Comparison of the trabeculae structure of the spongy bone of the bilateral pastern bones in racehorses based on the imaging analysis of radiograms

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Abstract

On the basis of a digital analysis of radiograms it was checked if, and to what extent, the extended loading of one of the sides of the body of racehorses leads to differences in the microstructure of the spongy bone of the bilateral pastern bones of the thoracic limbs. The research material consisted of radiograms of the pastern bones of the right and left thoracic limbs of racehorses. On the basis of computer image radiological analysis with the use of the “Trabecula,” programme, a quantitative evaluation of the structure of the spongy bone of the pastern bones was conducted. It was noted that the differences between the right and the left pastern bones, despite extensive loading of the left thoracic limb, were not statistically significant as far as all studied parameters of the trabecula structure of the spongy bone were concerned.

Key words: spongy bone, racehorses, computer analysis of radiograms, proximal phalanx

Introduction

We can observe cases of increased loading of one side of the body and unknown mechanisms of influence of the unequal loading on shaping particular structures of the locomotor system of the bilateral limbs. Racehorses experience such an asymmetrical loading. In Poland and in other countries horse training in preparation for flat races as well as the flat races themselves take place on banked tracks. As far as loading of the locomotor system is concerned, it is significant that more intensive training concerning faster pace and longer distance take place on the left-side of most tracks. It can be stated that the character of racing training as well as conditions of conducting races, on banked track, have a significant influence, not only on frequency of injuries (Estberg et al. 1998, Hernandez et al. 2001, Kalisiak 2008), but also on the morphological parameters of anatomical structures of the bilateral thoracic and pelvic limbs (Davies et Watson 2005, Pearce et al. 2005). The aim of this investigation was, therefore, to compare parameters of the spongy bone of the bilateral pastern bones of the race horses' thoracic limbs.

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Table 1. Parameters of the trabecula structure of the spongy bone of the pastern bones and their statistical estimation for the right thoracic limb (PP) and the left thoracic limb (LP).

<table>
<thead>
<tr>
<th>Statistical parameters</th>
<th>PP (n = 30)</th>
<th>LP (n = 36)</th>
</tr>
</thead>
<tbody>
<tr>
<td>number of radiological trabeculae per mm²</td>
<td>7.27 – 12.95</td>
<td>0.61 – 1.2</td>
</tr>
<tr>
<td>volume density of radiological trabeculae %mm</td>
<td>35.26 – 47.23</td>
<td>8.24 – 13.02</td>
</tr>
<tr>
<td>number of radiological trabeculae per mm²</td>
<td>0.64 – 1.56</td>
<td>37.5 – 48.65</td>
</tr>
</tbody>
</table>

Materials and Methods

The Thoroughbreds and Arabian horses whose pastern bones were the subject of the research were aged from 3 to 6 years. Their training, similar as far as intensity and distance were concerned, took place on the same sandy tracks. The horses examined did not show any signs of lameness or other clinical symptoms indicating diseases of the locomotor system. The research material consisted of radiograms of the pastern bones of the right-PP and left-LP thoracic limbs – 30 radiograms of PP and 36 radiograms of LP. The radiograms were made at Służewiec Hospital for horses in Warsaw. The central beam was directed through the centre of the length of the shaft of the pastern bone. The limb location and the photography conditions were the same each time: dorso-palmar projection, the distance between the object and the lamp-90 cm, exposure conditions-65 kV, exposure time -0.16 s. Comparison of parameters of the spongy bone of the bilateral pastern bones was conducted using a digital image analysis of radiograms with the use of a Trabecula programme (Czerwiński 1994). The study of the structure of the bone tissue was preceded by the method adaptation (Dzierzęcka et al. 2007). The programme generated a trabeculae map and, for the whole area of the analysis, calculated: the number of recognised radiological trabeculae per mm² of marked analysis area, the average volume of the trabeculae as a percentage of the volume of a cube with the maximal and minimal base measured given in % mm and density given as a percentage of the surface covered with trabeculae. To establish differences in the studied quantitative traits, which could be connected with the left or right pastern bones, the obtained results were analysed statistically. Descriptive statistics were determined: the average and coefficient of variability parameters. Normality of the studied parameters was checked using the Shapiro-Wilk test. Average values for the parameters were compared using the t-Student test for matched pairs. Variance equality was examined. All statistical calculations were made using Statgraphics, a statistical programme.

Results and Discussion

Values of parameters of the spongy bone for LP and PP are presented in Table 1. On the basis of the statistical analysis, it appeared that differences between the right and left pastern bones are not statistically significant as far as the studied parameters of the trabecula spongy bone were concerned. Assumptions concerning normality of the examined parameters and the variance equality required from the t-Student test were fulfilled. Despite the existence in the literature of studies concerning asymmetry of morphometric values between the bilateral limb bones of racehorses (Davies and Watson 2005, Pearce et al. 2005), there is no study examining the influence of the extensive loading of one side of the body of horses trained for races on the shaping of the microstructure of the bilateral long bones. Taking into account the speed of the races (about 60 km/h) and the distance run (between 1200 and 2200 m), it should be noticed that during the race the physical factor stimulating remodelling of the bone – the extensive loading of the left thoracic limb – occurs while galloping on the bank. Therefore, lack of statistically significant differences in the structure of the bilateral pastern bones in the thoracic limbs of racehorses could result from the fact that the influence of the physical factor, unequal loading on the bilateral pastern bones, is too short to have an important impact on varied shaping of this microstructure.

References

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