Limitations and Improvements in the Quality of Navicular Flexor View Radiographs (21-Nov-2003)

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Abstract

The degree of angulation of the X-ray beam relative to the radiographic film is a limiting factor in obtaining diagnostic quality flexor view radiographs. The use of an angled cassette tunnel yields an improvement in the quality of the radiographs obtained.

1. Introduction

The palmaroproximal-palmarodistal oblique (PaPr-PaDiO) or flexor radiographic view of the navicular bone is an important projection for identifying early navicular bone changes, which can indicate disease. In one study, 71% of radiographic abnormalities of the navicular bone were evident only on this view [1]. However, in the authors' experience, it can be difficult to obtain consistently diagnostic radiographs. A large number of repeats are often required, and poor quality radiographs may still be obtained for evaluation. It has been stated that the primary beam should be directed parallel to the flexor cortex of the navicular bone [2]. However, there are widely varying (35 - 70º) recommendations for the optimal beam angle to use when obtaining the radiograph. The degree of angulation of the X-ray beam relative to the X-ray film can lead to distortion, and in other sites, it is also recommended that the beam be kept perpendicular to the film. This is not possible with the standard method of obtaining this projection (i.e., with the foot placed flat on a cassette tunnel containing the X-ray cassette).

The aims of this study were to investigate the variables involved in obtaining diagnostic PaPr-PaDiO views of the navicular bone and to make practical recommendations for the improvement of radiographic quality.

2. Materials and Methods

Three isolated navicular bones were radiographed at different angles relative to the flexor cortex and at different angles of beam incidence relative to the film.

Lateromedial foot radiographs from 50 horses with foot lameness were assessed to determine the angle of the flexor surface of the navicular bone relative to the ground.

Ten normal horses were radiographed in a variety of limb positions. Lateromedial radiographs were obtained with the limb in three different degrees of retraction; these radiographs were used to determine the influence of the limb position on the angle of the flexor cortex of the navicular bone. For each foot position, PaPr-PaDiO projections were obtained at beam angles ranging from 35 - 70º. Each PaPr-PaDiO radiograph was scored for radiographic quality using five different criteria: definition of flexor surface, cortico-medullary demarcation, medullary trabecular pattern, definition of the articular surface, and degree of overlap of the distal phalanx.

A custom-designed, 15º-angled cassette tunnel was used to elevate the heel and thus, increase the angle of the navicular bone relative to the film. Then, the effect of this custom cassette tunnel on radiographic quality was assessed. Along with the initial study, this wedged tunnel has been evaluated on clinical cases over the last 4 years.

3. Results

In the isolated bones, optimal visualization of the flexor cortex was obtained when the primary beam was closely aligned
with the cortex, within a range of approximately 15°. When the beam angle was kept parallel to the flexor cortex but was
varied relative to the film, angles less than 55° gave a rapid increase in dorso-palmar distortion. This resulted in a lack of
definition of the flexor surface of the bone and poorer quality definition of the cortico-medullary junction. This was
particularly marked at angles below 45°.
In the 50 lame horses, the angle of the flexor surface of the navicular bone relative to the ground surface ranged from 25° to
48° (38 ± 4.7°).
Measurements from the lateromedial radiographs in the 10 normal horses demonstrated no significant alteration in the angle
of the flexor cortex of the navicular bone with limb retraction. The range of flexor cortex angle was 31 - 53° with a mean
value of 40°. The optimal angle for the PaPr-PaDiO projection did not significantly alter with limb position, and it ranged
from 40° to 60° with a mean of 47°. This was significantly steeper than the angle of the flexor surface of the navicular bone.
The clinical application of a 15° heel wedge yielded a significant improvement in the quality of the PaPr-PaDiO projection
in cases where the initial views obtained with a standard cassette tunnel were not of diagnostic quality. These poor views
were generally seen in horses with a low-heeled foot conformation where the angle of the flexor cortex of the navicular bone
was relatively shallow to the ground. Even with good radiographic technique in these cases, there is a false appearance of
medullary sclerosis and loss of cortico-medullary definition (Fig. 1). The wedged block allows the beam to be maintained at
a steep angle relative to the X-ray cassette, while remaining parallel to the flexor cortex. The practical outcome is that the
cortico-medullary definition reappears, and the false appearance of medullary sclerosis is lost (Fig. 2).

4. Discussion
These results suggest that the optimal beam angle for the PaPr-PaDiO projection is a compromise. The angle should be
parallel to the flexor cortex of the navicular bone but should also avoid excessive obliquity of the beam relative to the film.
In the normal horses used in this study, the average angle of the navicular bone was only 40° to the horizontal, whereas the
preferred beam angle relative to the film was greater than 55°, indicating that the optimal beam angle of 47° was a balance
between these factors. In horses with foot lameness, there was a similar, although slightly more acute, angle of the flexor
surface. Although the compromise position yields satisfactory images in the majority of cases, this is not always possible in
horses with a low-heeled foot conformation and shallow angle of the navicular flexor cortex. In these horses, the use of a
15°-angled cassette tunnel is particularly advantageous in improving the quality of the PaPr-PaDiO projection. Elevation of
the heel allows a steeper beam to film angle to be used, while maintaining the beam parallel to the flexor surface of the
navicular bone. The use of an angled cassette tunnel is recommended as a simple, practical technique for improving the
quality of PaPr-PaDiO projections of the navicular bone.
References


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