

# Use of Adding T2 Mapping Sequence to a Routine MR Imaging Protocol to evaluate of the Articular Cartilage Changes of the Knee and Ankle Joint with Hemophilia in Children

N.N. Zhang<sup>1</sup>, Y.Q.Lv<sup>1</sup>, D. Hu<sup>1</sup>, H.Y.Kang<sup>1</sup>, Y.Liu<sup>1</sup>, G.H. Ying<sup>1</sup>, R.H.Wu<sup>2</sup>, Y.Peng<sup>1</sup>

<sup>1</sup>Imaging Center, Beijing Children's Hospital, Capital Medical University, Beijing, China, People's Republic of, <sup>2</sup> Haematology Center, Beijing Children's Hospital, Capital Medical University, Beijing, China, People's Republic of.

**Introduction:** T2 mapping sequences can help detect changes in the water and collagen content. This sequence have been used extensively in osteoarthritis research studies to detect disease and treatment related changes in articular cartilage(1-3). However, little is known about the early cartilage changes in hemophilia patients, and once established, arthropathy follows a progressive and non-reversible process despite the use of factor concentrates.

**Purpose:** This study was to evaluate whether addition a T2 mapping sequence to a routine magnetic resonance (MR) imaging protocol could improve diagnostic performance in the detection of early chages of cartilage lesions within the knee and ankel joints at 3.0 T.

**Methods:** Fifteen clinically diagnosed hemophilia boys aged 8-17 years ( $12.2 \pm 3.5$  years) with hemophilia A were involved in this study, with the approval of local IRB. Seven knee joints and eight ankles were scanned by a Philips Achieva TX 3.0T MR with a 8 channel knee coil and a head coil for ankle. Routine MR imaging protocol included T1W, T2W, T2/FFE, T2 SPAIR, PDW/TSE and T1 3D-WATS. Sagittal T2 mapping was scanned with parameters: FOV 140x140cm, slices thickness 2.5mm with 0.25mm gap, recon matrix 480x480, TR1700ms, 5 echoes with TE 13,26,39,52,65ms, NSA 1, total scan time 5'08. The outline of cartilage was drawn manually by two experienced radiologists, then the area was divided into anterior(A), central(B) and posterior(C) regions automatically by the commercial software in the IntelliSpace portal. Statistical Package 17.0 was used for data analysis. The Kappa index (k) was calculated to test the degree of agreement between the two radiologists of the measurement results. Agreement was considered insignificant if  $k < 0.20$ , weak if between 0.21 and 0.40, moderate if between 0.41 and 0.60, strong if between 0.61 and 0.80 and very strong if  $\geq 0.80$ .  $P \leq 0.05$  was considered significant.

**References:**

1. Quatman CE, et al., Am J Sports Med 2011;39(7):1557-1568.

2. Pan J et al., Radiology 2011; 261(2):507-515.

3. Victor M er al., Radiol Clin N Am 51 (2013) 689-702.

4. Lv Yingru et al., Journal of Clinical Radiology. 2011,30(8):1170-1173.

**Results:** The cartilage of T2 relaxation time of distal femur cartilage, proximal tibia, distal tibia talus surface, and the average T2 relaxation time of whole layer cartilage and the normal reference, please see fig.1. The degree of correlation in the measurement of the two radiologists was very strong ( $k = 0.84$ ,  $p < 0.05$ ). T2 relaxation time of both Knee distal femur and proximal tibia articular cartilage were higher than those of healthy children (4). There were four morphologically normal joint cartilage in the routine MR protocol where their T2-mapping showed visible unevenness, out of these two cases were ankle (fig. 2) and the other two were knees.

**Conclusion:** T2 mapping has the ability of detecting early cartilage degeneration prior to morphologic changes in pediatric patients with hemophilia. So T2 mapping has the potential to monitor the progression of cartilage damage in hemophilia and help to improve future treatment options.

Fig.1

Item\Region	Anterior region (ms)	Central region (ms)	Posterior region (ms)	Average (ms)	Normal reference <sup>4</sup>
Distal femur cartilage	46.5 ± 8.9	47.1 ± 12.3	46.6 ± 11.6	47.6 ± 9.3	40.27 ± 3.5
Proximal tibia cartilage	45.6 ± 6.6	47.2 ± 14.7	44.0 ± 5.1	45.6 ± 7.1	31.15 ± 1.86
Distal tibia cartilage	38.9 ± 8.6	36.8 ± 9.4	36.9 ± 6.6	37.5 ± 8.2	_____
Talus surface cartilage	36.8 ± 5.8	43.1 ± 9.8	44.9 ± 4.9	41.6 ± 6.8	_____

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1. Quatman CE, et al., Am J Sports Med 2011;39(7):1557-1568.

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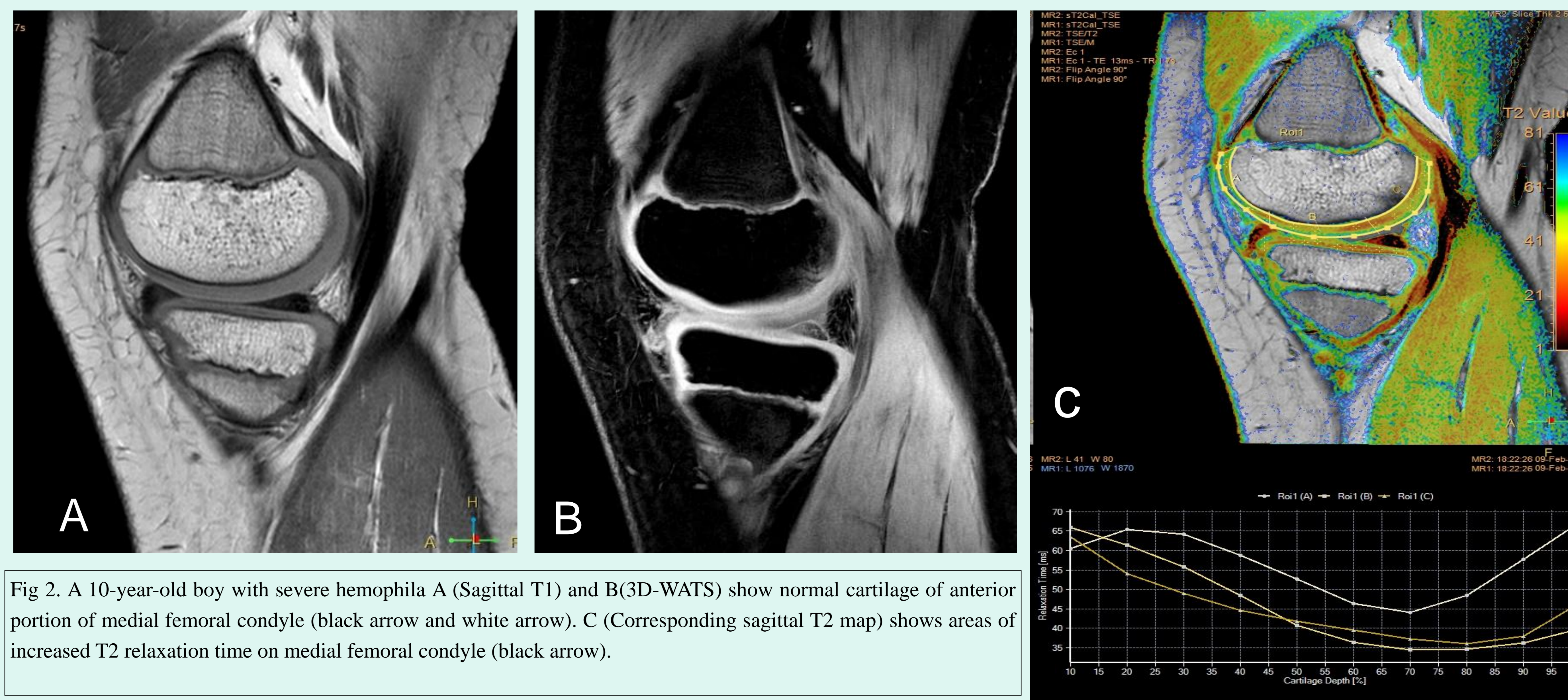


Fig 2. A 10-year-old boy with severe hemophilia A (Sagittal T1) and B(3D-WATS) show normal cartilage of anterior portion of medial femoral condyle (black arrow and white arrow). C (Corresponding sagittal T2 map) shows areas of increased T2 relaxation time on medial femoral condyle (black arrow).

