinal roots stream caudally toward the intervertebral foramina, where the roots exit. Collectively these roots are known as the cauda equina.

The dural sac and cauda equina within the epidural space are surrounded by epidural fat. The vertebral canal is dorsoventrally flattened at the level of the lumbosacral junction. Lateral depressions of the vertebral canal, referred to as nerve root canals (lateral recesses), form a passageway for the nerve roots from their dural exit points to the intervertebral foramina. At the lumbosacral region the spinal roots are bounded 1) dorsally by the lamina, the interarcuate ligament and the articular facets, 2) laterally by the pedicles and the intervertebral foramen and 3) ventrally by the vertebral body, the dorsal annulus fibrosus of the intervertebral disc(L6-L7 and L7-S1) the dorsal longitudinal ligament, and the paired venous sinuses. Pathological conditions of the ligaments, bony structures and the intervertebral disc may narrow the diameter of the spinal canal and the intervertebral foramina which affects the spinal roots enclosed with the remnant epidural space. This may lead to a clinical neurological and/or orthopaedic dysfunction known as the cauda equina syndrome. The L7-S1 disc is the largest disc and may undergo a fibrinoid degeneration (Hansen type II disc degeneration) which usually occurs in large breeds.

Survey Radiography: Lateral and ventrodorsal radiographs are the initial steps in evaluation of lumbosacral disease. Survey radiography is only diagnostic in conditions that involve bony destruction or displacement including discospondylitis, osseous neoplasia, traumatic fracture and subluxation, sacral endplate osteochondrosis and idiopathic lumbosacral stenosis. Indirect evidence of degenerative lumbosacral stenosis (eg. spondylosis deformans, disc space narrowing, vacuum phenomenon indicating disc rupture, end plate sclerosis and transitional vertebrae) is frequently present on survey radiographs. These findings suggest but do not confirm the diagnosis. Spondylosis may be a benign radiographic change and is often present in asymptomatic dogs. However, (non-bridging) lumbosacral spondylosis in the presence of the cauda equina syndrome is considered to be highly suggestive of degenerative

lumbosacral stenosis. When survey radiographs are suggestive for lumbosacral instability this can be confirmed by stressed views including flexion and extension views.

Contrast radiography: Because clinical signs of lumbosacral disease are usually the result of soft tissue compression of the cauda equina, contrast radiography has become the primary means of definitive diagnosis in dogs.

1. Epidurography is the preferred means of lumbosacral evaluation. The technique combines technical ease and superior sensitivity compared with the other techniques. Epidurography involves the injection of contrast medium into the epidural space and is performed in patients under general anaesthesia and usually does not require fluoroscopy. After surgical preparation of the injection site, a spinal needle is inserted into the dorsal space at vertebra S3-Cd1 or Cd1-Cd2. The bevel of the needle is directed cranially and advanced to the floor of the spinal canal. Cerebrospinal fluid cannot be retrieved because the needle is in the epidural space rather than the subarachnoid space. Approximately 0.2 - 0.3 ml/kg BW of contrast medium (eg iopamidol, Iopamiro) is injected. Lateral radiographs after injection should include neutral, flexed and extended (dorsiflexed) positions. Extension often enhances ventral and dorsal compressive lesions. Dorsoventral views should also be taken but are diagnostic in fewer patients. There is strong correlation between epidurography and surgical findings. Epidurographic findings include elevation of the epidural space, total obstruction to cranial flow of contrast medium, concomitant filling of the epidural space and vertebral venous sinuses as well as extravasation of contrast material into adjacent soft tissue adjacent to the injection site. The contrast material may leak to the paravertebral region through the intervertebral foramina.

2. Discography involves the injection of contrast medium into the intervertebral disc. The needle is directed dorsoventrally through the interarcuate space between L7 and S1 and advanced to the floor of the spinal canal and continued through the dorsal longitudinal ligament and dorsal annulus fibrosus to the nucleus pulposus. Normally it is impossible or difficult to inject a small amount of contrast medium into the nucleus pulposus. When contrast medium can easily be injected in the disc and lateral and ventrodorsal views show extensive spreading of contrast medium within the disc this is indirect evidence for a Hansen type II disc degeneration.

3. Myelography involves the injection of contrast medium into the subarachnoid space. For evaluation of the lumbosacral junction it is best injected between L4 and L5. Myelography has been criticized as a method of lumbosacral junction evaluation because the subarachnoid space is tapered or ends cranial to the lumbosacral junction in dogs. Stressed views (flexion and extension) improve the diagnostic sensitivity of myelography.

High Technology Imaging: Computed tomography and magnetic resonance imaging have revolutionized the definitive diagnosis of lumbosacral disease in humans. The high technology techniques allow actual visualization of the compressive soft and bony tissue as well as nervous tissue parenchyma. As these techniques are usually not within the scope of the practitioners and experiences are restricted to (academic) specialized institutions, their primary use should be to serve as a gold standard for the contrast techniques which are still the mainstay of lumbosacral disease in veterinary medicine.

1. Computed tomography (CT). Computed tomography of the lumbosacral region is a direct imaging technique and allows assessment of the cauda equina and related bony or soft tissue structure. CT of the lumbosacral region is usually performed with the dog in sternal recumbency. Sequential transverse images of 2mm thickness (or 1 mm overlapping) are made from L6-L7 and/or L7 to S1. Specific CT findings suggestive of degenerative lumbosacral stenosis are obliteration of the spinal canal by disc protrusion (*central or unilaterally left or right), dorsal displacement of the dorsal sac and spinal nerve roots, swelling of the spinal nerve roots and hypodense spots in the intervertebral disc indicating disc rupture. In addition, CT allows for assessment of the articular facets, pedicles and the intervertebral foramina. CT is especially useful in patients with cauda equina syndrome in which radiographic findings are negative and in patients that demonstrate a profound unilateral lameness due to spinal nerve root compression ("nerve root signature").

2. Magnetic Resonance Imaging (MRI). Magnetic resonance imaging of the lumbosacral region and the cauda equina will be described elsewhere.

MRI OF THE CAUDA EQUINA

Davies J

Plain film radiography and a variety of radiographic contrast techniques have been used previously for the investigation of possible cauda equina compressive lesions. Stressed views have also been suggested. Myelography via a cisternal puncture is only of use if the thecal sac traverses the lumbosacral (LS) joint and in at least 15% of cases this is not the case. Epidurography, discography and intraosseous venography are probably even more unreliable techniques. Results are therefore confusing and both false positive and false negative conclusions can be reached. Computed tomography (CT) and magnetic resonance imaging (MRI) are the procedures of choice for imaging the human lumbar spine and are clearly applicable to canine patients.

The LS region of 90 dogs has been imaged using a 0.5T ultra lightweight actively shielded superconducting magnet (Philips Gyroscan T5-11). The images were collected using a Quadrature T/L-spinal coil and were viewed for possible intervertebral disc degeneration, loss of epidural fat, intervertebral disc herniation into the vertebral canal or foramen and nerve root impingement.

The overriding conclusion was that the predominant feature of the degenerative cases was disc-associated disease. It was also noted that a number of smaller breeds had lesions normally expected in larger breeds such as the German Shepherd Dog. The technique demonstrates this fact clearly, suggesting a sequence of disc degeneration and dehydration followed by nuclear fragmentation and then discs protrusion (Hansen type II). The technique is also sensitive for defining other disease processes such as neoplasia that might confound the diagnosis.

TREATMENT OF CAUDA EQUINA SYNDROME

Jeffery N

Cauda equina syndrome commonly results from compression within the vertebral canal, especially at the lumbosacral junction (L7/S1). There are several causes for compression at this site, including congenital malformation (stenosis), hypertrophy of the flaval ligament and osteochondrosis dissecans (in the GSD) - but by far the commonest cause is dorsal protrusion of the intervertebral disc at L7/S1.

As in cervical spondylomyelopathy there are two ways of accomplishing decompression, either by excision of the compressive material or by applying linear traction or flexion to the affected area.

i) **dorsal laminectomy/discectomy.** The dorsal approach allows inspection of the flaval ligament, which is excised during the approach to the cauda equina. After laminectomy the dorsal aspect of the L7 disc can be examined by retracting the nerves. Cauda equina is peripheral nerve and so can be handled in a similar manner to other peripheral nerves - it is more resilient than spinal cord. Positioning of the animal during surgery is important, since if the lumbosacral region is flexed the degree of disc protrusion may be less than that occurring during life. The cauda equina is moved first to one side and then the other while the dorsal annulus of the disc is incised and then removed using rongeurs. In cases in which compression of the L7 nerve root is suspected the root can be followed to its exit point through the intervertebral foramen. Nerve root entrapment within the foramen can be reduced by foraminotomy or removal of the articular facets. Bilateral removal of facets should not be attempted since it may lead to instability and subluxation.

ii) **dorsal cross pinning and fusion.** By fixing the lumbosacral joint in flexion this technique aims to reduce the compression of the cauda equina and the nerve roots exiting through the intervertebral foramina. Pins are driven from a dorsal approach through the base of the spinous process of L7, across the synovial joints into the wings of the ilia. Crushed bone taken from the ilia is then placed onto the operated region after partial removal of the lamina of L7 and S1 vertebral segments.

Success rate in the literature for both these techniques is high for animals in which there is only pain. In cases of incontinence recovery is less certain. Complications mainly result from implant failure (pin migration) or failure to adequately decompress the cauda equina. In occasional animals subluxation of the LS joint following dorsal laminectomy has also been reported.

TWO CASES OF AXIAL LIMB DEFORMITY CORRECTED BY MEANS OF ILIZAROV TECHNIQUE: DECISION MAKING AND TECHNICAL CHOICES

Rovesti G L

Axial limb deformities are a challenging orthopaedic disease. In order to effectively solve the problem, the surgeon must not only correct the obvious deviation of the bone but also the concomitant involvement of soft tissues and joint relationships. The Ilizarov technique introduced a new operative philosophy in approaching these problems. Two cases of axial limb deviation treated at the Ambulatorio Veterinario Asocatio "M.E. Miller" in Cavriago (RE) Italy were reviewed. The first one was an English Setter, 18 months old, with a left carpus deviation in varus and precurvatus, and antebrachial shortening following a distal radial physeal fracture when she was 4 months old. The dog had an obvious gait abnormality but no pain in the affected limb. After application of the Ilizarov apparatus, an oblique radial distal osteotomy was performed: the ulna was left intact, as the ulnar styloid was considered to be the fulcrum of rotation for the correction of the varus deformity. The hinges were positioned in such a way to correct simultaneously both axial deviations. The distraction was performed at a rate of 1 mm per day calculated at the centre of the radius. During the lengthening, the digits of the dog were kept extended by means of elastic bands, to avoid flexion contracture of the carpus and digits. At the end of axial correction a radio-carpal subluxation developed and was treated by means of another ring, with a single wire passing through the radial carpal bone progressively pulling upwards. After the correction was achieved, a stabilization time of 4 weeks was allowed before removing the apparatus. The clinical, radiographic and functional results were very good.

The second case was an English Pointer, with a valgus deviation of the right distal tibia and supination of the foot. There was no apparent reason for the deviation but the fibular distal physis was different from the contralateral one on x-ray examination. Once the apparatus was applied to the limb, distal tibial and fibular osteotomies were performed. The hinges of the frame were positioned below the plane of the deformity so as to make possible the simultaneous correction of the valgus deviation and the translation of the distal segment - in order to maintain the overall tibial alignment. Had the hinges been positioned at the plane of the deformity, the correction would have been obtained but with lateral translation of the distal bone segment, causing the so-called "club-shaped" bone. The distraction was performed as for the previous case. The consolidation of the osteotomy occurred with a slightly abundant callus that was remodelled within a few months. The clinical, radiographic and functional results were excellent.

The Ilizarov technique was useful and clinically applicable for the correction of axial limb deformities in these two cases.

FEMORAL AND HUMERAL FRACTURES IN GROWING CATS AND DOGS TREATED WITH AN IM PIN/EXTERNAL SKELETAL FIXATOR TIE-IN CONFIGURATION

Camuzzini D Filippi D Valazza A & Peirone B

Introduction: Fracture treatment in growing animals is complicated by the elastic properties of the bone, the thinness of the cortices, the presence of growth plates and the necessity to obtain a rapid functional recovery in order to avoid muscle contractures. The IM pin/external fixator tie-in configuration described by Aron successfully resolves the aforementioned problems.

Materials and methods: the technique has been used in 8 dogs and 7 cats with complete femoral (12 cases) and humeral fractures (3 cases). The age varied from 3-11 months, and the body weight of dogs ranged between 5-40 kg.

Following an open approach to the fracture site, a 2-4 mm Steinmann pin (depending on body weight) was driven proximally, emerging from the greater trochanter or the trochanteric fossa of the femur, and the greater tuberosity of the humerus before perforating the skin. The fracture was reduced and the threaded part of the pin driven in the distal segment. The IM pin was not cut so that an extracutaneous portion was present.

A 2-3 mm threaded pin was driven through the femoral condyles parallel to the articular surface and connected with a 2-3 mm arched bar to the IM pin. To achieve further stability a 2-3 mm threaded pin was inserted in the s cerclage wire and Kirschner wire were inserted to reduce fragments. Within 18-24 days after surgery the distal pin was removed in order to dynamize the bridging callus. IM pin migration was prevented by the presence of the proximal pin.

Results: Post operative radiographic examination showed excellent fracture reduction in ten cases and good reduction in five. All patients walked within 2-3 days and the implants were well tolerated throughout the follow-up period. Implant dynamization was performed when stabilizing callus was visible radiographically. Weight bearing on the limb markedly improved in all patients after distal pin removal. Minor complications arose only in a case; breakage of the distal pin due to external trauma. Full functional recovery and radiographic bone healing were achieved within 25-60 days.

Refs.

Aron, D.N. et al: Experimental and clinical experience with an IM pin-external fixator tie-in configuration. VCOT, 4: 86-94 1991.

USE OF EXTERNAL SKELETAL FIXATION IN 129 CATS

McCartney W CarmichaelS & Langley-Hobbs S

One hundred and twenty nine cats were treated using external skeletal fixation (ESF) over a 7 year period. Threaded and non threaded pins were inserted using a Jacobs chuck. At least one threaded pin was used on each side of the ESF. In the vast majority of cases a Kirschner clamp was used to secure the pins to the bar. A variety of ESF configurations were used (Type 1, Type II, biplanar, contoured, transarticular). The types of injuries treated were fractured humerus (13), fractured radius/ulna(5), carpal injury (4), fractured femur (35) fractured tibia (36) tarsal injury (31) and non union (5).

ESF was successful in managing all of the types of injuries. Pin loosening and intolerance were not a common clinical problem when using ESF in cats. The results of this series indicate that ESF is one of the first choices for orthopaedic injuries in cats.

PROPHYLACTIC AND CURATIVE USE OF CEPHALEXIN IN CANINE ORTHOPAEDIC SURGERY

Bousquet E Chancrin J L. Pantaloni D

Cephalexin is a first generation cephalosporin which exerts a bactericidal action against gram positive and gram negative bacteria. Its spectrum of action includes strains of *Staphylococcus aureus* producing penicillinase. A study has been performed to assess the efficacy of cephalexin in prevention and treatment of infection in dogs undergoing orthopaedic surgery with a high infectious risk.

Materials and Methods: Ninety-two dogs were included (polytraumatic animals, open fractures, osteosynthesis failure cases, arthrodesis, hip or stifle arthroplasty, pelvic or femoral osteotomy). Cephalexin was administered as extemporaneous injectable powder at the time of premedication (25 mg/kg bw by intravenous route and 25 mg/kg bw by intramuscular route). Cephalexin was administered by oral route as tablets from 36 hours after surgery (15 mg/kg bw bid for 5 days). Treatment efficacy was assessed from daily rectal temperature between day 2 and day 6 and from inspection of wound on day 6 post surgery.

Results: Mean rectal temperature regularly decreased from day 1 to day 6. Numbers of animals with rectal temperatures over 39° C were 23 on day 1 and 6 on day 6 respectively. Numbers of animals with rectal temperatures over 39.5° were 5 on day 1 and 2 on day 6 respectively. In 82% of cases no local inflammation of the wound was observed on day 6. In 13% of cases a transitory inflammation of the wound was noticed on day 6. Treatment failure was recorded in 5% of cases - as assessed by purulent wound secretions on day 6. A bacterial strain resistant to cephalexin was isolated from 2 cases (*Enterobacter cloacae* and *Pseudomonas aeruginosa* respectively). An alternative therapy was administered to these 2 dogs.

Discussion: An early in vitro bactericidal effect of cephalexin has been reported on gram positive and gram negative bacteria. (1) High cephalexin plasma concentrations are achieved at once after intravenous administration. Availability of cephalexin in the targeted site of infection before the start of surgery can be expected from interstitial fluid concentrations; measured in dogs implanted subcutaneously with tissue cages (2). Consecutive intramuscular and oral administration maintains therapeutic levels after surgery with a high infectious risk. In the present study, cephalexin efficacy was demonstrated by the lack of post surgery infection in 95% of cases treated.

References:

(1) Silley, P., Brewster, G. Kill kinetics of the cephalosporin antibiotics cephalexin and cefuroxime against bacterial of veterinary importance. *Vet.Rec.* 1998, 123, 343-345.

(2). Cadorniga, R., Barrios, S. Segura, J., Robert. D.J. Penetration of antibiotic into interstitial tissue fluid following parenteral administration of lysine cephalexin. *Arzneim. Forsch./Drug. Res.* 1979, 29(II) 1547-1549.

SPONTANEOUS FRACTURE AFTER TRIPLE PELVIC OSTEOTOMY

Zaera J P

A 5 month old, 15 Kg male intact American Cocker Spaniel was presented to the Clinic of the Veterinary Faculty ULPGG with a slight lameness of the left hind limb, most apparent early in the morning and after exercise. After clinical and radiological examination subluxation of the left coxofemoral joint subluxation characteristic of unilateral Hip Dysplasia was diagnosed. Because of the dog's age and the slight radiological signs of coxarthrosis a triple pelvic osteotomy was proposed as treatment. We currently perform the surgery employing a standard technique using a modified TPO Slocum plate.

The only problem encountered during the surgery was the relatively large size of the plate compared with the width of the iliac body. Routine follow up was performed one month after surgery. At that time the dog presented with an abnormal gait, with abduction and internal rotation of the left hind limb. Radiography revealed a transverse iliac body fracture caudal to the plate at the level of the last screw.

The owner did not remember any accident or trauma to the dog during the postoperative period but he reported a worsening of the operated limb ten days after surgery.

Considering the elapsed time of the fracture, the radiologically evident external rotation of the acetabulum, and the possibility to perform a femoral head and neck resection if the lameness persisted we decided to manage the iliac fracture conservatively.

Six months later the dog was re-examined. At this time there was good weightbearing of the limb. Radiologically, we appreciated absence of subluxation of the left joint and worsening of the right coxofemoral joint without clinical signs.

In our opinion there was a spontaneous fracture induced by overprotection because of the big size of the plate compared with the ileum and the necessity to drill the holes for the screws closer to the bone cortex.

POST-TRAUMATIC HYPERMETABOLIC PATIENTS - HOW MUCH ENERGY DO THEY NEED?

Dobernecker, B

ENTHESIOPATHY OF THE ORIGIN OF THE SHORT RADIAL COLLATERAL LIGAMENT IN RACING GREYHOUNDS

Guilliard M J

A retrospective study of the radiographs of greyhounds with carpal lameness showed five dogs to have mineralised changes to, or around, the distal radial tubercle on which both the straight part of the short radial collateral ligament and the flexor retinaculum are attached. The significance and frequency of these changes was not known.

A prospective study was undertaken using a consecutive series of one hundred greyhounds that at sometime in their lives had raced on a greyhound track. Craniocaudal radiographs were taken of both carpi and the age and any known incidence of carpal injury recorded. Fourteen dogs were found to have radiographic evidence of an enthesiopathy (14%) and none had any historic evidence of carpal injury apart from one retired dog with sclerotic changes to the distal ulna. The changes were seen unilaterally apart from one dog with bilateral lesions.

The fourteen cases found in the survey together with the five review cases give a total of nineteen dogs with twenty affected carpi. Sixteen cases occurred in the left carpus and four cases in the right carpus.

The radiographic abnormalities identified showed either new bone deposition on the tubercle, or the presence of a small mineralised mass distal to the tubercle, or a combination of the two.

The ages of the affected dogs were from one to eleven years. Statistically it can be shown that there is no increase in the incidence in the retired group compared with the racing group. The numbers were too small to determine whether or not the incidence increased with exposure to racing.

None of the dogs had historical evidence of any adverse effect on performance and the radiographic changes were perceived as not causing a clinical problem.

ANATOMICAL ASPECTS OF THE PATHOGENESIS OF CANINE CRANIAL CRUCIATE LIGAMENT RUPTURE

Reese S

The intact cranial cruciate ligaments of 69 dogs were examined by classical light microscopical techniques as well as by histochemical, immuno-histochemical and electron-microscopical methods. In addition, the biomechanical properties of the cranial cruciate ligaments of 36 dogs were examined. The resulting morphological findings are related to the respective ages and weights of the examined dogs and compared to the biomechanical properties of the cranial cruciate ligament and the epidemiological data regarding cranial cruciate ligament rupture.

The investigation yielded the following results: the cranial cruciate ligament, excluding the attachment zones, consists of three histologically distinguishable parts: a proximal and distal third with the structure of a tensile tendon and a middle third with the structural properties of a compressive-tendon fibrocartilage. Initial stages of differentiation of this fibrocartilage could be shown electron-microscopically even in the one-month-old dog. The further developmental pace of the differentiation of fibrocartilage, which depends on the body weight exerted on it and the physiological and pathological changes occurring with advanced age are described continuously. The differentiation of the compressive-tendon fibrocartilage in the middle third of the cranial cruciate ligament is - according to PAUWELS's theory of the causal histogenesis of connective tissue - a physiological reaction to pressure forces. The compression of the cranial cruciate ligament is caused, as in the wringing out of a wet cloth, by a pronounced twist around its own longitudinal axis. There probably exists a genetic disposition to develop a fibrocartilage in the middle third of the canine cranial cruciate ligament.

The tensile strength of the fibrocartilage in the cranial cruciate ligament is considerably lower than that published in literature for tendons. The tensile strength decreases with increasing weight and age of the dog as a result of the further differentiation of the fibrocartilage. Large dogs have a considerably lower maximum load per kilogram body weight of the cranial cruciate ligament compared to smaller dogs, since the body weight increases much faster than the cross-sectional area of the cranial cruciate ligament.

Due to its relatively low tensile strength the middle third of the cranial cruciate ligament is predisposed to rupture. The dependence of the tensile strength on body weight and age correlates with the epidemiological figures on canine cranial cruciate ligament rupture. Normally the rupture does not occur suddenly but a slow, progressive disintegration of the ligament tissue takes place. The phases of overtraction first occur in intraligamentous fibre ruptures. Secondly a partial rupture and finally a total rupture caused by minor trauma follows.

A CLINICAL STUDY TO COMPARE THE EFFICACY OF VEDAPROFEN AND MELOXICAM IN PROVIDING PAIN RELIEF TO DOGS WITH CHRONIC MUSCULOSKELETAL DISORDERS

Bergman J van Laar P & Wood G N

Introduction: Vedaprofen (Quadrisol 5) is a new non-steroidal anti-inflammatory drug (NSAID). It is formulated as a palatable gel for oral use and is presented in a calibrated "dial-a-dose" syringe. The aim of this study was to demonstrate the comparative clinical efficacy of vedaprofen in providing pain relief to dogs with chronic musculoskeletal disorders.

Methods: A total of 175 dogs suffering from chronic musculo-skeletal disorders were randomly divided into two treatment groups, 84 dogs being treated with vedaprofen and 73 dogs with the positive control product meloxicam (Metacam). The treatment period was either 7 or 28 days. Physical examinations were undertaken on day 0,5,14,21,28 and 35 and scores (0-100) given on a Visual Analogue Scale for 5 parameters (Lameness, pain on palpation, pain on flexion/extension, limitation of flexion/extension and an overall severity score). Blood samples were obtained on days 0, 28, and 35 and examined for total protein, albumin, blood urea, creatinine, packed cell volume and reticulocytes. At the final examination the investigator and owner classified the case as "cured", "improved", "no improvement" or "worse".

Results. Treatment with either vedaprofen or meloxicam brought about a significant reduction in the overall score ($P < 0.01$) and the specific parameter scores recorded on admission. This was reflected in the final assessment made by the investigators, which showed that 90% of dogs improved following treatment with vedaprofen and 84% of dogs improved following treatment with meloxicam. The mean blood values (vedaprofen or meloxicam) for all parameters at all sampling times (blood 1-3) remained within the normal reference range. The results of the final evaluation are presented in table 1.

Table 1. Response to treatment

Response to treatment	Vedaprofen		Meloxicam	
	Number	%	Number	%
Cured	11	14%	12	17%
Improved	61	76%	46	67%
Total "responded:"	72	90%	58	84%
No improvement	7	9%	4	6%
Worse	1	1%	7	10%
Total "not responded" 8	10%	11	16%	

Conclusion: treatment with vedaprofen is effective in reducing the clinical signs of pain associated with chronic musculoskeletal disorders and is well tolerated when used at the recommended clinical dose for up to 28 days.

INTRACRANIAL SURGERY IN 46 DOGS AND CATS

Niebauer. G W

The report is based on 41 dogs and 5 cats with craniotomy. Computed axial tomography and/or magnetic resonance imaging was done in each animal prior to surgery. Forty animals had intracranial neoplasia, 3 had chronic inflammatory brain disease and in 3 dogs craniotomy was done because of traumatic skull fractures and associated brain damage. Candidates for surgery with suspected brain tumour were selected for craniotomy when, first, the lesion was surgically accessible with a reasonable chance for an excisional biopsy and, second, when despite aggressive medical treatment the neurological status progressively deteriorated. The surgical approach included a standardized anaesthetic protocol and a surgical technique which differed from the standard craniotomy protocol by purposely not closing dural defects. Meningioma was the most frequent tumour found in 4 cats and in 17 of the 35 dogs with neoplastic brain lesions. Median survival time in this group was 480 days (range >1000-2) and 220 days (range >1000-1), respectively. Of the 17 dogs with meningiomas, 41% survived one year and the 2 year survival rate was 12%. Dogs suffering from a variety of other tumours (astrocytomas, gliomas, choroid plexus carcinomas, infiltrating skull bone tumours and metastatic brain tumours) had a median survival time of 70 days (range >1000-1) and a one year and 2 year survival rate of 44% and 31%. All dogs with traumatic skull lesions survived long-term, all dogs in which biopsy revealed granulomatous meningoencephalitis or brain abscess died of causes related to the disease but unrelated to surgery. Overall, the death of 15% of all operated animals could be related to a combination of advanced brain disease and surgery (survival less than 7 days after surgery, with a morbidity/mortality rate of the craniotomy procedure of 13% on average). Fifty-four percent of all animals survived one year and the two year survival rate was 28%. Because fatality seldom occurred as a result of surgery morbidity and mortality associated with craniotomy in dogs and cats can be seen as acceptably low (13%).

CT-OSTEOABSORPTIOMETRY IN THE CANINE SHOULDER JOINT - A NEW METHOD TO ASSESS THE LONG-TERM LOADING

Maierl J Gutmannsbauer B Bootcher P Liebich, H G & Matis U

The shoulder joint can be affected by certain diseases involving the articular cartilage as well as the subchondral bone. These are the chondrosis and osteochondrosis dissecans which occur with a high incidence in large breeds. At present diagnostic procedures such as x-raying, arthrography, CT-scans and arthroscopy can only confirm a provisional diagnosis based on clinical signs of degeneration. Computed tomography, however, offers the possibility to measure the radiologic density of bone and the results of these measurements can be used for mapping the distribution of density in subchondral bone. The latter correlates with the loading history of the joint. The aim of our study was to establish the normal anatomical characteristics of the CT-osteabsorptiometry(CTOAM) in the canine shoulder joint.

The shoulder joints of 17 German Shepherd dogs were investigated by CTOAM. The dogs have been clinically without signs of lameness or disease in the shoulder joint as well as in other joints. They have been euthanized for reasons other than orthopaedic problems. The joints have been removed from the carcass with adhering muscles and skin and have been fixed in 8% formalin. Two series of scans (W2000/c700) have been taken from each shoulder joint with both the slice thickness and feed set to 1mm or 2 mm respectively. The density distribution of the subchondral plate of bone could be presented graphically by projecting the maximal density of the bone towards the articular surface.

In comparison, the articular surfaces of the scapula and the corresponding humerus the cavitas glenoidalis apparently shows a higher mineralization than the caput humeri. The maximal density within the cavitas glenoidalis can be found in the periphery of the articular surface with an especially high density in the caudal half. The humeral facet - clearly less mineralized - shows an almost hook-shaped maximal density with the convexity of the hook oriented laterally. A peak of density can be found in the caudal half of the articular surface. No differences could be found as far as sex and body side are concerned. Additionally we have discovered interdependences between changes in bone density and different body weight.

Further on in this study we compared the quality of maximal density projection in scans performed with different slice thickness (1mm/2mm). The thicker the slices, the shorter the length of anaesthesia possible.

The conclusion we can establish that on one hand CT-osteabsorptiometry can serve as a control in a follow-up investigation after surgery. On the other hand the procedure described

above might be helpful in evaluating early changes in bone density preceding clinical signs. Further investigations are necessary in order to define reference values for different age groups and breeds.

CT IN DIAGNOSIS OF TORSIONAL DEFORMITIES IN CANINE PATELLAR LUXATION

Loer B

CT MYELOGRAPHY IN THE DIAGNOSIS OF ROOT AVULSION OF THE CANINE
BRACHIAL PLEXUS

Forterre F

NUTRITIONAL INNOVATIONS FOR COMPANION ANIMAL SURGEONS

Nap R C

Nutritional needs of surgical patients before and after surgery have historically been disregarded by surgeons and veterinary surgeons are no exception to that rule. The attention of the surgeon for the well being of the patient typically diminishes from the moment the subcutaneous sutures are put in place and continue into the postsurgical period. The fact that after-care is an integral part of the treatment is often not practised as such. Fortunately the veterinary assistant personnel (nurses and technicians) take pride in the aftercare and make up for much of the surgeons sub-optimal performance. As technicians and owners become more and more educated on the subject of peri-surgical care, the veterinary surgeon can no longer neglect that part of the profession.

There are two reasons to pay more attention to perisurgical nutrition. First of all from a strictly nutritional scientific point of view. It has been proven in both animals and humans that recovery is faster and better when nutrition is adequate. Losing condition by allowing catabolic processes to develop should be avoided. Catabolism and negative nitrogen balance slow down wound healing and increase the risk of impaired immunological response. Although overall survival might not be at risk in most cases the morbidity and thereby the well being is affected by sub-optimal nutrition. Characteristics of nutrition that is developed to fit the animals requirement in the recovery phase are the overall digestibility of the food, the biological value of the protein amino acid profile, the energy density, the caloric distribution (split in energy supply by protein, fat and carbohydrates) and the fat and fatty acid composition. The amount and the ratio between omega 6 and omega 3 fatty acids (optimally formulated between 5 and 10:1) is important for the management of inflammatory mediators. Although the n-3 fatty acids are classically not considered "essential", the vast amount of beneficial effects for pets and humans have given them a comparable status. The type of fibre and the amount will determine the availability of essential ingredients, the stool volume and the overall gastro-intestinal health. It has been proven in dogs and cats that the presence of the correct amount and type of fermentable fibres stimulates enterocytes (especially colonocytes) to recover and also increase the total absorptive intestinal surface. Presence of special fibers like Fructo-Oligo-Saccharides will help balance the intestinal flora by supporting the non-pathogenic bacteria versus the pathogenic species.

When feeding post-surgical patients the rule of thumb is that "when the gut functions, use it". This implies that the enteral route is always preferred over the parenteral. This applies for both fluid (water is the most essential nutrient) and all other nutrients. The parenteral route should only be used when the enteral one is not available or when its use would impair the

animal's well being. Enteral feeding includes tube feeding and the type of tube that is used will depend on indication, predicted duration and surgeons preference. For tube feeding the "tubability" of the formula and the energy density is of high importance. When active (self) feeding is not an option, tube feeding is preferred over forced feeding. The latter is time consuming and stressful for the patient and for the hospital staff. For obvious reasons (both nutritional and psychological) the palatability of nutrition is important in case of active food intake although it is not at all a feature of quality of the nutrition.

The second important reason to pay high attention to post surgical home care and nutrition is the fact that owners are well prepared to pay special attention to - and money for - their pets during this period of treatment. Prescriptions for dietary pet food that potentially increase the animals' well being and fast recovery are in line with this attitude. They match the emotional and social needs and will increase the owners perception of total care concept that was delivered by the veterinarian and the hospital staff.

MYOPATHIES: DIAGNOSIS AND TREATMENT

Olby N

Introduction: Contraction of skeletal muscle is dependent on both extrinsic factors (an intact nerve supply and neuromuscular transmission) and intrinsic factors (correct electrolyte levels, sufficient energy and normal protein constituents). Abnormalities in any one of these intrinsic factors can result in a clinical myopathy. Myopathies can be inflammatory (immune mediated and infectious) and non-inflammatory (defects in structural components, metabolic disorders, endocrine abnormalities, ion channel defects, nutritional, drug-induced and toxic myopathies).

Diagnosis: Clinical signs of a myopathy can be difficult to differentiate from other lower motor neurone diseases but include weakness, exercise intolerance, muscle atrophy or hypertrophy and muscle pain. In myotonia, stiffness that improves with exercise may also be seen. Other important indicators include hyperpnoea, reflecting metabolic acidosis, and dark urine due to myoglobinuria. Minimal laboratory tests include electrolyte levels, creatine kinase and AST levels. If a metabolic myopathy is suspected, the animal's metabolic state needs to be stressed with exercise or by withholding food to highlight abnormalities. Many laboratories will now run lactate and pyruvate levels and some will screen for organic acids in urine. Not all myopathies are accompanied by changes that will be detected by a standard biochemical panel; therefore, if a myopathy is suspected a work up that includes electromyography and muscle biopsy should be performed. Muscle samples should be frozen isothermally in pre-cooled isopentane for full histochemical analysis - preferably by a specialist laboratory.

Treatment: Treatment of muscle disease is most effective if the cause can be identified. It is always important to remember the effect of a sudden release of large amounts of myoglobin on the kidneys. In addition, it should be noted that cardiac muscle is very similar to skeletal muscle in its structural components and in its metabolic requirements. Thus, the heart should be carefully assessed. In the dog, it is important to remember that the oesophagus contains skeletal muscle as development of megaesophagus alters the prognosis of the animal. Immune mediated and infectious myositis should be treated with steroids or appropriate antibiotics respectively. Dietary manipulation has been found to be useful in the treatment of specific metabolic myopathies in man, and more recently in the horse. However, it can be difficult to identify the underlying cause of metabolic myopathies and therefore to recommend appropriate treatment. Supplements that can be of use include L-carnitine, co-enzyme Q and riboflavin. Unfortunately, most structural myopathies carry a poor prognosis and the course of the disease is dependent on the severity of the abnormality.

Conclusion: Skeletal muscle is a complex tissue that is dependent on a ready supply of energy, correct ion balance and a large number of structural proteins. As current understanding of muscle disease improves, and means of assessing muscle accurately become more readily available, the diagnosis and treatment of muscle disease should also improve. The first step to be taken by veterinarians is to take muscle biopsies whenever there is a high index of suspicion of a myopathy.

PRINCIPLES BEHIND THE ILIZAROV TECHNIQUE IN FRACTURE REPAIR

Jukema G N and Muhr G

For treatment of open fractures external fixation is a sufficient method with a low risk for infection in humans. In order to obtain a stable transosseous osteosynthesis for early load bearing Gavril A. Ilizarov used a ring fixator for the treatment of open and closed fractures. Its purpose was to preserve full function of an extremity without temporary loss of function in the adjacent joints. There is a loss of joint function - at least temporarily - in conservative fracture treatment with plaster casts.

The healing process in transosseous osteosynthesis corresponds to indirect bone healing. This is also seen in other "unstable", less rigid fixations such as intramedullary nailing. Indirect bone healing represents a form of physiological fracture healing. Bier (1923) pointed out the importance of the haematoma in fracture healing, which is replaced by granulating tissue which is transformed into connective tissue, cartilage and finally bone.

Ilizarov treated more than 25,000 patients with his apparatus including some of the most complex disorders of the locomotor system. New solutions to many therapeutic problems were described before he died on July 23rd, 1992. In particular, severe limb trauma with large defects of bone, vessels, nerves and skin can be managed without resort to transplantation. Radical debridement surgery can be followed by one-step restoration of the missing tissue, thus decreasing the likelihood of a serious wound infection or an amputation.

The Ilizarov ring fixator consists of concentric rings (80-240 mm) which are connected by tension of 100 kp with transosseous 2.0 mm K-wires. These rings are connected with treated rods resulting in a highly stable system, allowing weight-bearing.

The importance of compression-distraction-osteosynthesis is seen in tissue grown under constant traction. The use of the Ilizarov ring fixator is based on this and allows the treatment of fracture defects, congenital and acquired deformities, pseudoarthrosis and infections. In humans this method has proved highly effective in the treatment of osteitis. The resection of infected areas of bone followed by bridging of the defects by segment transfer is viewed as the standard treatment of infected bones. The idea of callus distraction for limb lengthening is not new. In 1903 Codvilla reported on callus distraction and in 1923 Bier described 7 cases of leg lengthening. Block (1923) also introduced an apparatus for callus distraction using crossed K-wires fixed in a frame. A few years later Klapp demonstrated a traction device consisting of half-rings. This device was not far from that which we have now in the modern Ilizarov ring fixator. It is not known whether Ilizarov, in Kurgan/USSR, was aware of these

experiments. It might have been simply simultaneous development. Nevertheless it is due to his work that this technique has found its way into the treatment of a variety of problems. The method is based on many scientific evaluations which he carried out.

EXTERNAL SKELETAL FIXATION IN HORSES

Richardson D W

Despite much progress in our ability to successfully use internal fixation in many types of fractures in horses, there are many serious fractures in horses that defy successful reconstruction within internal fixation techniques. These include both fractures that are too comminuted to allow accurate reconstruction, as well as those injuries with vascular compromise and/or soft tissue loss that virtually preclude the option of internal fixation. In human and small animal orthopaedics, external skeletal fixation is virtually always the treatment of choice for such injuries and we still need a consistent, reliable, external skeletal fixation technique in horses.

The major limiting problem in horses is that success in an equine orthopaedic case generally requires that the horse is afforded at least a moderate level of comfort on the fractured limb. This demands that the external fixator be capable of bearing the complete weight of the horse over an extended period of time. Because most true external fixators have not been strong enough to allow full weight bearing, most successful transfixation techniques involve the combination of some type of cast or external coaptation in combination with transfixation pins. Although this is a versatile and valuable technique, it still has the limitation of not allowing regular inspection of the injured site as can be done with a true external fixator. Cast pin combinations also do not allow regular cleaning of the pin-tissue interface. Nonetheless, transfixation pin cast combinations remains a valuable and versatile technique for managing many types of injuries. Although people have had success with a number of techniques, some principles should be emphasised.

- Positive profile pins (pins in which the outside diameter of the thread is larger than the core diameter of the pin) should be used whenever possible. This is true for both full and half-pin techniques.
- If more than one pin is used, the pin should be placed at slightly divergent angles to minimise propagation of cracks between pin holes.
- If possible, pins should not be placed close to the open end of a cast.
- The pin cast interface should be reinforced with some wear resistant material such as metal or acrylic.

One major advantage of transfixation casts is that motion at joints within such casts is essentially eliminated so rub sores are rarely a problem. I therefore prefer to use a cast padding that "breathes" even though this type of cast padding is not ideal in terms of its ability to protect the skin. This cast padding material made of Gore-Tex has been improved in recent years and, in my opinion, does result in the skin under the cast remaining drier.

True external fixators designed specifically for the horse have been rarely described. Simple application of human devices will usually not work in weight bearing applications in mature animals. Human sized devices can have some application in foals but, generally speaking, transfixation pins in foals become loose because of the quality of the bone. The design of an external skeletal fixator for horses is problematic because the device must be large enough to sustain the weight bearing loads of a 400+/kg animal at the same time that it minimises the chances for a catastrophic fracture through one of the transfixation pin holes. Such fractures through the pin holes have been the predominant complication of such fixators. We have attempted to minimise this complication by optimising the transfixation pin size without compromising the strength of the frame. One design strategy that shows promise is to use tapered outer connectors on the transfixation pins to effectively increase the diameter of the pin as it attaches to the sidebar without increasing the diameter of the pin as it passes through the bone. Other technical goals in the design of an external fixator are to minimise weight by the use of composite materials and light alloys and to minimise the bone-sidebar distances. Our current design (cf. Nunamaker & Nash) employs these design principles.

THE USE OF THE ILIZAROV TECHNIQUE FOR MANAGEMENT OF GROWTH DEFORMITIES IN CHILDREN

Jukema G N and Muhr G

The Ilizarov technique is very useful for treatment of fracture defects, congenital and acquired deformities, pseudoarthrosis and infections. In children there is significant growth capacity for correction of congenital or post traumatic bone deformities. The Ilizarov ring fixator consists of concentric rings (80-240mm) which are connected by 2.0 mm K-wires with 100 kp tension, resulting in a highly stable system, allowing weight-bearing.

In a case of fracture of the distal radius in a young boy, the distal epiphysis was damaged, resulting in the following years in a shortening of the radius compared to the ulna. An ulnar deviation of the wrist joint could be corrected by the Ilizarov technique by callus distraction of the radius.

In a case of hereditary vitamin D resistant rickets in a younger boy, 7 years after fracture of the lower leg pseudoarthrosis with shortening of the leg, malrotation and antecurvature of tibia was diagnosed. Weight-bearing could no longer be performed, because the unstable pseudoarthrosis was very painful. In this case the resection of the pseudoarthrosis, following by callus distraction was performed. At the same time a special medicament therapy for treatment of the hereditary rickets was administered. After 1 _ years the lower leg was stable and was capable of full weight-bearing.

A young girl with dysplasia of the radius with axis deviation of the forearm was treated by segmental resection of the radius followed by callus distraction. Due to insufficient callus formation, secondary cortico-cancellous bone grafting from the fibula was necessary.

In a case of 1^o open multifragmentary metacarpal fracture of a 4-week old Arabian foal, an osteosynthesis with the Ilizarov ring fixator was performed. Immediate full weight-bearing (100 kg) was possible, demonstrating the high stability of the Ilizarov ring system. After 12 weeks sufficient bony union was achieved, and the fixator could be removed. At that time, the body weight of the foal was 150 kg. In our opinion, this case proves the high stability and efficiency of the ring system under difficult and unusual conditions.

JOINT DISEASE AND ITS MANAGEMENT IN THE FOAL

May S

The foal is affected by a variety of arthritides, both inflammatory and relatively non-inflammatory. These include infective arthritis, involving haematogenous spread from other foci of infection, traumatic arthritis, osteochondritis dissecans (OCD), and degenerative joint disease secondary to conformational abnormalities such as angular deformities.

In contrast to the adult horse, articular cartilage in the foal is a much more labile tissue. This, presumably, relates to increased synthetic activity associated with growth and articular maturation. *In vitro*, adult articular cartilage is relatively resistant to breakdown by the cytokine, interleukin-1 (IL-1), and few proteoglycan degradation products can be measured in the culture medium. However, IL-1 stimulates the production of stromelysin (a proteoglycan-degrading enzyme) by foal chondrocytes, and this, possibly together with other enzymes, results in proteoglycan release, leading to degradation of the cartilage.

Unfortunately, the lability of foal cartilage means that following an articular insult, such as bacterial infection, articular cartilage is quickly compromised, and the clinician must rapidly remove the cause of the problem if the joint is to be saved. In the very early stages, the first few hours after infection, systemic antibiotic therapy may suffice. However, once the infection is established, it becomes important to lavage the joint, to decrease the bacterial load and remove inflammatory mediators, as well as supply effective antibacterial therapy. Indeed, within only a few weeks, without this sort of treatment, a foal joint will be completely destroyed by infective arthritis, where joint infections in adult horses can still be successfully treated, in some cases, up to 3 months after they start. Similarly, OCD lesions, in young foals, tend to progress, even after surgical removal and correction.

In a few situations, the lability of foal cartilage allows the possibility of joint healing and remodelling which is superior to that seen in adult horses. The prognosis for a return to soundness of a foal, following conservative management of a bone cyst, is much better than the prognosis for an animal over 3 years which is discovered to have the condition. In addition, foal joints suffering from quite marked degenerative changes, secondary to angular deformities, can show considerable remodelling and healing following correction of the underlying deformity.

TRAUMA SURGERY IN THE FOAL

Richardson D W

Trauma surgery in foals is at once both challenging and rewarding. The surgeon has the opportunity to successfully repair injuries that may be untreatable in adult horses. Foals' tissues typically heal more quickly, their lesser musculature allows reasonable exposure of long bones, and their lighter weight allows longer survival of metal implants. There are also some serious disadvantages in the management of foals with orthopaedic injuries. Excessive weight bearing on the limb opposite the injury often results in deformity and external coaptation (splints/casts) of the injured limb results in tendon and ligamentous weakness. Both complications can result in a successful resolution of the original problem but eventual clinical failure. Another difficulty encountered in foals with orthopaedic injuries is that treatment decisions must be made in consideration of their intended use. Although this isn't unique to foals, accurate prognostication for cosmetic and/or functional outcome is difficult and is often demanded by owners before they will proceed with treatment.

Diaphyseal long bone fractures in foals should generally be treated with internal fixation IF the fracture is displaced or otherwise severe enough that simple rest and limited external coaptation does not allow adequate comfort. Failure to achieve nearly normal weight bearing on the injured limb will frequently result in rapid plastic deformation of the contralateral limb. Some fractures such as those involving the ulna can be treated in foals with simpler orthopaedic techniques such as tension band wiring.

Physeal fractures in foals may heal very quickly so simple external coaptation can be successful, particularly in very young foals. In displaced and unstable physeal fractures or those in the proximal limb unsuited to external coaptation, internal fixation is needed. The fixation must provide immediately stability and must be removed as quickly as possible to prevent additional growth plate problems. Physeal fractures such as those involving the proximal tibia, proximal ulna, and proximal femur present unique and demanding challenges to the surgeon.

Tension Band Wiring for Ulnar Fractures

Case Selection:

Although there is no absolute weight limit for this technique, there are distinct limitations for its use dictated by the configuration of the fracture and there are many occasions when plating is both easier and more reliable. The primary indication for wiring technique is in the young

horse (< 6 months) where plating techniques might compromise growth plates. Plating an ulnar fracture using screws affixed to the radius should be avoided if at all possible in any foal of this age. Tension band wiring is the technique of choice for Salter-Harris I fractures of the proximal olecranon and is highly recommended for repair of simple, minimally displaced fractures at or distal to the level of the humeroradial articulation. The technique is not well suited for comminuted or intrinsically unstable fractures and is usually not used in adult horses with fractures proximal to the joint level if there is enough bone to insert 3 screws into the proximal fragment.

Surgical Approach:

A standard approach to the ulna is used between the ulnar head of the deep digital flexor muscle and the ulnaris lateralis. With simple wiring of the mid ulna, a very small incision is required. If a pin and wire technique is necessary, the incision is carried proximal to the point of the olecranon. Both pins and wires can be placed in the proximal olecranon without extensive dissection of the triceps insertion.

Technique:

Wire alone (for fractures at or below the humeroradial joint level): The fracture is held in reduction digitally or with forceps. If there is any obliquity to the fracture plane, a 3.5 or 4.5 mm lag screw is inserted. A 2.5 mm(2.7 or 3.2) bit is used to drill holes transversely through the ulna at least 2 to 3 cm proximal to and distal to the fracture. Figure-8 loops of wire are passed through the holes and tightened with a wire tightener or vice grips. At least two loops of wire are used even in small foals. Usually 3 or 4 wires are used in yearling or adult horses. The wire should be at least 1.2 mm diameter and in larger horses, 1.5 mm wire is used.

Pins and wire (for fractures proximal to the joint): A pin held in a Jacobs chuck is inserted in a proximal to distal direction through the proximal fragment being careful to both center the pin and allow enough room for a second pin to be placed. The pin size is dependent on body weight. In small foals, 3 mm pins are adequate but in an adult horse up to a 3/16 inch pin might be used. The two pins do not have to be the same size. The fragment is reduced through manipulation (elbow extension with varying amounts of rotation) and the fragment skewered onto the distal bone. It is highly desirable not to completely penetrate the distal cortex, only to engage it securely. Complete penetration can lead to the pin migrating distally in the limb over a period of weeks to months. The second pin is then inserted in a similar manner. One or two transverse 2.5 to 3.2 mm holes are drilled through the ulna approximately 3 cm distal to the fracture. A minimum of three wires (sized as above) are passed through the holes and around the proximal protruding pins. A 14g 1.5 or 2 inch needle is helpful for wire passage. The wires are tightened alternately to help avoid any tendency to shift the fracture. The pins are cut (*Don't twist the handles of the cutters*) and

tapped down with a mallet and nail set, leaving 6-8 mm above the bone surface. The pin and wire technique can also be used in conjunction with one or two lag screws if the fracture is oblique *but* care must be taken to leave enough room for the pins.

Closure and Recovery: The closure is routine. Drains are neither necessary nor desirable unless there is an unusual amount of soft tissue damage. I prefer an ether bandage on the incision without a bulky dressing. The recovery is attended in all cases. Foals are lifted to their feet. Use a tail rope and any available special recovery system (e.g. deep mats) for larger horses.

Results:

Martin et al have recently reported the results of wire fixation (+/- pins and screws) in 22 horses with ulnar fractures. Ages of these horses ranged from 2 weeks to 12 years with a median of 4 months. Fractures healed in 18/22 horses (82%). Long term follow-up was obtained on 17 horses. Of these, 13 (76%) became athletically sound.

Proximal Salter-Harris II fractures

Occur in foals from the neonatal period up through 16-18 months of age. They usually occur when the foal is kicked on the lateral aspect of the stifle while the foal is bearing weight on the limb. They have a highly stereotypical configuration with the metaphyseal component of the fracture on the lateral aspect of the tibia and separation of the fragments occurring on the medial aspect of the physis. There is usually marked soft tissue swelling over the medial physis and the foal is usually (but not always) non-weight bearing.

The surgical approach is very simple. A slightly curved (caudal concavity) incision is made directly over the medial physis. The incision is made just long enough to accommodate a 4 to 5-hole plate.

Technique:

The fracture is displaced by forcefully abducting the distal limb and the fracture line is debrided of any large fibrin clots or folded fragments of physeal cartilage. If large fragments of healthy looking cartilage are present, they are left within the fracture line. Adduction of the distal limb with slight traction will usually reduce the fracture.. if it is several days old, and "sticky" reduction may require more forceful manipulation and even the use of a Hohman retractor to lever the fragment.

Following reduction, a malleable template is fitted and a 'T'-plate is bent appropriately. Twisting should not be necessary if the plate is positioned medially. The proximal screws, usually 5.5 or 6.5 fully threaded screws, are inserted being very careful to direct them parallel

with the joint surface. With the larger diameter screws, it is also important not to angle them towards each other. The 'T'-plate has the advantage of providing 2 screws in the proximal fragment and is easy to shape to the proximal tibia. Its primary disadvantage is that its cross section is thin making it very weak in bending. The medial position in the proximal tibia puts the plate in tension because of the foal's tendency to abduct the distal limb. This makes the plate strong enough to survive in small foals. The distal screws are placed neutrally in the plate if the fracture is well reduced. If there is still some medial gapping, the DCP can have 1 or 2 screws placed in a load position. (Make sure the loaded screws are on the distal side of the plate.) In heavy weanlings and yearlings, I prefer to use 2 narrow 4.5 mm DCP's placed adjacently. In small foals, lag screws alone or simple crossed pins can be used successfully. The distal screws are placed neutrally in the plate if the fracture is well reduced. If there is still some medial gapping, the DCP can have 1 or 2 screws placed in a load position. (Make sure the loaded screws are on the distal side of the plate.) With the plating technique it is not essential to lag the metaphyseal spike in position although it will provide additional stability if it is done.

The soft tissue overlying the plate are apposed with interrupted tension sutures (cruciate or near-far far-near) of absorbable synthetic material. The skin is closed with interrupted simple or vertical mattress sutures. An ether bandage directly over the incision covered with a lightly padded stacked bandage is placed for recovery.

These fractures are straightforward to repair and have an excellent prognosis for healing but not necessarily for athletic function. Unfortunately, the trauma associated with the fracture often permanently injures the physis and some growth problems are possible regardless of surgical repair technique. Implant removal has not been done consistently in the past but current follow-up on some horses suggests that it be done in young foals. These fractures heal quite quickly and plate removal could be safely done in most within 8 weeks. In foals less than 6 weeks of age, the implants should be removed even earlier.

ANAESTHESIA OF THE TRAUMATISED FOAL

Gasthuys F M R

Foals can be categorised as neonates (birth to 1 month) and juveniles (1 to 3 months). Neonates are physiologically different from mature horses. Mean arterial blood pressure (= lower vascular resistance) is relatively low but shows a steady increase with age. Cardiac output is primarily rate dependent so an adequate heart rate level must be maintained at all time. Arterial oxygen tension is low at birth and during the first weeks; oxygen consumption is 2 to 3 times greater than in mature horses (more susceptible to hypoxaemia). Pre-existing problems (trauma, ruptured urinary bladder) have a clear influence on the anaesthetic management.

Foals require sedation for minor procedures or as premedication before general anaesthesia. Phenothiazines e.g. acetylpromazine induce a long lasting vasodilatation resulting in an increase of heat loss, hypotension and a decreased PCV. These drugs are not indicated when the overall general condition is not optimal. Alpha-2 sedatives are frequently used in foals. Xylazine induces less bradycardia compared to detomidine and romifidine. It is prudent to administer parasympatholytic drugs (atropine) to avoid hypotension and bradycardia (constant cardiac output). Benzodiazepines (diazepam, midazolam) mostly induce recumbency but do not provide a sufficient analgesia. Narcotics e.g. butorphanol improve analgesia.

Induction of anaesthesia can be achieved using injection (bolus or infusion) or inhalation techniques (mask or nasotracheal intubation). Benzodiazepines mixed with ketamine produce about 10 - 15 min anaesthesia (least risk). Guaifenesin and thiopentone are rather irritant for use in foals. Propofol is expensive and lacks analgesia. Infusion of the different "triple drip" solutions or other mixtures (including e.g. propofol) can be administered for longer procedures. Oxygen supplementation during injection anaesthesia is recommended to avoid arterial hypoxaemia.

Adult human anaesthetic machines (+ ventilators) can be used in foals up to 150 kg of bwt. Induction of anaesthesia with halothane is associated with a high percentage of complications. Isoflurane offers certain advantages (rapid induction and recovery, minimally metabolised, higher therapeutic index).

Routine monitoring (blood pressure, pulse oxymetry, anaesthetic gas analysis, body temperature) is justified in all foals. Intraoperative fluids can include glucose but a rebound

hypoglycaemia can occur afterwards. Control of the body temperature is essential during and after anaesthesia.

References: S.A. Robertson. Sedation and anesthesia of the foal. *Equine vet. Educ.*, 9, 1997, 37-44.

PLASTIC SURGERY OF COVERED AND PENETRATING PENIS TRAUMA IN THE STALLION

Fruhauf B Bartmann C P & Klug E

Case 1: A five year old pony stallion was referred to the clinic because of acute penis trauma after being kicked by a mare. The stallion showed a total penis prolapse with caudoflexion due to a hematoma of about 20 cm in diameter. The mucosal surface was ruptured in multiple locations because of the tension of the hematoma.

The hematoma was split and flushed under general anaesthesia. Penile fascia and mucosa were sutured completely. After placing a catheter into the urethra the penis was repositioned in the preputial cavity. Finally the preputial orifice was closed temporarily by using the Buhner-technique to prevent penile prolapse due to secondary edema. Because of a slight consecutive bleeding another similar surgical intervention was necessary. No complication in wound healing was noticed. After reopening the prepuce a complete functional recover in erection and retraction of the penis could be achieved.

Case 2: A four month old male foal was hit in the preputial area. A partial rupture of the penis proximal to the glans and a complete transversal rupture of the urethra was diagnosed. The defect was treated by plastic surgery under general anaesthesia. After catheterisation of the urethra the urethral mucosa was bluntly dissected and sutured longitudinally to prevent scar constriction. The corpus cavernosum was sutured separately and the skin was closed by an intracutaneous suture. The catheter was removed seven days following surgery. No further additional treatment was necessary. Erection, retraction and urination could be performed normally. No signs of scar stricture could be recognised. the cosmetic effect was very good.

Discussion: Penetrating lesions of the penis with defects of the corpus cavernosum or spongiosum usually have a high incidence of complications. Infections and strictures due to scar tissue with following functional failure are common. Especially defects of the urethra are a severe problem. Even non-penetrating lesions of the penis with huge hematomas are often followed by necrosis and persisting penile prolapse. Amputation in these cases is necessary.

An immediate surgical intervention should be performed to achieve best cosmetic and functional results. The impending paraphimosis due to secondary edema can be averted by placing a temporary suture in the preputial orifice to keep the penis within the prepuce. The classic method of using a purse string suture seems to be a lot more irritating to the prepuce than the modified "Buhner-suture"

UNUSUAL FINDINGS IN THE NAVICULAR BONES OF TWO HORSES

Wollanke B. Gerhards H Binder U & Zechmeister R

Case 1.

A four-year-old Quarter Horse gelding was presented because of intermittent lameness in both front legs. The owner had bought the horse 6 months ago. During the 6 months the horse had never walked normal and the last 3 months the lameness had obviously increased. Clinical examination revealed a short stilted gait and additionally a moderate lameness in the right forelimb at the trot. In both frontlegs mild to moderate pulsation of the digital arteries could be palpated. Other abnormalities could not be detected by clinical examination. A palmar digital nerve block in the midpastern was performed and the lameness in the right frontleg improved, but the short stilted gait was still obvious. Both feet were prepared for radiographic examination. The 90⁰ radiographs of both feet showed no pathological findings. The dorsal-palmar view (oxspring technic) showed in both feet a "fracture" of the navicular bone. This was confirmed by the palmaroproximal-palmarodistal (tangential) radiographs. As there were no special findings on the 90⁰ radiographs and no signs for a bone-reaction or inflammation on all radiographs, it was concluded, that there were no fractures but separate centers of ossification in both navicular bones. The horse was euthanased because of the unfavourable prognosis. Post mortem examinations of the navicular bone, including CT and MRI, were suggestive for separate centers of ossification and excluded fracture lines.

Case 2.

A fifteen-year-old warmblood gelding was presented with a history of severe hindlimb lameness on the right side for 3 weeks duration. The practitioner diagnosed a subsolar abscess and established a drainage hole. The following time the lameness was still obvious. When the horse was presented to the clinic there was still a severe lameness in the right hindlimb whereas the subsolar abscess had healed completely. However, a severe lameness was still present. A palmar digital nerve block in the midpastern was performed and the lameness disappeared. Several radiographs of the digit and the navicular bone were taken and revealed a central cyst in the navicular bone of the right hindlimb. Despite the poor prognosis the owner wanted to try a treatment with NSAIDs and an orthopaedical shoeing with a full-bar shoe. Six months later the horse showed no lameness at walk, but it has not been in training any more.

THE USE OF HEEL WEDGES IN THE ORTHOPAEDIC SHOETING OF HORSES

Whillemen M A. Savelberg H H C M & Barneveld A

Introduction

Heel wedges are frequently used in horses suffering from navicular disease. Furthermore, they are applied in horses with a tendinitis of one of the three major ligamentous structures associated with the suspensory apparatus of the fetlock. The biomechanical rationale behind this therapeutic measure is that heel wedges result in an altered equilibrium of the moments of force at the different joints of the lower limb. This is supposed to lead to a reduced force on the navicular bone exerted by the deep digital flexor tendon and possibly to reduced tension in the flexor tendons and the suspensory ligament. The goal of this study was to evaluate objectively the biomechanical effects of heel wedges.

Materials and methods

Simultaneous collection of kinematic and kinetic data allowed for an inverse dynamics approach, which presumes quasistatic equilibrium at the distal interphalangeal joint and the metacarpophalangeal joint at the stance phase. This means that the flexing moments of force and the extending moments of force at these joints are supposed to be equal. Experiments were performed in twelve sound Dutch warmblood horses and in six horses in which a tendinitis of the superficial digital flexor tendon was induced using a collagenase model. Data were collected of the horses shod with flat shoes and with shoes with 6° heel wedges, according to a Latin Square schedule. Between the measurements, the horses were allowed an adaptation period of at least three days, during which they were subjected to a uniform training schedule.

The horses were trotted over a track with an inbuilt Kistler force plate, while a CODA-3 apparatus was used to record the kinematics of the horse's forelimb, that was equipped with photodiode markers at anatomically well defined sites. Lateromedial radiographs of the lower limb were used to relate the position of the CODA-3 markers to the centres of joint rotation of the distal interphalangeal joint and the metacarpophalangeal joint. To relate the position of the centres of joint rotation to the point of application of the ground reaction force, the position of the force plate within the CODA-3 frame was determined.

Statistical analysis was performed using a repeated measures ANOVA.

Results

In the sound horses shod with heel wedges, the maximal force exerted by the deep digital flexor tendon on the navicular bone was significantly ($p < 0.05$), reduced by 24% compared to

the horses shod with flat shoes. This resulted from a reduced maximal moment of force at the distal interphalangeal joint ($137 \pm 27\text{Nm}$ and $175 \pm 48\text{Nm}$ respectively, $p < 0.05$), and this effect was enhanced by the reduction of the angle of the deep digital flexor tendon at the level of the navicular bone. In the horses with an induced tendinitis of the superficial digital flexor tendon the maximal moments of force at the fetlock joints of both the lame limb and the sound limb did not differ between shoeing types.

Conclusions

It is concluded that the heel wedges are efficient in reducing the force exerted on the navicular bone by the deep digital flexor tendon. No beneficial effects of heel wedges can be expected in horses suffering from a tendinitis of the superficial digital flexor tendon.

FORGING CONDITIONS AND USE OF PARTICLE REINFORCED ALLOY HORSESHOES
IN SPORT HORSES

Stanek C H Brandstetter J Anich J & Hinterhofer C

INTRA-ARTICULAR AND INTRAVENOUS USE OF SODIUM HYALORONATE FOR THE TREATMENT OF OSTEOARTHROSES IN HORSES

Gerhards H & Schwenzer K

The aim of this study was to compare the treatment results of intravenous vs. intra-articular application of recombinant sodium hyaluronate (Hyonate) in horses suffering from lameness due to degenerative joint disease in a single joint. Also, the results of the treatment with sodium hyaluronate of horses with diseases of several joints were evaluated.

32 horses which had received no other treatment than the tested drug were included in the study. 30 horses had degenerative joint disease. Two horses were treated after arthroscopic joint surgery because of OCD lesions. The 32 patients were allocated to 3 treatment groups, groups **1a** (11 horses) and **1b** (12 horses) being randomly allocated to either intravenous or intra-articular treatment. Horses of group 2 (9 horses) had received intravenous treatment because of multiple joint involvement.

Each patient received an average of 1, 3 injectins of the tested drug. 20 of 32 (= 62.5%) were treated successfully which meant, that the horses returned to full performance.

In group 1a (intravenous application) 8 horses (72.8%) and in group 1b (intraarticular application) 11 horses (75.0%), returned to previous work, whereas only 3 horses of group 2 returned to full performance.

It was concluded, that both, the intravenous and the intraarticular route of treatment of horses with degenerative joint disease with the sodium hyaluronate seems to be less successful, but has to be clarified in further studies.

LONG TERM RESULTS OF INTRAARTICULAR TREATMENT WITH HYLARTIL OR HYLARTIL-CELESTOVET IN DISTAL INTERPHALANGEAL & METACARPOPHALANGEAL JOINT DISEASE IN HORSES

Brumhard J Na Songkhla V & Stadler P

Introduction

Non infectious arthritis and arthrosis are a frequent cause of lameness in horses. Due to their function and mechanical load, the coffin joint and fetlock joint are frequently affected. Beside shoeing intraarticular treatment with Hyaluronic acid and Glucocorticosteroids is recommended. In this study the effect of initial treatment with Hylartil or Hylartil and Celestovet and its long-term results was investigated.

Materials and methods

130 horses with disease of the distal interphalangeal joint and 68 horses with disease of the metacarpophalangeal joint were treated with Hylartil or Hylartil and Celestovet. Further intraarticular treatment with Hylartil was done. All horses received orthopaedic shoeing and were involved in an exercise program. Before and after treatment the degree of lameness was evaluated with the aid of a lameness score. In 168 horses a follow up examination was performed. Long-term results were evaluated by a questionnaire 6 months after treatment.

Results

There was no significant difference between groups with initial Hylartil or Hylartil/ Celestovet treatment. 68.4% of horses with distal interphalangeal joint diseases and 69% of horses with metacarpophalangeal joint disease became sound within an average of 1.98 and 1.81 intraarticular injections of Hylartil respectively.

76.4% of owners answered the questionnaire. Six months after treatment 31.7% of horses had a recurrent lameness. 22.1% of horses showed a reduced performance and 46.2% of the horses the same or better performance after treatment. 35.4% of horses returned to sport tournament.

CELLULAR EVENTS CAN EXPLAIN DIFFERENCES IN WOUND HEALING BETWEEN HORSES AND PONIES

Wilmink J M van Weeren P R & Stolk P W Th.

Complications are common during healing of traumatic wounds on the distal limbs of horses. After primary closure dehiscence frequently occurs as a result of wound infection and sequester formation. Subsequently, second-intention healing follows, which is a time-consuming process that can not be entirely controlled.

In a recent experimental study it was found that second-intention healing occurred significantly faster in ponies than in horses, and this was mainly due to the greater contribution of wound contraction to wound closure. However, no reports existed about any possible differences in wound healing between horses and ponies in the clinical situation. It was also unclear what the reason was of these differences in healing. Therefore, a retrospective study was performed on the healing of traumatic wounds in 496 horses and ponies. Also a microscopic evaluation was done of biopsy material from the experimental study mentioned above.

The retrospective study showed that there were no substantial differences between the groups of horses and ponies or the respective types of wounds, with exception of the fact that in the limb wounds of ponies in significantly more cases periosteum was damaged and denuded bone was present. However, primary closure was achieved significantly more often and sequesters were formed significantly less often in ponies, thus confirming the experimentally found differences between horses and ponies.

The microscopic study revealed that in ponies the acute inflammatory response was strong but short with initially high numbers of polymorphonuclear leukocytes, whereas in horses this response was weaker but long-lived. This strong and short inflammation in ponies may be more effective against wound infections which would explain that in ponies primary closure was achieved more often and less sequesters were formed. With respect to second-intention healing this strong and short inflammation resulted in a faster demarcation and thus a faster preparation for healing to occur. In the granulation tissue no differences existed in numbers of myofibroblast or their smooth muscle actin content. However in the ponies these cells were regularly organized perpendicular to the vessels and parallel to the wound surface, whereas in the horses these cells were chaotically and randomly dispersed. The regularly organized myofibroblasts in ponies appeared to develop higher contractile forces resulting in more wound contraction. Also the mitotic activity in the granulation tissue of the limb wounds was

significantly higher in horses than in ponies. This could explain that formation of exuberant granulation tissue in horses is so commonly seen in equine practice.

Although the events at cellular level can explain the clinically and experimentally observed differences in healing between horses and ponies, there is still uncertainty about the initial factors. The role of both inflammatory mediators and growth factors should be thoroughly investigated although genetic differences between horses and ponies can not be excluded either. For the equine practitioner it is good to know that the prognosis in general will be better in ponies than in horses irrespective whether primary or second intention wound healing is aimed for.

SOME BIOMECHANICAL AND DIAGNOSTIC ASPECTS OF BACK PROBLEMS IN HORSES

Ranner W

Little is known about the etiology and pathogenesis of the Kissing Spine-Syndrome (KSS) in horses. Therefore, clinicians assumed a lot of factors, such as bridle, saddle, unrecognised lameness or the rider's weight to be responsible for KSS. Difficulties in interpreting reactions from results of palpation correctly and working on cases over a long period of time are the main reasons for the empiric knowledge about the KSS.

An explanation about the development of KSS will be theoretically described and logically substantiated: The summits of the thoracolumbar spine of the horse are subjected to a physiological remodeling-process, which is mainly caused by the traction of the Lig. supraspinale. The summits approach each other and can possibly come into contact without causing pain (inapparent KSS). If the backbone is repeatedly flexed past normal degree in a ventral direction, the summits and the Ligg. interspinalia will be traumatized and apparent KSS will develop. The reason for this lies in the absence of shock absorbing dynamic tension in the backbone ("natural movement"), which is fundamentally dependent on the position of the head and neck. The rider greatly influences the position of the head and neck. If, over months and/or years, the rider does not allow the horse, "natural movement", the musculature is not able to compensate for the weight of the rider during downward movement of the backbone. The backbone is then forced downward past a normal degree and the summits of the Processus spinosi and the Ligg. interspinalia are traumatized. Therefore, besides all other factors that lead to tension, such as inadequate bridle, saddle, or lameness, the rider and his riding style must be considered as the most important cause for KSS.

AETIOLOGY OF PARASAGITTAL FRACTURES OF THE DISTAL CONDYLES OF THE THIRD METACARPAL BONE - A NEW HYPOTHESIS

Riggs C.M Jones S J & Boyde A

Para-sagittal fractures of the distal condyles of the third metacarpal (McIII) and third metatarsal (MtIII) bones are common in Thoroughbred racehorses. They usually occur during high speed exercise but are rarely associated with any single traumatic event. In the absence of an obvious cause these injuries are often classified as “spontaneous” in nature.

The configuration of para-sagittal fractures of McIII and MtIII is highly consistent, suggesting a common aetiopathogenesis between cases. A number of hypotheses have been advanced to explain these fractures although to date none have stood up to critical scrutiny.

The current report describes a detailed study of the microarchitecture of the distal condyles from normal and fractured McIII and MtIII from Thoroughbred racehorses. Novel SEM techniques were developed to determine the three dimensional structure of cancellous bone and its mineralisation density at the microscopic scale. Computerised tomography and histomorphometric studies were used to document variation in apparent bone density throughout the condyles. Various methods were used to demonstrate pathology at macro- and microscopic resolution.

There is a characteristic motif to the structure of the distal condyles: Trabeculae are arranged as plates orientated in the sagittal plane. Subchondral bone in the distopalmar/plantar aspect of both condyles, but not the sagittal ridge, becomes sclerotic in older animals. Defects in the mineralised cartilage which were associated with intense focal remodelling of underlying subchondral bone were a frequent finding in “normal” bones at the usual site of fracture. Close analysis of fracture specimens revealed the fracture to initiate and pass through similar, relatively long standing changes.

These findings suggest that condylar fractures are a composite of undue stiffening of the palmar/plantar aspect of the condyles, but not the sagittal ridge, which leads to concentration of strain at the condylar grooves which results in increased fatigue damage, a reactive remodelling response and, in some cases, extension to catastrophic fracture. The arrangements of trabeculae is such as to offer minimal resistance to propagation of fractures in the sagittal plane.

DIAGNOSIS OF LAMENESS IN CATTLE

Edwards G B

Although trotting and lunging, which are vital aspects of investigation of the lame horse are not applicable to the cow, the diagnosis of lameness in cattle is generally much less difficult. In approximately 88% of lame cattle the problem is located in the feet and, of those, approximately 90% involve the outer claw of the hind foot. With very few exceptions, foot lameness in cattle is associated with infection which gains entry to the deeper structures via a breach in the solar horn, skin of the interdigital cleft or, less frequently, through the hoof wall. Secondary infection with *Actinomyces pyogenes* rapidly follows and the ability of this organism to cause severe destruction, not only of soft tissue but also bone, makes it imperative that the condition is quickly diagnosed and treated, particularly when the lesion is located at the sole heel junction where three vital synovial structures are located within the hoof.

The remaining 12% of lameness in cattle comprises a variety of conditions affecting the hip, stifle, hock and, less frequently, other joints, muscles and nerves.

Observation

Cattle which are halter-trained cattle may be assessed at a walk, but if not, standing or when turned out into a yard. Much can be learned from observing the stance. For example, the level of the accessory digits relative to the ground is useful in comparing the weight borne by the two hind feet. Cattle can relieve the weight on a painful digit by abducting or adducting the leg and in a cubicle may stand with the heel overhanging the rear of the standing to avoid putting weight on a solar ulceration lesion. Outward rotation of the stifle with inward rotation of the hock is seen in coxofemoral dislocation and hip dysplasia. Redness and swelling of the interdigital cleft or heel bulb may be present and palpation of coronary band for pain is helpful in detecting infection which is tracking up the hoof wall. Two claws on the same foot allow for direct comparison when feeling for increased heat or a pain response to manipulation.

Any one of a variety of methods of physical restraint may be employed to facilitate examination of the feet.

It is essential that the foot be thoroughly scrubbed clean, not only the sole but also the hoof wall. Percussion and compression are useful in identifying pain in the absence of an obvious horn lesion. The solar horn should be pared to eliminate any dark areas which may lead to a focus of infection. In the majority of cases there is an obvious lesion to be found provided the examination is carried out carefully and thoroughly. In the absence of such a lesion, a

diagnostic nerve block should be considered. The rather complicated nerve supply of the bovine digit makes it impossible to block one digit completely while leaving the other with normal sensation. However the perineural block described by Raker (1956) can be modified to allow pain to be localised to a particular digit.

Radiography of the foot is rarely carried out on the farm but is necessary to confirm a diagnosis of fracture of the third phalanx and can provide valuable information about the amount of bone destruction and proliferation due to actinomyces infection.

Lameness problems located at sites other than the foot frequently require radiographic investigation. Joint problems such as osteochondrosis, sepsis and cruciate ligament rupture can be demonstrated in the standing position but investigation of the hip joint must be carried out in dorsal recumbency preferably under general anaesthesia. Radiographs of even the hock and carpus in adult cattle may be beyond the scope of even the high-powered portable equipment and investigation of these and the more proximal joints is best performed at a referral centre.

In valuable cattle when a definitive diagnosis is not possible by other means scintigraphy is worthy of consideration as is arthroscopy. Ultrasonography may be applied with advantage in combination with radiography to evaluate joints, and identification of radiolucent foreign bodies.

RADIOGRAPHY AND RADIOLOGY OF BOVINE ORTHOPAEDIC PROBLEMS

Verschooten F

The technique for radiographic examination of the bovine appendicular system is comparable to that used in equines. The shoulder joint and particularly the stifle joint in adult bovines are less accessible than in horses. With the mnemonic "ADDITTOM (Anomalies of development, Dysplasia + dystrophy, Degeneration, Infection Trauma, Tumour, Osteochondrosis, Metabolic disease) in mind, affections of the musculoskeletal system are almost completely covered.

Anomalies in development such as congenital abnormalities, are rare: polydactyly, syndactyly, arthrogryposis or CAR, flexed pastern/flexed fetlock, unilateral malformations of bones and/or joints.

Hip dysplasia is extremely rare and bone dystrophy is uncommon as well.

In older bovines, degenerative joint disease of the distal interphalangeal joint, the metacarpo(tarso)-phalangeal joint, the carpal, tarsal joints and stifle, ankylosing spondylosis are often referred to in the literature, but are uncommon in our clinical files.

Infections in bones and joints of the appendicular skeleton were found in 976 of the 4,462 radiographic bovine patients during 12 years in our clinics. Osteomyelitis is found either close to the growth plate (GP), mainly at the metaphyseal and/or the epiphyseal side (the GP is mostly involved as well). Primary subchondral epiphyseal osteomyelitis or osteomyelitis secondary to infectious osteo-arthritis are commonly found as well. General infections of the lungs, disorders of the intestines and other internal organs are in most cases not responsible for the occurrence of osteomyelitis or infectious arthritis. Primary infectious (osteo)-arthritis is possibly induced by traumatic events to the joints which are subsequently rapidly infected. Any joint can be infected. Infections of the vertebrae might induce ataxia or paraplegia.

Distinct traumatic joint affections, e.g. distortion, are rarely encountered in cattle. Luxation of the hip and the sacro-iliac joint rarely occur in adult cattle and lateral luxation of the femoro-patellar joint in new-born. Subluxation as a result of a rupture of the cranial cruciate ligament is common in the adult animal, subluxation of the elbow occurs rarely in adult cattle. Pathological subluxation occurs in addition to infectious (osteo)-arthritis.

Fractures of the tibia, femur, metacarpus, metatarsus and the 3rd phalanx are the most common. GP fractures are common in the metacarpal and metatarsal bone.

Osteochondrosis is no real problem in cattle. Bone tumours of the appendicular skeleton are extremely rare (1 osteosarcoma at the metacarpus in 7,573 cattle during a period of 22 years).

Metabolic disease: a rickets-like condition is occasionally seen. Epiphysolysis, upward fixation of the patella and spastic paralysis are difficult to classify.

Traditionally radiographic examinations are rarely performed on a large scale in practice (notwithstanding some exceptions) due to financial considerations. They are nevertheless imperative in order to make an accurate diagnosis, prognosis and treatment.

ANAESTHESIA OF THE YOUNG BOVINE SURGICAL PATIENT

Gasthuys F M R

Many anaesthetic drugs are not approved for use in food animals, including calves. Although little research has been performed, young calves are physiologically different from mature animals. Because of the immature ruminant system, calves have seldom regurgitation and/or tympany problems compared to adult animals.

Sedation is often required in calves for diagnostic and surgical procedures. Phenothiazines e.g. acetylpromazine can induce with profound cardiovascular effects (hypotension).

Benzodiazepines e.g. diazepam produce minimal calming effects in normal adult animals but are effective in younger bovines. All ruminants are particularly sensitive for alpha-2 agonists (xylazine, detomidine). These drugs are associated with a dose dependant respiratory depression, bradycardia, moderate hypotension and salivation. Alpha-2 antagonists (tolazoline, atipamezole) can be administered as antidotes, even after long lasting anaesthetic procedures. Narcotic analgesic drugs have not been extensively used in cattle.

Local anaesthetic techniques combined with sedation allow most of routine surgical interventions in calves. Procaine can be preferred in young animals because it is metabolised by the plasma cholinesterase. However, lidocaine (\pm norepinephrine 1:200,000) remains the agent of choice. Diluting the 2 % to a 1 % solution is indicated in all calves to avoid possible toxicity. Infiltration analgesia (line block) of the abdominal wall is commonly used for laparotomy, even in "the acute abdomen". A caudal epidural analgesia (between S5 - Co1 or Co1- Co2) can be used for surgical procedures involving the hind quarters. Intravenous regional analgesia of the thoracic or pelvic limbs is an accepted technique for different interventions (e.g. arthodesis, fractures, amputation). However, the application of a tourniquet can provoke a pain reaction.

General anaesthesia can be achieved using injection (bolus or infusion) or inhalation techniques (mask or orotracheal intubation). Ketamine (\pm benzodiazepine) gives about 10 - 15 min anaesthesia. The "triple drip" (guaifenesin + xylazine + ketamine) is an useful alternative, even for longer procedures. Premedication with xylazine and local anaesthetic techniques reduces the dose. Oxygen supplementation is recommended to avoid arterial hypoxaemia. Adult human anaesthetic machines (+ ventilators) are suitable for calves up to 150 kg of bwt. Isoflurane offers certain advantages (rapid induction and recovery, minimally metabolised, higher therapeutic index). Routine monitoring (blood pressure, pulse oxymetry and anaesthetic gas analysis, body temperature) can be justified.

References: C.R. Swanson. Anesthesiology Update. The Veterinary Clinics of North America, Food animal Practice, 12,3, 1996.

MANAGEMENT OF METACARPAL, METATARSAL, RADIAL AND TIBIAL FRACTURES IN CALVES

Steiner A

Fracture configuration:

Physeal fractures are classified according to Salter and Harris. The proximal physes of metacarpus (MC) III/IV and metatarsus (MT) III/IV are fused at birth. The proximal radial physis fuses at 12 - 15 months, the distal physes of MC III/IV, MT III/IV, and tibia at 2 - 2.5 years, and the distal radial and the proximal tibial physes at 3.5 - 4 years, respectively.

Diaphyseal fractures may be classified according to Unger et al.(1) Simple fractures are characterised by almost complete circumferential contact, wedge fractures by partial contact, and complex fractures by lack of contact of the proximal and distal main fragment after fracture reduction.

Frequency of occurrence:

MC/MT-fractures: MC III/IV fractures are more frequently diagnosed than MT III/IV fractures, and the latter more frequently than radial and tibial fractures (2,3). Most fractures occurring as a consequence of forced extraction during parturition, are classified as complex distal diaphyseal metacarpal fractures. Skin perforation (open fracture) in these cases is common. Closed Salter-Harris type II is among the most frequently diagnosed fractures in cattle within the first 12 months of life (3,4).

Radial fractures: Diaphyseal fractures are most commonly encountered.

Tibial fractures: Both, physeal (proximal and distal) and diaphyseal fractures are commonly encountered.

Principles of treatment:

MC/MT-fractures: Cases, in which fracture configuration allows sufficient stability in the longitudinal axis, closed reduction and external fixation is indicated (half-limb cast for Salter-Harris type I and II fractures and full-limb cast for simple horizontal diaphyseal fractures). Simple oblique and wedge diaphyseal fractures are best treated by open reduction and internal fixation (ORIF), while application of a walking-cast according to Németh and Back is a valuable technique for treatment of complex fractures (5). Curettage, lavage, and implantation of gentamycin-impregnated collagen sponges may be beneficial as additional measures in cases of open complex fractures (6). Up to a body-weight of 250 kg, fracture repair, using one broad 4.5 mm DCP and 5.5 mm screws provides sufficient stability in most cases of simple or wedge diaphyseal fractures (2).

Radial fractures: Complex fractures of the distal radius are treated by administration of a walking-cast, while ORIF, applying 2 broad 4.5 mm DCP in the cranial and lateral aspects of

the radius, provides adequate stability in cases of simple or wedge diaphyseal fractures (7). Administration of an angle plate may be indicated, if one main fragment is too short to harbour sufficient screws.

Tibial fractures: Physeal fractures may best be treated by cross-pin fixation alone (proximal physis), or in combination with a full-limb cast (distal physis). Simple and wedge diaphyseal fractures may be treated by transfixation pinning or by ORIF, applying 2 broad 4.5 mm DCP in the cranial and medial aspects of the tibia. Transfixation pinning seems to be the only promising technique in cases of complex diaphyseal fractures (8).

References:

- 1.Unger M, Montavon PM, Heim UFA. Classification of fractures of long bones in the dog and cat: Introduction and clinical application. VCOT 1990;3:41-50.
- 2.Steiner A, Iselin U, Auer JA, et al. Shaft fractures of the metacarpus and metatarsus in cattle. VCOT 1993;6:138-45.
- 3.Steiner A, Iselin U, Auer JA, et al. Physeal fractures of the metacarpus and metatarsus in cattle. VCOT 1993;6:131-7.
- 4.Köstlin RG, Nuss K, Elma E. Metakarpal- und Metatarsalfrakturen beim Rind: Behandlung und Ergebnisse. Tierärztl Prax 1990;18:131-44.
- 5.Németh F, Back W. The use of the walking cast to repair fractures in horses and ponies. Equine Vet J 1991;23:32-6.
- 6.Hirsbrunner G, Steiner A. Treatment of delayed union and septic osteomyelitis of metacarpus III/IV in a calf using gentamicin-impregnated collagen sponges and minimal external coaptation. VCOT 1998;11:19-22.
- 7.Steiner A. Principles of treatment of shaft fractures of metacarpus III/IV and radius in cattle, as advocated for breeding animals. Proc. 8th Annual ESVOT Congress 1996;129-30.
- 8.Martens A. Tibial fractures in cattle: Results of a transfixation technique. Proc. 8th Annual ESVOT Congress 1996;131.

MANAGEMENT OF SEPTIC ARTHRITIS IN CALVES: 63 CASES (1994-1997)

Nuss K

Introduction

Septic arthritis is a frequent condition in bovines. In contrast to small animal or equine patients, institution of treatment is often delayed, resulting in the presentation of more advanced stages of joint infection.

Materials and methods

Between January 1994 and December 1997, 40 male and 23 female bovines up to 8 months with septic monoarthritis were presented. A range of joints were affected (table 1). Diagnostic aids included radiography, ultrasound and occasionally scintigraphy. The character of the arthritis was serious in 3 joints, serofibrinous in 21, fibrinous in 10, purulent in 27 and putrid in 2 joints. In 60 patients, synovia was examined macroscopically, and in 28, cell count and chemistry was performed. Mean WBCC was 46,766 /l (range 16,400 to 150,000) with 92.5% neutrophils (sd 6,5), and a mean total protein of 52 mg/dl.

Culturing of 44 synovial samples was positive in 50% of the cases. Predominant micro-organisms were *A. pyogenes* (10) and *Streptococci spec.* (10), but also other Cocci (5), *Bacteroides spec.* (4), *E. coli* (2), *Clostridium spec.* (1) and *Staphylococcus spec.* (1).

Eleven calves were put to sleep on the basis of a poor prognosis, 52 were treated by distension-irrigation-lavage, arthroscopy or arthrotomy (table 1).

Joint	No. of joints	Not treated	Lavage (healed)	Arthroscopy (healed)	Arthrotomy (healed)	Other methods (healed)	Total treated (healed)
Shoulder	4	1	2 (1)	-	1 (1)	-	3 (2)
Elbow	4	2	1 (0)	-	1 (0)	-	2 (0)
Radiocarpal	9	3	4 (4)	-	1 (0)	1 (1*)	6 (5)
Intercarpal and carpometacarpal	6	1	1 (1)	-	4 (3)	-	5 (4)
Hip	3	0	3 (3)	-	-	-	3 (3)
Medial femorotibial and femoropatellar	9	2	6 (4)	1 (0)	-	-	7 (4)
lateral femorotibial	3	1	1 (1)	1 (0)	-	-	2 (1)
Tibiotarsal	13	0	11 (8)	1 (1)	-	1 (1**)	13 (10)
Fetlock	12	1	3 (3)	-	8 (7)	-	11 (10)
Total (healed)	63	11	32 (25)	3 (1)	15 (11)	2 (2)	52 (39)

Table 1: Septic arthritis in 63 calves. Affected joint, treatment methods and results.
*amputation of limb; **medical treatment only

Results and Discussion

In total, 75% of the treated calves were cured with regards to normal function. Distension-irrigation-lavage was found to be a successful method of treating early septic arthritis (Jackson et al 1996). Arthroscopic debridement with implantation of gentamicin sponges is successful but expensive (Steiner et al. 1997). In addition, in advanced cases of septic arthritis, the entry into the joint is difficult because of the intense thickening of the skin and subcutaneous tissue. Also, the observation and debridement of the joint is made difficult due to fibrin adhered to the cartilage and synovial membrane. (Trotle et al 1997). In purulent arthritis of the carpal and fetlock joints, arthrotomy as described by Verschotten et al. (1974) was a successful therapeutic technique.

References:

1. Jackson PGG, Strachan WD, Tucker AW, Martin-Smith N, Watts TC Treatment of septic arthritis in calves by joint lavage - a study of 20 cases. Proc. 19th World Buiatrics Congress 1996, Vol 2; 554-8.
2. Steiner, A. Hirsbrunner G. Use of gentamicin-impregnated collagen implants for treatment of chronic intrasynovial infections in ruminants: Preliminary results. proc 6th An Scient Meet ECVS. Versailles 1997; 83-4.
3. Trostle SS, Nicoll RG, Forrest LJ, Markel MD, Clinical and radiographic findings, treatment and outcome in cattle with oseocondrosis. 29 cases (1986-1996). JAVMA 1997; 211: 1566-70.
4. Verschooten F., DeMoor A. Infectious arthritis in cattle. A radiographic study. JAVRS 1974. JAVRS 1974; 15; 60-9.

FLEXURAL DEFORMITIES IN CALVES: PATHOGENESIS AND RETROSPECTIVE ANALYSIS OF SURGICAL TREATMENT

Van Huffel X

Flexural deformities in newborn calves (congenital arthrogryposis) are characterised by bilateral articular rigidity, mostly in flexion, of the phalangeal, metacarpo-phalangeal, carpal and or metatarso-phalangeal joints. In most cases (80%) both forelimbs are affected. The hindlimbs can also be affected either alone (10%) or in combination with the forelimbs (10%). Some cases also show outward rotation of the limbs and abduction of the shoulder.

This malformation involving the posture and the function of the limbs, occurs predominantly in oversized, male (85%), double muscled beef calves of which the parturition circumstances are characterised by dystocia, posterior presentation (48%) and caesarean section (81%).

Experimental models of congenital flexural deformity have shown that articular rigidity is caused by a lack of intra-uterine movement by the foetus during the second half of gestation due to foeto-maternal disproportion.

Depending on the severity of the flexural deformity (joint angulation, number of joints involved) therapy consists of conservative treatment (active stretching of retracted limbs, protecting the limbs against decubitus by bandaging, or splinting and immobilising the limbs) or surgery.

The surgical treatment is reserved for severe flexural deformities, or for calves that do not improve spontaneously with age or with conservative treatment. In general, the surgery consists of desmotomy or tenotomy of retracted tendons or peri-articular soft tissues. Afterwards a plaster cast is applied for 4 to 5 weeks. At the hindlimbs the metatarso-phalangeal joints are straightened by a deep flexor tendon lengthening procedure. In general, 80% of the operated calves can be kept to normal slaughter-weight. Failures are mainly caused by complicating presurgical conditions (poor general health, umbilical infection, open arthritis), or by poor surgical technique.

Exceptionally, if the angle between metacarpus and radius is less than 100°, it is better to perform an arthrodesis of the radio-carpal joint with resection of one or both carpal rows, in order to straighten the limb. In calves affected with a severe unilateral flexural deformity, radiocarpal arthrodesis can be considered as a good salvage procedure providing excellent results. In bilaterally affected calves the results of radio-carpal arthrodesis are poor.

SPASTIC PARESIS IN CALVES: PATHOGENESIS AND A RETROSPECTIVE STUDY OF TREATMENT BY PARTIAL TIBIAL NEURECTOMY

De Moor A Vlaminc L Martens A. & Steenhaut M

Spastic paresis is a disease of unknown etiology that is found in many breeds of cattle. An overactive stretch reflex has been proven to be the basis of the disease. Indeed, the signs of spasticity can be completely eliminated by resection of the dorsal roots of the lumbar spinal cord containing the afferent nerve fibres of the gastrocnemius muscle. Moreover, a selective epidural anaesthesia of the g motor neurons, responsible for the tonus in the gastrocnemius muscle, results in the disappearance of the spastic contractions. The treatment of spastic paresis is symptomatic. A tenotomy of three branches of the gastrocnemius muscle or a partial neurectomy of the tibial nerve can be performed.

In a five year time period (1993-1997) 113 cattle with spastic paresis were surgically treated using a partial neurectomy of the tibial nerve. The final results were obtained by telephone questionnaire and were classified as good when the surgically treated limb showed no further spastic contractions, moderate when the affected limb had improved considerably but still showed intermittent spasticity. The results were classified as poor when the spastic contractions persisted or when the animals showed a severe hyperflexion of the hock. The minimal follow-up period was 3.5 months.

Of the 113 treated animals, 69 were male and 44 female. Mean age was 4.5 months. All animals belonged to the double muscle Belgian blue breed. In 61 cases, the spasticity was bilateral. Only three of those animals were bilaterally operated with one month interval. In the remaining 58 bilateral cases, only the most severely affected limb was surgically treated. Good results were obtained in 94 animals (83.2%). In 71 of them, the position and motility of the hindlimbs was completely normal. Twenty three others showed a slight deviation of the normal position of the affected limb. Moderate results were obtained in 5 cases (4.5%). Poor results were obtained in 14 cases (12.4%). Nine of these animals showed persistent spasticity of the surgically treated limb. The remaining five animals had a persisting hyperflexion of the hock. In 15 bilaterally affected animals that were treated with good results on the most severely affected limb, a spontaneous improvement of the other limb was observed. The obtained results were independent of the sex of the animals or the uni- or bilateral affection. The mean age of animals treated with poor results (3.4 months) tended to be lower than the age of the animals treated with good or moderate results (respectively 4.6 and 5.9 months).