Date: 31-12-20

Final report

Growth cartilage blood supply to the small tarsal joints, versus developmental disease and spavin

(Norwegian title: Blodtilførselen til vekstbrusken i glideleddene, med relevanse for utviklingssykdommer og spatt)

Project number: H-16-47-192, NRC: 272 326

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Main applicant:
Kristin Olstad, Norwegian University of Life Sciences, kristin.olstad@nmbu.no

Co-applicant(s):
Main applicant, Sweden: Kerstin Hansson, Swedish University of Agricultural Sciences

Co-applicants:
Sigridur Björnsdottir, Icelandic Food and Veterinary Authority
Stina Ekman, Swedish University of Life Sciences
Charles Ley, Swedish University of Life Sciences
Magnus Lilledahl, Norwegian University of Science and Technology

Cathrine Fjordbakk, Norwegian University of Life Sciences was not a formal co-applicant, but has contributed to the project.

PLEASE NOTE: The report has been formatted to match the final report in Norway.

Part 1: Detailed summary

Hovedmålet var å undersøke blodtilførselen til vekstbrusken i kuboidalknoklene i hasen, for å beskrive utvikling og øke forståelsen av sykdommer som osteochondrose og osteoartritt/spatt. Bakbeinspar fra døde føll donert til forskning ble undersøkt med kontrast-perfusjon og mikro-computertomografi (CT), magnetisk resonans (MR) avbildning og histologi. MR representerte blodtilførselen til vekstbrusk bedre enn CT fordi perfusjon gav tilstopping og lekkasje. Blodtilførselen bestod av vertikale og horisontale blodkar, og var tilbakedannet ved ca. 60 dager på CT og MR, og 120 dager på histologi. Både CT og MR viste osteochondroselesjoner som fulgte vertikale og horisontale blodkar. Histologisk undersøkelse bekreftet at lesjoner skyldtes svikt i blodtilførselen til vekstbrusk, og viste at noen av forandringene i osteochondrose overlappet med tidlig osteoartritt/spatt. MR bør brukes for å studere blodkar, mens CT er bra for å fange opp lesjoner, og begge deler kan overføres til levende dyr.

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Part 2: Main report

Introduction

The skeleton of the limbs consists mainly of long bones and small, so-called cuboidal bones found in the knee (carpus) and hock (tarsus) joints. Both categories of bone can suffer from developmental diseases,[1] characterised by the fact that they arise while the animal is still growing, even if they are often discovered after the animal is skeletally mature.

In long bones, the understanding of developmental diseases has benefitted greatly from studies of the blood supply to growth cartilage.[2] Osteochondrosis is defined as a focal disturbance/delay in endochondral ossification. Research has shown that failure of the blood supply leads to ischaemic chondronecrosis, or infarcts in growth cartilage, and it is these infarcts that cause the delay in endochondral ossification and osteochondrosis.[2] Cuboidal bones suffer from osteochondrosis, but the hock joint also gets other developmental diseases such as incomplete ossification and wedge malformation. In the hock joint, the cuboidal bones articulate in small, low-motion joints that can acquire developmental joint inflammation or osteoarthritis, known as bone spavin. Icelandic horses have high prevalence[3] and are heritably predisposed[4] for spavin.[3]

The main project aim was to determine whether the understanding of developmental diseases such as osteochondrosis and osteoarthritis/spavin could be increased by studying the blood supply to the growth cartilage of cuboidal bones in the hock.

Material and methods

It turned out easier to organise computed tomography (CT) than magnetic resonance imaging (MRI), and the different parts of the project were therefore completed in the order of A: barium perfusion and CT, B: histological validation and C: MRI. The practical work with parts A-C is 100 % complete; part A has been published, whereas part B is nearly ready for submission to the journal *Veterinary Pathology*, and part C is currently being written up.

A: Barium perfusion and CT, performed at NMBU Faculty of Veterinary Science
Materials: One hind limb, most often the left, from 23 foetuses and foals from 228 days of gestation to 5 months old, donated to research after death or euthanasia for various reasons. This included 12 Icelandic Horse foals, and 11 foals of various breeds for comparison.
Methods: The limb was suspended from the hoof and drained, before it was perfused with barium and imaged using conventional CT (results not reported). The two largest cuboidal bones: the central, and the third tarsal bone, were dissected out, sawed into two halves and scanned using high resolution micro-CT. In total, 23 limbs x 2 bones x 2 halves = 92 blocks were scanned and read for normal development, blood supply and lesions.

B: Histological validation, prepared at NMBU and sectioned at SLU
Materials: 16/23 hind limbs from part A were selected for histological examination because they contained generalised (n = 3 limbs; 1x coarse patches, 2x incomplete ossification) or focal (n = 13; radiological osteochondrosis) changes in micro-CT scans.
Methods: Bone halves were formalin-fixed, decalcified, split into quarters, then parasagittal slabs and paraffin-embedded. All slabs with macroscopically visible changes, and all slabs that appeared to correspond to the location of changes in micro-CT scans, were selected for sectioning and staining. A total of 71 slabs; 43 from the central and 28 from the third tarsal bone, were selected, and 219 sections were prepared (average: 3 sections/slab) and stained

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with haematoxylin and eosin, toluidine blue and gram TWORT for histological evaluation of tissues, blood supply and lesions, individually and together to show development with age.

C: MRI, prepared at NMBU and performed at NTNU, Trondheim
Materials: Initially, pilot scans of 4 small, intact foal and pig samples were performed. Next, the central and third tarsal bones from 10 larger, Icelandic Horses were dissected and sawed in half for MRI scanning. Dissection is recommended to reduce field of view and maximise image quality, but scans of 4 dissected tarsal bones were non-diagnostic because of severe, un-correctable blooming artefacts, and further scanning of dissected bones was abandoned. Instead, 5 archived limbs from 1 foetus and 4 foals were recruited. The foetus was aborted at 270 days of gestation, and the foals were 3-63 days old.
Methods: The original plan was to describe development with age, but after the discovery of the artefacts, it was determined that it was necessary to first describe how best to achieve diagnostic scans of tarsal cuboidal bone blood supply, tissues and lesions. Methods therefore consisted of comparing several practical aspects of limb preparation/scanning: draining vs. not draining, dissection vs. intact, thawing for 24 vs. 48 hours, and scanning in air vs. immersed in a susceptibility-reducing medium (fluorinert). Samples were scanned in a 7T commercial rodent scanner (Bruker Corp). A large number of acquisition protocols were obtained including various 2D and 3D T1-, T2- and T2*-weighted spin or gradient echo sequences, inversion recovery sequences and fat-supressed images. Finally, a number of commercial and self-generated scripts for post-processing were applied, including mainly susceptibility-weighted (SWI) and quantitative susceptibility mapping (QSM) to show blood vessels/cartilage canals, and T2* mapping to examine growth cartilage matrix/lesions. MRI images were tentatively interpreted based on comparison with the histological sections acquired in part B, and the appearance of blood vessels/canals, growth cartilage, bone and fibrous tissue/ligaments were compared between different acquisition/processing protocols. Tissue and vessel characteristics were described in multi-gradient sequences from foetus to 63 days old, and focal changes compatible with osteochondrosis lesions were described.

Results and discussion
Below, we use the results of parts A, B and C together to answer research questions D, E, F and the overall research aim.

Research question D: Is it possible to study blood supply to the growth cartilage of tarsal cuboidal bones in limbs from foals donated to research after death using CT or MRI?
-Other authors have described successful perfusion of the circulation (arteries, veins) with barium in bones collected after death/post-mortem.[6-7] It was therefore not unreasonable to believe that post-mortem perfusion could be a highly ethically acceptable and good method for studying blood supply, and the perfusion in part A was originally meant to function as validation for MRI of the blood supply in part C.
-The historical studies[6-7] contained subjective comments that perfusion was difficult and sometimes seemed incomplete, but it was not quantified exactly how incomplete it was.
-It would have been ideal to validate the post-mortem perfusion by comparing it to the previously used terminal perfusion protocol,[2] but the teaching hospital was closed with salmonella for 2 years and there were no foals available for terminal perfusion.
-Instead, the specimen with the most successful post-mortem perfusion was identified by criteria like evenness of barium contents and consistent gradual tapering of contrast column termini to a point. Perfusion success of the rest of the specimens was then judged by comparing them to the most successfully perfused specimen.

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-Subjectively, it was noted that the perfused specimens either contained very little barium, or were dominated by large foci of barium, representing vessel blockage, bursting and leaks.
-Ranking the perfusions relative to each other revealed that perfusion yielded partial information in 9/22 (41%) limbs and no useful information in 13/22 (59%) limbs.
-This forced the conclusion that the success of post-mortem perfusion by the current method was extremely disappointing and therefore could not be used as originally intended.
-Even so, it was useful to be able to develop a systematic method for evaluating and "semi-quantifying" perfusion success in the absence of a terminal perfusion comparison. We hope this save other researchers from attempting post-mortem barium perfusion in future.
-In comparison, when judging diagnostic vascular SWI and QSM MRI scans, the signal from cartilage canals was more evenly distributed and there was no evidence of vessels bursting, meaning that MRI gave a much more complete representation of the blood supply than contrast-perfusion micro-CT.
-The teaching hospital is open again and, subject to permissions, we may be able to procure a positive control for the MRI scans in terms of a terminally-perfused specimen.
-In the meantime, the histological sections from part B are being used for interpretation and control of the MRI scans in part C.
-The MRI scans in part C also function partly as their own comparison controls because: two limbs were suspended by the hoof to drain after collection, before scanning, and the other two limbs lay flat. Some of the blood vessels enter the tarsal cuboidal bones, makes a 90 degree turn proximal/up or distal/down. In the drained limbs, it is possible to see a difference in signal between the distal/drained and proximal/non-drained side that is not apparent in the non-drained limbs. From this, it is possible to infer and indirectly validated that the signal that emanates from the non-drained side must represent blood vessels.

In answer to research question D: It is possible to study the blood supply to the growth cartilage of tarsal cuboidal bones in limbs from foals donated to research after death. Based on the current results, it is not recommended to use barium perfusion and CT, but rather; it is recommended to avoid draining or dissecting limbs, freezing them whilst lying flat and scanning them using vascular MRI protocols like QSM or SWI.

E: What is the configuration and development of the blood supply to the growth cartilage of cuboidal bones?
-In simplified terms, both CT and MRI revealed that the blood supply to the central and third tarsal bones consisted mainly of vertical and horizontal vessels. Vertical vessels were present both peripherally and centrally, where they could traverse the entire thickness of the bone, referred to as transverse vessels. Horizontal vessels were mainly present towards the front/dorsally, where they followed the circumference of the bone, starting from the medial/inside or lateral/outside side of the limb.
-Blood vessels demonstrated both features that have previously been implicated in why vessels fail, the first feature being: traversing junctions between growth cartilage and bone,[2] and the second feature being traversing junctions between growth cartilage and ligaments.[8]
-The blood supply had regressed by about 60 days of age in CT and MRI scans, and by about 120 days of age in histological sections. The difference is due to the fact that by how they were used in the current study, histological sections had higher resolution and therefore showed smaller vessels than CT and MRI. Micro-CT can achieve similar resolution to histology, but in order to show vessels, the perfusion must be more successful than it was in the current study, i.e. performed as a terminal,[2] rather than a post-mortem procedure.

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-During the evaluation of the blood supply, it was discovered that the tarsal cuboidal bones grow in a slightly different way than the previously studied ends of long bones like the femur and tibia. The femur and tibia ends grow exclusively by endo-chondral, or within-cartilage ossification. The central and third tarsal bones grew exclusively by endochondral ossification up to about 4 days of age. After this age, it continued to grow by endochondral ossification in the proximal/up and distal/down directions, but around the periphery, i.e. to all sides of the bone, growth cartilage was gradually replaced by fibrous tissue and growth changed from being within-cartilage, to being within-fibrous tissue, also known as intramembranous ossification. From 105 days onwards, peripheral growth was purely intramembranous. To the best of our knowledge, this has not been described in limb bones before, and it will be interesting to study this further and determine what, if any difference it may make to how diseases arise and progress in tarsal cuboidal bones compared to other bones.

In answer to research question E: The blood supply to the growth cartilage of tarsal cuboidal bones could in simplified terms be said to consist mainly of vertical and horizontal vessels, and it regressed by about 60 days in CT and MRI scans, and 120 days in histological sections.

F: What is the relationship between blood supply and developmental disease in cuboidal bones?

Incomplete ossification:
-Two foals had ossification centres that were under-sized relative to foals of similar age in CT scans, compatible with clinical diagnosis of incomplete ossification. In histological sections, the bones of these foals had a 1-2 mm-thick rim zone that looked relatively normal, and a central core zone where cells were abnormally pale and swollen. The contents of the cartilage canals in the core zone had dropped out, and it was therefore not possible to say if they contained live blood vessels or not. Drop-out can be artificial, but it can also occur due to disease, and it would be unusual for it to happen in multiple sections of different thickness, such as here. Blood vessels are present before, and responsible for initiating formation of ossification centres.[9] With the current results, it remains a possibility that incomplete ossification is a result of failure of the blood supply to growth cartilage, but if so, that failure is slightly different from osteochondrosis because it affects central arteries before formation of the ossification centre and results in pale, swollen cells, rather than dead, shrunken and dark cells like osteochondrosis.

Wedge malformation:
-It was not obvious that any of the included foals had wedge malformation, but theoretically speaking, failure of one of the horizontal blood vessels at the front of the cuboidal bones could lead to delayed ossification around a large part of the circumference of the bone. Delayed ossification at the front of the bone would mean that this would grow less than the back of the bone, causing wedge malformation.
-One foal had an osteochondrosis lesion that consisted of a shelf-like defect in the dorsal/front part of the third tarsal bone. It was not apparent that the bone was wedge-shaped at the time of the examination, but the foal was only ~50 days old, and wedge malformation could have developed later if it had lived on.
-It is interesting to note that the periphery of the tarsal cuboidal bones switched from endochondral, to intramembranous ossification. Cartilage has a matrix that is both compressible and rigid at the same time. The fibrous tissue in intramembranous ossification is not firm in the same way, it is just compressible, and it would be interesting to investigate whether this plays any role in the pathogenesis of wedge malformation.

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Osteochondrosis:
-It is easier to survey bone tissue in three dimensions quickly in many bones using CT than MRI, and as described, some of the material intended for MRI could not be used because it had been dissected. Thankfully, the splodges of leaked barium in the CT scans did not interfere with viewing of the bones because the software enables removal of the barium.
-It was possible to identify focal defects in ossification, or radiological osteochondrosis, with both CT and MRI, and CT revealed defects in 14/23 (61 %) of the examined bones. In the femur, identical CT defects have been confirmed to correspond to osteochondrosis in 100 % of cases. With the methodology used here, CT defects were confirmed to correspond to osteochondrosis lesions in 26 % of cases. The main reason for this difference was the fact that the cuboidal bones are small, have thin cartilage and develop small lesions, combined with the fact that an average of 3 thin sections were prepared per 2-3 mm-thick slab for histological examination, meaning there was a great risk of lesions escaping being captured in sections. We tried to counter-act this risk by sectioning multiple slabs, multiple times at up to four different depths, but it was not possible to support complete sectioning of all slabs financially.
-The 26 % confirmed lesions consisted of 6 separate lesions in 3 foals. Each of these foals had from 1-3 additional lesions that were not captured in histological sections. This indirectly supports that part of the reason why the percentage of lesions that was validated was so low was that it was challenging to capture small lesions in histological sections.
-The captured lesions all contained failed, necrotic/dead vessels, confirming that osteochondrosis in cuboidal bones represent failure of the blood supply to growth cartilage. The osteochondrosis lesions included one cyst-like lesion, one truly cystic lesion, two transverse, cylindrical lesions, and a shelf and a groove defect both in the same foal.
It was possible to see failed, vertical transverse vessels inside the transverse cylindrical lesions, and lesions detected in CT and MRI scans but not captured in histological sections also followed the configuration of vertical and horizontal vessels, strongly suggesting that they were the result of vascular failure.
-Most lesions were compatible with heritably predisposed osteochondrosis, in which case vessels apparently fail where they traverse junctions between different tissues[2,8] and there is no evidence of any other, acquired cause. Necrotic cartilage canals in one foal contained evidence of inflammation, which has previously been associated with failure of the blood supply caused by acquired bacterial infection,[11] so the lesions in this foal were potentially acquired, rather than heritably predisposed, but there were no bacteria in the lesion at the time of sampling.

Osteochondrosis and osteoarthritis/spavin:
-Some of the changes detected in the current examined up to 5 month-old foals with osteochondrosis overlapped with changes previously detected in 6 months to 2.5 year-old Icelandic Horses, examined because they were heritably predisposed for osteoarthritis/spavin.[3, 7, 12]
-For example; both groups had defects like grooves and cysts in their articular surfaces. In the group up to 5 months old, it was confirmed that the defects represented osteochondrosis. This means that if that osteochondrosis persists, rather than resolves, it could theoretically constitute the defects seen in early osteoarthritis at 2.5 years old, which in turn theoretically could progress to full-blown, radiological osteoarthritis by screening of Icelandic Horses at 5 years old.
-The implication is that osteoarthritis/spavin may be due to failure of the blood supply to growth cartilage and osteochondrosis; a failure that arises before 120 days/4 months old, and which it may be possible to detect and follow in foals from before that age and until screening age of 5 years old using advanced diagnostic imaging like CT and MRI.

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Conclusions

-MR was better than contrast-enhaned CT for studying the blood supply to the growth cartilage of the tarsal cuboidal bones of foals donated to research after death.
-CT nevertheless remained useful because it is easier to survey bone tissue in three dimensions quickly in many bones using CT than MRI.
-It was confirmed that defects in CT and MRI scans were the result of failure of the blood supply to growth cartilage and osteochondrosis. Failure of the blood supply can have both heritably predisposed and acquired causes.
-Both the CT and MRI techniques can now be translated to live animals so that they can be monitored over time to determine whether osteochondrosis really does lead to osteoarthritis/spavin.

Relevance for the practical horse sector incl. recommendations

This section matches the section in the Norwegian final report.
For the research field and competence development:
The most important implication of the project is that it represents the first time that MRI has been used to study the blood supply to growth cartilage within Scandinavia, something which opens up a world of opportunities. At SLU, there is a 1.5T MR-scanner with insufficient resolution to show blood vessels, but the new NMBU Veterinary Teaching Hospital has a 3T MR-scanner that is capable of demonstrating vessels in pigs, so it should work in horses, too. The fact that one can study blood vessels in bones from foals donated to research after death markedly increases potential material.
For industry, in this case: the equine industry:
-We conclude that the project has increased the understanding of developmental diseases in the cuboidal bones, something which is a requirement in order to improve prevention, diagnosis and treatment of such diseases.
-Clearly, the results must be examined and confirmed in more foals, and it is anticipated that it is important to the equine industry that this can now be achieved by translating the project results to CT and MRI of live foals.
-If it turns out that osteoarthritis/spavin occurs due to heritably predisposed osteochondrosis, this can dramatically influence the breeding/sale value of animals. It can become necessary to develop tests to distinguish between heritably predisposed, and acquired failure of the blood supply, such as analysis of biopsies, synovial fluid or genetic testing. Horses with negative genetic tests may increase in value.
-The results support that failure of the blood supply can be due to disease before 3-4 months of age. This means that disease prevention in foals is even more important than before, including early diagnosis and close monitoring to optimise conditions for spontaneous resolution, and reduce the risk of persistent disease.
-For horse owners with an interest in osteoarthritis/spavin, it can now be recommended to read the literature on how osteochondrosis is best prevented, or alternatively: encouraged to resolve, through manipulation of factors like selection of animals for breeding, prevention of infections, feeding and exercise.

Future studies:
-The single-most important thing that should be done next is to translate the results of micro-CT and 7T MRI to conventional CT and 3T or 7T clinical MRI, so that one can literally monitor disease development as it occurs in foals, from before 3 months to 5 years old, as this can conclusively prove whether osteochondrosis causes osteoarthritis/spavin or not.

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Part 3: Result dissemination

Scientific publications, *published*	***Radiological, vascular osteochondrosis occurs in the distal tarsus, and may cause osteoarthritis.*** *Sigurdsson SF, Olstad K, Ley CJ, Björnsdóttir S, Griffiths DJ, Fjordbakk CT. Equine Vet J. 2021 Feb 3. doi: 10.1111/evj.13432. Online ahead of print. PMID: 33534938*
Scientific publications, *submitted*	*(Manuscript number 2 is currently with all co-authors for final discussions, editing and preparation for submission to the journal Veterinary Pathology, see below)*
Scientific publications, *manuscript*	***Small tarsal bones of foals grow by endochondral and intramembranous ossification, and can develop osteochondrosis due to vascular failure*** *Olstad K, Ekman S, Sigurdsson SF, Fjordbakk CT, Ley C, Hansson K, Björnsdottir S* *Formatted for Veterinary Pathology, plan to submit in May, 2021*
	What to do and what not to do in post-mortem vascular MRI of equine small tarsal bones *Olstad K, Nissi M, Ley C, Hansson K, Ekman S, Hill D* *Manuscript in preparation*
Conference publications/ presentations	*(An abstract was submitted and accepted to the European College of Veterinary Surgeons annual meeting 2020, but was withdrawn because we needed more time to prepare)*
Other publications, *media etc.*	*Journals like The Equine Veterinary Journal will not accept results that have been presented with more than 300 words or any figures, so we tend to delay other publication until after scientific publications have been safely accepted, but an interview about paper 1 is scheduled with Trav- og galoppnytt on May 5th, 2021*
Oral communication, *to horse sector, students etc.*	***Carpus – en betydelsesfull led för utveckling av osteartrit hos häst****, 2019/september, Stina Ekman presented at open, public retirement seminar for professor Nils Ivar Dolvik, NMBU*
	Løse biter i ledd: hvor kommer vi fra, hvor står vi, hvor går vi*, 2019/september, Kristin Olstad presented at open, public retirement seminar for professor Nils Ivar Dolvik, NMBU*
	Spavin in Icelandic Horses – The role of epiphyseal cartilage in the disease process and its relevance to human juvenile osteoarthritis*, 2019/November, Sigurdur F. Sigurdsson presented at open, public PhD start-up seminar at NMBU*
	Bone spavin in Icelandic Horses: Role of the growth cartilage in disease development and its relevance to human osteoarthritis*, 2020/Aug. 17th, Sigurdur F. Sigurdsson presented at open, public mid-term evaluation*
	Spattkontroll på islandshest. Er det nødvendig og har vi noen fremgang? *2020/Feb. 9th, Sigridur Björnsdottir presented at Norsk islandshestforening avlsseminar, https://nihf.no/tidenes-avlsseminar/*

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Student theses	***Distal tarsal osteoarthritis in Icelandic Horses: a literature review*** *Veterinary undergraduate students: Stine Simonsen Frosdal, Gina Nakken, Erna Marie Svendsli Otnes* *Supervised by Cathrine T. Fjordbakk, NMBU*
Other	*There have been two group meetings during the project period, with multiple presentations within the group at each meeting.*
	2018, March 15th-18th: Olstad, Hansson, Björnsdottir met in Iceland, and Ley participated via videolink from Sweden, for presentations, discussion and planning.
	2019, June 10th-11th: The entire project group and invited guests: PhD students Sigurdur F. Sigurdsson and Bjørn Wormstrand, associate professor Sigrid Lykkjen and professor Nils Ivar Dolvik, gathered in Oslo, Norway for two full days of presentations, discussions and planning.

Facsimile from Sigridur Björnsdóttir presenting at Icelandic Horse breeding seminar before COVID19:

Avlsseminaret 2020 Tekst og foto: Ragnhild Rekanes

Avlsseminaret 2020

Sigridur Björnsdottir holdt flere spennende foredrag om valsinasjonsprosjekt, studier av bitt og mulige sammenhenger mell skader i avl og sport, samt om spatt, for en fyllhar forsamling.

4- og 5-gjengere likestilt på avlsvisninger

Spennede avlsseminar

Tidligere har en firgjenger ofte havnet lavt i poengsum i forhold til en femgjenger fordi firgjengeren bare kunne oppnå karakteren 5 for pass. En ny fordelingsnøkkel av vekttallene gjør at en firgjenger i høyere grad kan likestilles med femgjengere. Dette er en av flere endringer i de nye reglene for bedømming av islandshest.

Rundt 30 personer var samlet til avlsseminar på Clarion Hotel & Congress Oslo Airport, Gardermoen lørdag 8. og søndag 9. februar. Avlsutvalget hadde satt sammen et spennende program denne helgen.

Stambokfører Nils Ole Gilde ønsket velkommen. Målet for helgen var å viderebringe kunnskap og forståelse for både forskning på sommereksem, studier av bitt og mulig sammenheng mellom skader i sport/avl, samt BLUP-verdier, fargegenetikk og nye regler for bedømming av islandshest.

Nasjonale/ internasjonale regler

Helse, holdbarhet og fruktbarhet er i fokus for all avl. Etter avlsmålet bør hesten være minimum 138 cm høy. Målet er å avle en ridehest som kan bli brukt i ulike sammenhenger og av forskjellige ryttere. Allsidighet er viktig, samt å beholde alle farger. Hesten skal være rolig, trygg og samarbeidsvillig.

Nye regler for bedømmelse av islandshest

I henhold til bestemmelser fra FEIF, er vektingen av hestens egenskaper endret. Hver enkelt oppgavedel er beskrevet med ny karakter. Vekting av egenskaper for bygning er endret fra 40% til 35 %, mens vekting av rideegenskaper har gått opp fra 60% til 65%. Vekting av vilje og lynne er redusert fra 9 % til 7. 4-gjenger og 5-gjenger likestilles, så for hester som ikke har vist pass vil vekttallet for pass bli fordelt på de andre bedømmelsesdelene i rideprøven.

Galopp

Karakteren for galopp er nå delt i to; galopp og sakte galopp. Sakte galopp har fått vekttall 4. For å få 9 eller høyere i galopp, må hesten fatte galopp fra skritt eller medium tempo talt eller trav. Voksne hester skal vise galopp minimum 100 m, mens for en 4-åring holder det med 70 meter galopp for å oppnå den samme karakteren som en eldre hest.

Pass

Pass skal vises i 150 m, mens for en 4-åring holder det med 75 meter. For å få toppkarakter må passen legges fra galopp.

Mattilsynets regler

Vi plikter å følge Mattilsynets regler. Født før 1/7 skal ha pass inne 31/12, og født som er født etter 1/7 skal ha pass innen 6 måneder. Hester med pass utskrevet etter dette dømmes ut av matkjeden grunnet for sent utskrevet pass. Ved kjøp av hest på Island MÅ eierskiftebevis sendes til Stambokkontoret før ny eier blir registrert.

Før kunne du søke om å bruke en unghest på egne hopper, men nå er det kommet en endring der du kan bruke 2- til 4-års hingster på opptil åtte hopper, og ikke bare egen avl.

Tidligere måtte hingstene ha 7,75 for å bli godkjent til avl, men nå holder det at hingsten har vært på visning, og at den har bestått veterinærkontroll. Har du kjøpt en bedømt hest i utlandet, er den også nå bedømt i Norge. Alle land bruker nå standard dømming.

Dette er regler vi har i Norge, som NIHF, Norsk Hestesenter og Mattilsynet er enige om.

Hingster må betale lisens for å være godkjent.

Avlsplanen

Avlsplanen er nå godkjent.

Planer for avlsvisninger og andre avlsaktiviteter i 2020

Litt om 2019

Vi hadde fire avlsvisninger i fjor. Vi hadde 100 bedømte hester i fjor og antallet har gått opp. 53 prosent av hoppene er premiert. Vi viste seks bedømte hester under VM, der én høynet dommen sin.

Veien videre

Det er søkt prosjektmidler som skal gå til å arbeidet med se på om det er noen sammenheng mellom resultater fra unghestskuer og dommen på voksne hester. Vi venter på svar på dette. Vi vil også prøve å få til et unghestskue med foredrag av en dommer på kvelden.

Det vil bli avlsvisning i Seljord i mai, Tresfjord i juni og Haugesund i august.

Vi hadde aktive deltagere med mange spørsmål og diskusjoner rundt ulike temaer. Et av temaene som sto høyt i kurs, var hvorfor vi ikke har en hingstekatalog lenger? Vi har hatt det tidligere, men fikk ikke solgt det ut. Er dette noe vi kan ta inn igjen? Mange synes det er vanskelig og utfordrende å finne ut hvilke hingster som tar imot hopper, når, hvor og tidspunkt.

Har vi funnet løsning på problemet med sommereksem? v/Sigridur Björnsdottir

Dette var et av temaene veldig mange av oss var spente på. Det er en veldig interessant forskning på gang.

Målet er å avle en ridehest som kan bli brukt i ulike sammenhenger og av forskjellige ryttere

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GENERAL ARTICLE

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Radiological, vascular osteochondrosis occurs in the distal tarsus, and may cause osteoarthritis

Sigurdur F. Sigurdsson[1] | Kristin Olstad[1] | Charles J. Ley[2] | Sigríður Björnsdóttir[3] | David J. Griffiths[4] | Cathrine T. Fjordbakk[1]

[1]Faculty of Veterinary Medicine, Department of Companion Animal Clinical Sciences, Equine Section, Norwegian University of Life Sciences, Oslo, Norway

[2]Department of Clinical Sciences, Swedish University of Agricultural Sciences, Uppsala, Sweden

[3]Agricultural University of Iceland, Hvanneyri, Iceland

[4]Faculty of Veterinary Medicine, Department of Basic Sciences and Aquatic Medicine, Anatomy Section, Norwegian University of Life Sciences, Oslo, Norway

Correspondence
Kristin Olstad, Norwegian University of Life Sciences, Faculty of Veterinary Medicine, Department of Companion Animal Clinical Sciences, Equine Section, Ullevålsveien 72, 0454 Oslo, Norway.
Email: kristin.olstad@nmbu.no

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Abstract

Background: Osteochondrosis occurs due to failure of the blood supply to growth cartilage. Osteochondrosis lesions have been identified in small tarsal bones and suggested to cause distal tarsal osteoarthritis; however, it has not been determined whether distal tarsal osteochondrosis lesions were the result of vascular failure.

Objectives: To perform post-mortem arterial perfusion and micro-computed tomography (CT) of the central (CTB) and third tarsal bones (TIII) of fetuses and foals up to 5 months old, to describe tarsal development and any lesions detected.

Study design: Descriptive, nonconsecutive case series.

Methods: Twenty-three animals that died or were euthanased from 228 days of gestation to 5 months old were collected, comprising two fetuses and nine foals of miscellaneous breeds and 12 Icelandic Horse foals, a breed with high prevalence of distal tarsal osteoarthritis. One hindlimb from each foal was perfused arterially with barium, and the CTB and TIII were examined with micro-CT.

Results: Perfusion yielded partial information from 41% of the animals. The CTB and TIII were supplied by nutrient arteries and perichondrial vessels with vertical, transverse and circumferential configurations. Fourteen of the 23 (61%) animals had focal defects in the ossification front, that is, radiological osteochondrosis. The majority of lesions matched the configuration and development of vertical vessels. Additionally, full-thickness, cylindrical defects matched transverse vessels, and the long axes of some dorsal lesions matched circumferential vessels.

Main limitations: Lack of histological validation.

Conclusions: Post-mortem perfusion was poor for examination of the blood supply to the growth cartilage of the CTB and TIII. Radiological osteochondrosis lesions were compatible with vascular failure because they were focal, and because lesion geometry matched vessel configuration. The relationship between osteochondrosis and distal tarsal osteoarthritis warrants further investigation.

The work was conducted at the Norwegian University of Life Sciences, Oslo, Norway.
The abstract is available in Portuguese in the Supporting Information section of the online version of this article

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