

# High Resolution MRI of Asymptomatic Plantar Plate under Flexion and Extension: Implications for Understanding Normal Structure and Diagnosing Tears

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## Purpose:

The plantar plates of the lesser MTP joints are fibrocartilaginous structures which insert into the bone or cartilage of the proximal phalanx, stabilizing the MTP joints and resisting hyperextension. Tears of the plantar plate may result in instability and forefoot pain. MRI is widely used as a non-invasive technique for imaging the plantar plate where a hyperintense region at the insertion is often interpreted as a tear<sup>1</sup>. However, previous MRI research has suggested that increased signal intensity may also be seen immediately adjacent to the proximal phalanx insertion in normal subjects<sup>2</sup>. The aim of this work was to use high-resolution 3T MRI to investigate the plantar plate insertion further.

## Method:

The feet of 10 asymptomatic subjects (mean age 30 years) without previous forefoot trauma or pathology were imaged at 3T using an eight-channel knee or wrist coil. Proton-density fat-suppressed, T2 weighted fat-suppressed, water-suppressed and gradient-echo sequences were acquired in the sagittal plane through the MTP joints with a resolution of 2x0.2x0.3mm in 5 minutes at different angles of flexion/extension.

## Results:

This study consistently showed high signal centrally at the plantar plate insertion on fat-suppressed images as demonstrated inconsistently in previous studies. This study showed the high signal did not extend to the medial and lateral borders. The high signal was more marked in plantar flexion (Figures A & C). The same region was hypointense on T2 weighted images. In dorsiflexion one or more hypointense bands joining the proximal phalanx to the rest of the plantar plate with adjacent high signal were seen (Figures B & D). Water-suppressed images demonstrated foci of fat at the insertion of the plantar plate.

## Conclusion:

The hypointense bands at the insertion may represent connective tissue joining the fibrocartilage body of the plantar plate to the phalanx. Characteristically, the high signal does not extend to the medial or lateral borders, it is not seen on T2 weighted images and high resolution imaging of the joint in dorsiflexion demonstrates continuity of the plantar plate with the insertion into the proximal phalanx.

High signal is consistently seen at the insertion of the plantar plate centrally in asymptomatic volunteers and this should not be mistaken for a tear. High-resolution MRI in dorsiflexion together with an understanding of the normal appearances should help more specific diagnosis of symptomatic tears.

## References:

- 1 Gregg JM, 2006, Eur Radiol, 16, 2661-2669
- 2 Yao L, 1994, AJR, 163, 641-644



**Figures A & C:** High signal at the insertion of the plantar plate is more marked in plantar flexion at the MTP joint.

**Figures B & D:** Dorsiflexion of the MTP joint demonstrates hypointense bands connecting the body of the plantar plate to the proximal phalanx with adjacent high signal.