

1 **Medial meniscus posterior root tear causes swelling of the medial meniscus and expansion of the**
2 **extruded meniscus: a comparative analysis between 2D and 3D MRI**

3
4 **Abstract**

5 **Purpose:** This study aimed to clarify the advantages of three-dimensional (3D) magnetic resonance
6 imaging (MRI) over two-dimensional (2D) MRI in measuring the size of the medial meniscus (MM),
7 and to analyse the volumes of MM and the extruded meniscus in patients with MM posterior root tear
8 (MMPRT), at 10° and 90° knee flexion.

9 **Methods:** This study included 17 patients with MMPRTs and 15 volunteers with uninjured knees. The
10 MMs were manually segmented for 3D reconstruction; thereafter, the extruded part separated from the
11 tibial edge was determined. The length, width, height, and extrusion of MM were measured by the 2D
12 and 3D methods, and compared. The MM volume, extruded meniscus volume, and their ratio were
13 also calculated using 3D analysis software in the two groups.

14 **Results:** The estimated length and posterior height of MM was larger with 3D MRI than with 2D MRI
15 measurements. The MM volume was significantly greater in MMPRT knees than in normal knees,
16 with increasing MM height. In MMPRT knees, the mean volume of the extruded meniscus and its ratio
17 significantly increased by 304 mm³ ($p = 0.02$) and 9.1% ($p < 0.01$), respectively, during knee flexion.

18 **Conclusions:** This study demonstrated that 3D MRI could estimate the precise MM size, and that
19 MMPRT caused meniscus swelling due to the increased thickness in the posteromedial part. The

20 clinical significance of this study lies in its 3D evaluation of MM volume, which should help the
21 surgeon understand the biomechanical failure of MM function and improve MMPRT repair technique.

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23 **Level of Evidence: III**

24 **Keywords:** Medial meniscus; Posterior root tear; Osteoarthritis; Meniscal volume; Medial extrusion;

25 Three-dimensional magnetic resonance imaging; Flexed-knee position.

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