INCIDENCE OF PLANTAR PLATE TEARS AND ASSOCIATED ANATOMIC VARIATIONS OF THE SECOND METATARSOPHALANGEAL JOINT: A CADAVERIC STUDY

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ERIN E. KLEIN, DPM, MS

MY DISCLOSURE IS IN THE FINAL AOFAS PROGRAM BOOK.

I HAVE NO POTENTIAL CONFLICTS WITH THIS PRESENTATION.
INTRODUCTION

- The plantar plate is a structure that has come to the forefront of forefoot reconstruction as a structure that can cause pain and deformity.
- Previous scientific literature on this topic has focused on diagnostic criteria\textsuperscript{1-2}, imaging\textsuperscript{3-4} and surgical correction\textsuperscript{5-6} of pathology.
- The normal anatomic nature\textsuperscript{7-8} and blood supply\textsuperscript{9} to the lesser metatarsals has been previously investigated.
- A previous cadaveric study of the plantar plate found 15 plantar plate tears in 15 specimens with crossover toes\textsuperscript{3}.
- The incidence of plantar plate tears in cadaveric specimens without crossover toes is unknown as previous studies have focused on cadavers with crossover toe deformities\textsuperscript{3,11}. 
METHODS

- Twenty cadaveric specimens without crossover toes were selected from available specimens and the foot was harvested at the tibio-talar joint.
- A physical inspection was performed to note any digital deformities.
- The second ray was dissected free from the Lis Franc articulation, preserving all attachments to the metatarsophalangeal joint.
- The plantar plate and collateral ligaments were observed for any gross pathology. Pathology was noted and classified\textsuperscript{10}.
- The plantar plate was measured with a digital venier caliper.
- The data was analyzed.
RESULTS

- There were 6 male and 14 female cadaveric specimens.
- Male specimens: average age 56.7 ± 8.3 (48 – 68)
- Female specimens: average age 71.1 ± 1.4.6 (52 – 95)
- Medical records were unavailable for all specimens.

INCIDENCE OF PLANTAR PLATE PATHOLOGY

- 14 of the 20 specimens studied were observed to have pathology of the plantar plate.
- 3/6 (50%) of the male specimens had plantar plate pathology.
- 11/14 (78.6%) of the female specimens had plantar plate pathology.
Results

Length, width and thickness of the plantar plate was found to be different in specimens with and without hammered toes.

<table>
<thead>
<tr>
<th></th>
<th>Length</th>
<th>Width</th>
<th>Thickness</th>
</tr>
</thead>
<tbody>
<tr>
<td>With a hammered toe</td>
<td>16.9 ± 2.6 mm</td>
<td>16.2 ± 2.6 mm</td>
<td>2.2 ± 0.5 mm</td>
</tr>
<tr>
<td></td>
<td>(12.7 – 20.9)</td>
<td>(12.2 – 20.1)</td>
<td>(1.6 – 2.9)</td>
</tr>
<tr>
<td>Without a</td>
<td>13.3 ± 1.8 mm</td>
<td>15.8 ± 3.5 mm</td>
<td>1.8 ± 0.3 mm</td>
</tr>
<tr>
<td>hammered toe</td>
<td>(10.5 – 14.6)</td>
<td>(9.5 – 19.3)</td>
<td>(1.5 – 2.1)</td>
</tr>
<tr>
<td>Significance</td>
<td>p &lt;0.01</td>
<td>p = 0.068</td>
<td>p = 0.061</td>
</tr>
</tbody>
</table>
Results

There were differences noted in the insertion of the plantar plate noted in specimens with and without hammered toes.

<table>
<thead>
<tr>
<th></th>
<th>With a hammered toe</th>
<th>Without a hammerd toe</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Medial longitudinal band insertion (width)</td>
<td>3.4 ± 0.7 mm (2.7 – 4.9)</td>
<td>4.0 ± 0.3 mm (3.6 – 4.3)</td>
<td>&lt; 0.01</td>
</tr>
<tr>
<td>Lateral longitudinal band insertion (width)</td>
<td>3.4 ± 0.8 mm (2.0 – 4.1)</td>
<td>3.9 ± 0.6 mm (3.3 – 4.8)</td>
<td>&lt; 0.01</td>
</tr>
<tr>
<td>Central raffae</td>
<td>6.7 ± 1.2 mm (5 – 8.9)</td>
<td>3.7 ± 1.3 mm (2.2 – 5.4)</td>
<td>&lt; 0.01</td>
</tr>
</tbody>
</table>
VARIATIONS OF THE PLANTAR PLATE

- A. The deep surface of either the medial or lateral collateral ligament were continuous with the plantar plate.
- B. The deep surface of both the medial and lateral collateral ligament were continuous with the plantar plate.
- C. The deep surfaces of the medial collateral ligament, the lateral collateral ligament and the plantar plate were distinctly separate.
Of the 20 specimens reported here, 70% had pathology of the plantar plate and 50% had pathology of the collateral ligaments. This suggests that the presence of plantar plate and collateral ligament pathology may be higher than initially postulated.

The dimensions of the plantar plate have not been consistently reported in scientific literature. In the specimens with hammered toes:

- The plantar plate was significantly longer ($p<0.01$).
- The plantar plate was thicker ($p = 0.061$).
- The insertion of the medial and lateral longitudinal bands into the base of the proximal phalanx was narrower with a wider central ralf (p<0.01).

Taken together, these findings suggest that:

- The plantar plate may have a mechanism for responding to changes in load and alterations in tissue stress.
- Attenuation of the plantar plate as part of the lesser metatarsophalangeal deformation process may not be an entirely accurate portrayal of this pathoanatomic process.
- The insertion of the plantar plate onto the base of the proximal phalanx may be either a cause or a result of a digital deformity.
References:


Thank you!
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