Radiographic and clinical survey of degenerative joint disease in the distal tarsal joints in Icelandic horses

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Summary

The prevalence of degenerative joint disease (DJD) in the distal tarsal joints and the relation between radiographic and clinical signs was estimated in a population of Icelandic horses used for riding. The material consisted of 614 horses aged 6–12 years (mean age = 7.9 years). Radiographs with 3 projections of each tarsus were made and a clinical examination, including palpation of the medial aspect of the distal tarsus and motion evaluation of the hindlimbs before and after a flexion test of the tarsus, was performed. Radiographic signs of DJD in the distal tarsal joints were found in 30.3% of the horses and the prevalence was strongly correlated with age. Hindlimb lameness before and after flexion test and palpation abnormalities were significantly associated with the radiographic findings. The lameness was usually mild and, in most cases, detectable only after the flexion test. The prevalence of lameness was not significantly correlated with age. Lameness could not be predicted by details of the radiographic findings.

Introduction

Degenerative joint disease (DJD) of the distal tarsal joints, commonly called bone spavin, affects the centrodistal (CD), the tarsometatarsal (TMT) and more seldom the proximal intertarsal (PIT) joints (Barnevik 1983; Butler et al. 1993b). It has been reported to be a common cause of hindlimb lameness in horses (Vaughan 1965). The clinical manifestation is variable and radiography is considered essential for diagnosis (Stanah 1987c; Butler et al. 1993b). Radiographic signs associated with DJD in the distal tarsal joints include: periarticular osteophytes (Shelley and Dyson 1984; Butler et al. 1993b), subchondral bone lysis or rarefaction (Butler et al. 1993b; Park et al. 1996) and narrowing and collapse of joint space or subluxosis (Shelley and Dyson 1984; Butler et al. 1993b).

The disease has been reported to be most common in mature horses that are ridden hard at a gallop, horses that jump and Western horses used for reining, roping and cutting (Gabel 1980). High frequencies of radiographic abnormalities in the distal tarsal joints have also been reported in German riding horses (Winter et al. 1996) and in young, clinically sound trotters (Hartung et al. 1983). Wyn-Jones (1988) considered the disease to be widespread in the general equine population.

In the Icelandic horse, bone spavin has been described as a common cause of hindlimb lameness (Gísarsson 1931). In a study of 60 Icelandic horses with clinical suspicion of the disease, a radiographic examination revealed severe DJD in the distal tarsal joints in 58 horses (Sigurdsson 1991). An epidemiological study of Icelandic horses in Sweden showed radiographic signs of bone spavin to be present in 23% of the horses. The prevalence was strongly related to age increasing from zero at age 4 years to 33% at age 8 years (Ekstedt 1998). The rate of agreement between the radiographic signs and clinical findings (palpation and lameness examination) was reported to be 73% in Icelandic horses in Sweden (Axelsson 1998).

The Icelandic horse, also known as the Icelandic coloured horse, has been an isolated population since the settlement of the country in the 9th and 10th centuries, being the only horse breed in Iceland (Adalsteinsson 1981). Icelandic horses have traditionally been used for riding and have the ability to perform 4 or 5 different gaits of which tolt and pace are the most characteristic. They are usually saddledbroken at age 4–5 years and are expected to be in full use at the age 6 years. The most active period for riding is between 6 and 12 years although they are often used up to the age 20 years.

The registration of horses in Iceland is voluntary and includes mostly breeding horses (Hugason 1994). Consequently, the register is not representative for the whole population. The breeding programme is based on evaluations of different traits of the riding performance and conformation. The breeding indexes are published in the Agricultural Society's Annual Report on Horse Breeding (Hugason 1997). The Icelandic horse population included approximately 80,000 horses in 1996 of which about 30,000 were in use as riding horses. The number of Icelandic horses abroad exceeds 100,000 (statistics from the Farmers' Association of Iceland, 1997).

The aim of the study was to estimate the prevalence of DJD in the distal tarsal joints in a population of Icelandic horses being used for riding in Iceland. Further, to assess the association between radiographic and clinical signs compatible with DJD in the distal tarsal joints.

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### TABLE 1: Distribution of details of the radiographic findings in 306 limbs with radiographic signs of bone spavin and a bivariate logistic regression analysis of the details as possible indicators for lameness in 302 limbs (limbs with PIT affected were excluded)

<table>
<thead>
<tr>
<th>Radiographic findings</th>
<th>n</th>
<th>% lame</th>
<th>Logistic regression</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grading</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mild</td>
<td>46</td>
<td>28.3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Moderate</td>
<td>126</td>
<td>32.5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Severe</td>
<td>134</td>
<td>43.3</td>
<td></td>
<td>0.07</td>
</tr>
<tr>
<td>Joints</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PIT</td>
<td>1</td>
<td>100.0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CD</td>
<td>159</td>
<td>30.2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>TMT</td>
<td>19</td>
<td>31.6</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CD + TMT</td>
<td>124</td>
<td>44.4</td>
<td>0.0123</td>
<td></td>
</tr>
<tr>
<td>PIT + CD + TMT</td>
<td>2</td>
<td>50.0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Periarticular osteophytes</td>
<td>Not present</td>
<td>227</td>
<td>30.4</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Active bone remodelling</td>
<td>Not present</td>
<td>79</td>
<td>54.4</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td></td>
<td>Present</td>
<td>240</td>
<td>33.3</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td></td>
<td>Present</td>
<td>66</td>
<td>48.5</td>
<td>&lt;0.001</td>
</tr>
</tbody>
</table>

Lame = Lameness after flexion test of the tarsus, on the same limb as the radiographic findings; PIT = Proximal intertarsal joint; CD = Centrodeltal intertarsal joint; TMT = Tarsometatarsal intertarsal joint; Periarticular osteophytes = Periarticular osteophytes on the dorsomedial aspect of the distal tarsal joints; Active bone remodelling = Irregular, poorly demarcated bone proliferations.

### Materials and methods

#### Horses

By an official advertisement, horse owners in the south, west and north of Iceland were invited to submit horses to the study. The age range was 6–12 years and all of the horses were saddlebreds and in use for riding. Offspring from 17 selected sires, representing all the major blood lines of the Icelandic horses (Hagason 1997), were requested. This provided 420 horses. An additional 194 horses, meeting the same criteria but selected by unselected stallions, were included. The emigration was known for 144 but unknown for 50 horses. Information on age, gender, pedigree and whether the horses had a history of hindlimb problems was obtained from the owners. The material consisted of 614 horses, 24 (3.9%) stallions, 403 (65.6%) geldings and 187 (30.5%) mares. Mean age was 7.9 years and the age distribution is shown in Figure 1. Two horses presented with forelimb lameness were excluded from the study.

#### Radiographic examination

The radiographic examination consisted of Inter-o-5°-proximal-medial-distal (LSP-MD), dorso-35°-lateral-plantaromedial oblique (D35L-PMO) and plantar-45°-lateral-dorsomedial oblique (P45L-DMO) projections of each tarsus. The beam was centred on the CD joint and care was taken that the exposure settings and the latitude film (Fuji HR-L 30y) and screen (Kodak X-Omatic) combination produced optimal greyscale radiographs for evaluation of subtle skeletal details. A portable x-ray unit (Uniblock MultiImage Electrom Ray) and developing machine (Fuji FPM 100A) were used.

Select intra-articular diagnostic criteria for radiographic signs of DJD of the distal tarsal joints (radiographic signs) were used: rarefaction of the subchondral bone, narrowing or collapse of the intertarsal joint spaces. The location of the radiographic findings was identified by the specific joints involved and the extension of the lesions was graded as mild (radiographic signs in one or more of the distal intertarsal joints, in total up to a half joint space), moderate (in total between half and one joint space) or severe (in total more than one joint space). Presence of periarticular osteophytes on the dorsomedial aspect of the distal tarsus was recorded, primarily for comparison with palpation abnormalities at the same location. The radiographic findings of active bone remodelling, defined as irregular and poorly demarcated bone proliferations (Butler et al. 1993a), were noted as absent or present. The radiographs were coded and evaluated by 2 radiologists together. Equivocal findings were graded as the less severe alternative.

#### Clinical examination

Palpation of the medial aspect of the distal tarsus preceded motion evaluation of the hindlimbs. Firm, subcutaneous tissue swelling and indistinct margins of the distal tarsal joints were considered as palpation abnormalities and graded as mild, moderate or severe. Hindlimb lameness was first evaluated while trotting the horse by hand on a firm surface 25–30 m straight away from the examiner and back, after which a flexion test (Staalhak 1987a) was performed by flexion of each tarsus for 1 min and repeating the above motion evaluation. Lameness before and after the flexion test was graded as mild, moderate, severe, very severe, or nonweightbearing. Poor hindlimb impulsion and abnormal flexion of the hock were also taken into account as indicators of lameness. In doubtful cases, horses were designated free from lameness. The results were recorded after the consensus of the same 2 clinicians throughout the study without knowledge of the radiographic diagnosis. Lameness after the flexion test was used as dependent variable in the analysis and is referred to as lameness in the following text.

#### Data analysis

Multivariate logistic regression was used to examine the effect of age and gender (male, female) on dichotomised dependent variables (radiographic signs, lameness and palpation abnormalities). For limbs with radiographic signs, bivariate and multivariate logistic regression was used to evaluate details of

### TABLE 2: The relationship between radiographic and clinical signs compatible with DJD in the distal tarsal joints in 614 Icelandic horses

<table>
<thead>
<tr>
<th></th>
<th>Palpable abnormalities</th>
<th>Lameness at presentation</th>
<th>Lameness after flexion test</th>
</tr>
</thead>
<tbody>
<tr>
<td>Horses with radiographic signs, n = 186</td>
<td>53.8%</td>
<td>14.5%</td>
<td>54.3%</td>
</tr>
<tr>
<td>Horses without radiographic signs, n = 428</td>
<td>21.3%</td>
<td>3.3%</td>
<td>22.9%</td>
</tr>
</tbody>
</table>

Radiographic signs = Radiographic signs of DJD in the distal tarsal joints.
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The radiographic findings as indicators for lameness in the same limb. Chi-Square test and Chi-Square for linear trend were used to analyse the effect of age for categorical dependent variables (radiographic findings) and the association between radiographic and clinical signs. The minimum level of significance was chosen as P<0.05.

Results

Prevalence

Radiographic signs of DJD in the distal tarsal joints were found in 30.3% (n = 186) of the horses and most of them (n = 120) were bilaterally affected. The total number of affected limbs was 366 and there was no significant difference in the frequency of left (n = 162) and right (n = 144) limbs affected. The distribution of the radiographic findings is demonstrated in Table 1.

Palpation abnormalities on the medial aspect of the tarsal joints were found in 31.1% (n = 191) of the horses, and were significantly more frequent in the right (n = 167) compared with the left limb (n = 29, P<0.001). In 92.5% of the affected limbs, the palpation abnormalities were graded as mild.

After the flexion test, 32.4% (n = 199) of the horses showed hindlimb lameness, of which 6.7% (n = 41) were lame at presentation. The total number of limbs lame after the flexion test was 229 and there was no significant difference between left (n = 119) and right limbs (n = 110). The lameness was graded as mild in 88.6% of the affected limbs and as moderate or severe in 11.4%. The combination of radiographic signs and lameness was found in 16.4%, while 46.3% of the examined horses had radiographic signs and/or lameness (Fig 2).

According to the owners, 59 of the horses (9.5%) had a history of hindlimb problems and, of these, 36 proved to have radiographic signs and/or lameness while 23 had no findings. After the exclusion of the 59 horses, the prevalence of the dependent variables was not altered significantly.

Association between radiographic signs and lameness

Horses with radiographic signs had 5.02 higher odds for being lame at presentation (P<0.001) and 4.00 times higher odds for being lame after the flexion test (P<0.001) compared with horses without radiographic signs (Table 2).

For limbs with radiographic signs, the localization, extension, presence of periarticular osteophytes and signs of active bone remodelling were evaluated as indicators for lameness in the same limb. As the PIT joint was affected only in 4 limbs, they were not included, and limbs with radiographic signs in one joint exclusively (CD or TMT) were combined into one group in the analysis. The results from the bivariate analysis are summarised in Table 1. In a multivariate logistic regression model, only the presence of periarticular osteophytes on the dorsomedial aspect of the distal tarsus maintained a significant association with lameness (P<0.01). The positive predictive value for the periarticular osteophytes as an indicator for lameness was found to be 0.53 and the negative predictive value was 0.70.

Association between palpation abnormalities, radiographic signs and lameness

Horses with palpation abnormalities had a significantly higher prevalence of the radiographic signs (odds ratio [OR] = 4.31, P<0.01) and lameness (OR = 3.55, P<0.01) compared to horses without. Periarticular osteophytes on the dorsomedial aspect of the distal tarsus could be identified radiographically in 53 of the 226 limbs with palpation abnormalities.

Effect of age and gender

The prevalence of radiographic signs was strongly correlated with age (Fig 3) and increased from 18.4% in horses age 6 years to 54.2% in those age 12 years (OR = 1.35/year, P<0.001). The ratio between bilateral and unilateral appearance of radiographic signs was not affected by age. The number of affected joints in the same limb increased with age (P<0.05) and there was strong evidence of a linear trend where the grading of the radiographic signs increased with age (P<0.001). The presence of periarticular osteophytes on the dorsomedial aspect of the distal tarsus and radiographic signs of active bone remodelling was not
influenced by age. Females had lower prevalence of radiographic signs compared with males, but the difference was not significant (P = 0.052).

The prevalence of palpebral abnormalities increased significantly with age (OR = 1.18/year, P < 0.001), and was lower in females (OR = 0.97, P < 0.05). Lameness was not significantly correlated to age (P = 0.063) and was not influenced by gender.

Other radiographic findings

In 2 horses, degenerative joint disease was seen in the talocalcaneal joints. Both horses were bilaterally affected and DJD was also demonstrated in the distal tarsal joints. Lameness was identified at presentation on 1 of these limbs, and 2 others were lame after the flexion test. A single ossusus cyst-like lesion in a distal tibia was seen in 1 horse that also had DJD in CD and TMT bilaterally, but these findings were not associated with lameness. No radiographic signs of osteochondrosis in the tarsocural joint were detected.

Discussion

A random sample of the Icelandic horse population was not possible to obtain and the self-selection of horses, made by the owners, was considered to be the best way of providing horses for the study. There were no indications that the selection was biased to horses with hindlimb problems. Only 59 horses had a history of hindlimb problems, and excluding these horses from the analysis did not alter the results significantly. The age range of 6-12 years was chosen for the study as this is generally considered to be the most active period in the lives of Icelandic horses. Information on the age distribution of the riding horse population in Iceland is unfortunately not available, but the number of horses used for riding is expected to be reduced by age as horses are exported and mares are selected for breeding. Others are slaughtered for various reasons. The distribution of gender and geographic regions in the material corresponds well to the riding horse population when compared to figures from the annual counting of horses in Iceland 1996 (statistics from the Farmers' Association of Iceland 1997). Horses were selected to the study to allow heritability estimates as well as the prevalence assessment. The heritability estimates are presented separately (Björnaradottir et al. 2000). The selection of horses regarding the genetic background was not considered to bias the results because the selected stallions have greatly influenced the population and represent all the major breeding lines in Iceland (Hugason 1997). More than 80 other identified stallions were also represented in the 194 horses bred by unselected stallions. The material can, therefore, be considered to reflect the population of active riding horses in Iceland.

The prevalence of radiographic signs of DJD in the distal tarsal joints, hind limb lameness and palpebral abnormalities on the medial aspect of the tarsal joints, was found to be high in this study. The results correspond well to radiographic and clinical findings of bone spavin reported from Icelandic horses in Sweden (Axelson et al. 1998; Ekstøl et al. 1995).

To avoid overinterpretation, equivocal findings were graded as the less severe alternative. The decision to use 3 radiographic projections was based on the results from a study by Ekstøl et al. (1999). The risk of underestimating the number and extent of radiographic findings using 3 rather than 4 projections was regarded as minor while fewer exposures saved time and money and improved radiation safety. It is possible that the prevalence of lameness was underestimated as the horses were not examined on hnge or ridden. However, in the design of the study, a simple but accurate motion evaluation was considered essential in terms of standardisation, and to avoid too complicated classification.

Although there is a paucity of information on the prevalence of the disease in mature horses in other breeds, the results suggest that the Icelandic horse is predisposed to develop DJD in the distal tarsal joints. Horses with radiographic signs had 4 or 5 times higher odds for being lame than horses without radiographic signs, indicating a rather strong association. However, half of the horses with radiographic signs were free from lameness.

Radiography is considered to be insensitive in detecting the presence of early DJD in the horse (Trotter and McBirrith 1996) and before the condition is demonstrated radiographically, clinical signs originating from the distal tarsus may be located by intra-articular anaesthesia (Gabel 1980). Therefore, it is probable that some of the horses with lameness that did not have radiographic signs were reacting to early degenerative changes in the distal tarsal joints.

As no further tests were performed to locate the origin of pain, the lameness may in some cases have originated from anatomical regions other than the distal tarsus. However, this is just as likely to occur in horses with radiographic signs and therefore does not explain the difference in the prevalence of lameness between horses with and without radiographic signs.

The radiographic signs were graded as moderate or severe in 84.2% of the limbs and were most often found bilaterally. In contrast, the lameness was typically mild and detected only after flexion test and most often unilateral. A mild bilateral lameness would be hard to detect before the flexion test and might therefore have been underestimated. The prevalence of severe lameness was expected to be low since only horses actively in use for riding were included in the study.

In limbs with radiographic signs, the distribution of the radiographic findings (Table 2) did not seem to be a good indicator of lameness. Only the presence of periarticular osteophytes had a significant association with the prevalence of lameness. The specificity of the presence of periarticular osteophytes was low, however, demonstrated by a low positive predictive value (0.53). The variation in lameness in horses with radiographic signs may be due to a clinically intermittent course of the disease that is not necessarily associated with radiographic findings. Alternatively, other factors such as variations in hindlimb motion pattern, stability of the distal tarsal joints, or individual pain sensitivity may be of importance.

The close correlation between the prevalence of radiographic signs and age found in the study agreed with earlier reports about bone spavin in Icelandic horses (Ekstøl et al. 1998) and reports from other breeds (Gabel 1980). The prevalence of lameness appeared not to be correlated to age. This may have 2 explanations: the horses can be lame from DJD of the distal tarsal joints before the radiographic signs develop and the lameness may improve over time. Alternatively, with increasing age, more horses are excluded from the population being used for riding due to chronic hindlimb lameness.

The radiographic signs were seen most frequently in the CD joint or in both the CD and TMT joints. As horses with radiographic signs in 2 joints in the same limb were significantly older than horses with signs in one joint only, it may be that the degenerative changes detectable on radiographs generally
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Manufacturers’ addresses

3Fujifoto Film Co. Ltd., Tokyo, Japan.
4Kodak, Lane-Bergen, Rochester, New York, USA.
5Malinage s.r.l., Cavaria, Italy.

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