Case Report: Knee MR Imaging of Haemarthrosis in a Case of Haemophilia A

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Background

In daily patient-care imaging of joints in childhood is often still a domain of x-ray and ultrasound. However, the application of MRI in pediatric imaging is of growing importance not only because of the excellent soft tissue contrast and the superior capacity of this technique to visualize and evaluate the extension of involvement of soft tissues but also because of its capability to early and precisely detect bone destruction. In addition to its high sensitivity, MRI is also an invaluable tool to rule out differential diagnoses e.g. malignancies. However, MR in pediatrics requires different imaging approaches to those for adults. Imaging speed and high resolution are key elements. And since these two requirements are in direct conflict, several working groups recommend the usage of 3Tesla MR in combination with multi-channel coils to overcome at least partially the contradiction of fast and highly resolved MR scans in children.

Patient history

In this case we report on the imaging findings of a 14-year-old male adolescent with known haemophilia A. Very often these patients present after an initial traumatic event with recurrent bleedings into the large joints, dominantly in the knees but also hips, shoulders etc. Bleeding into muscles can also occur, but this is less common than in the joints. Recurrent haemarthrosis causes early destruction of the joints. Severe pain and disability are the most common but also very unspecific clinical symptoms and can have different causes in childhood and adolescence (e.g. aseptic osteonecrosis).

The said patient presented with these unspecific symptoms in the ambulance of our orthopedics department. Haemophilia A was already known und multiple events of haemarthrosis documented. Conventional x-ray showed effusion and discrete signs of arthrosis with smallest lateral and medial osteophytes. With the suspicion of a new event of intraartricular bleeding, the patient was immediately referred to the MRI department for further evaluation.

Sequence details
Examination was performed on a 3T open-bore MR system (MAGNETOM Verio), equipped with 18-channels (Tim [102 x 18] configuration) in combination with a dedicated 15-channel knee coil.

Imaging protocol included:

- **Sagittal PDw TSE without fat saturation** (TR / TE = 6090 / 88 ms, FOV (186 x 220) mm^2, matrix (346 x 512) px^2, slice thickness 3 mm, parallel imaging factor of 2, bandwidth 181 Hz/px, two averages, TA 3:21 min).

- **Coronal T2w TIRM** (TR / TE / TI = 6690 / 53 / 210 ms, FOV (218 x 220) mm^2, matrix (400 x 448) px^2, slice thickness 3 mm, parallel imaging factor of 2, bandwidth 280 Hz/px, no averaging, TA 3:41 min).

- **Transversal PDw TSE with spectral fat saturation** (TR / TE = 3420 / 77 ms, FOV (197 x 220) mm^2, matrix (804 x 896, interpolated) px^2, slice thickness 4 mm, parallel imaging factor of 2, bandwidth 162 Hz/px, no averaging, TA 2:38 min).

- **Coronal native T1w SE** without fat saturation (TR / TE = 872 / 11 ms, FOV (165 x 220) mm^2, matrix (384 x 512) px^2, slice thickness 3 mm, no parallel imaging, bandwidth 150 Hz/px, no averaging, TA 3:19 min).

- **Transversal enhanced T1w TSE** without fat saturation (TR / TE = 458 / 12 ms, FOV (194 x 220) mm^2, matrix (396 x 448) px^2, slice thickness 4 mm, parallel imaging factor of 2, bandwidth 180 Hz/px, two averages, TA 5:30 min).

- **Coronal enhanced T1w TSE with spectral fat saturation** (TR / TE = 1210 / 13 ms, FOV (165 x 220) mm^2, matrix (326 x 512) px^2, slice thickness 3 mm, parallel imaging factor of 3, bandwidth 181 Hz/px, no averaging, TA 2:50 min).

Total imaging time was approximately 25 minutes.

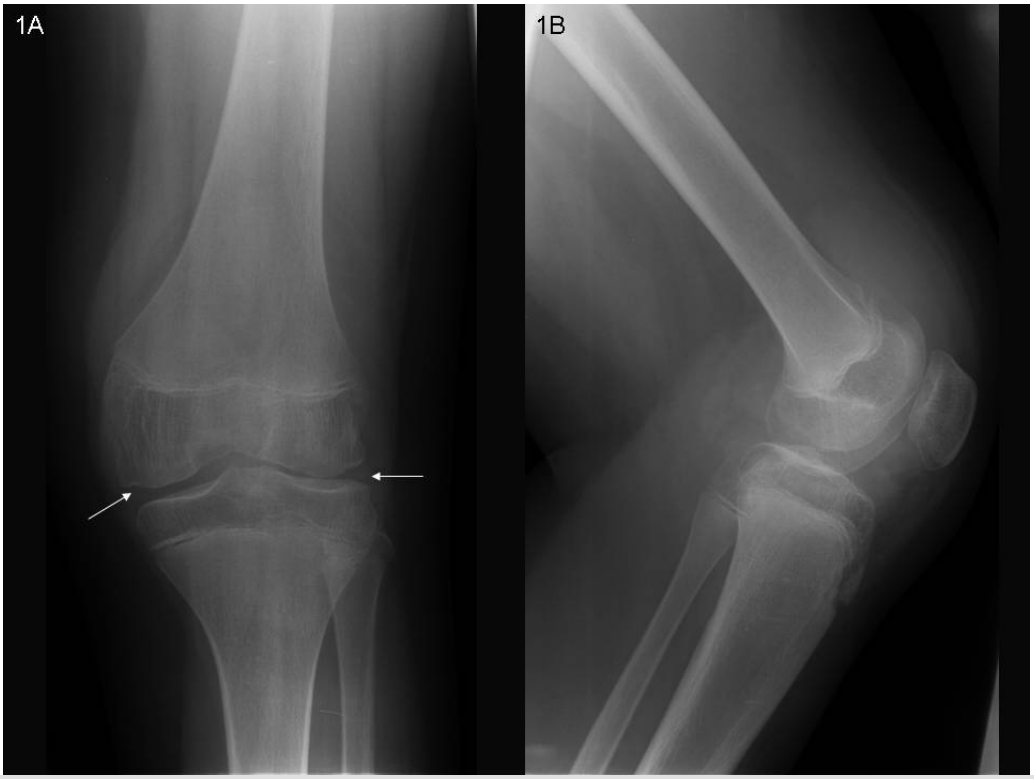

Figure 1: Conventional x-ray of the left knee (same examination date as MRI) with subchondral erosions of both femor condyles and thinning of the lateral joint space.

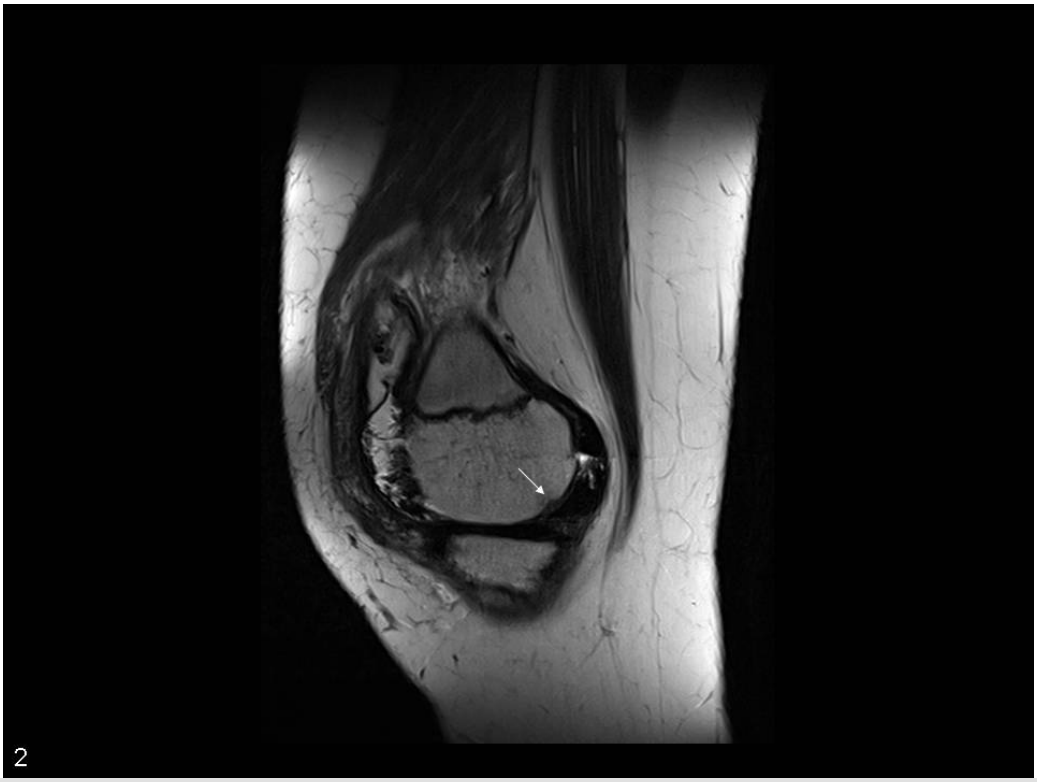

Figure 2: Sagittal PD-weigthed TSE MRI. Erosion of the anteriomedial femur condyle is shown (arrow).

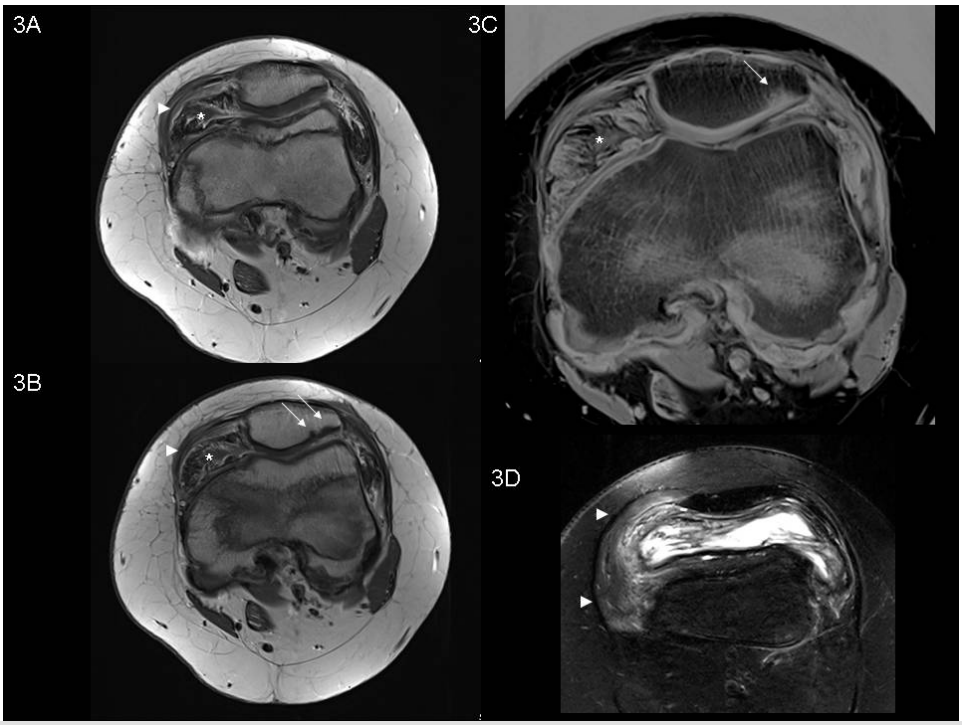

Figure 3A–C: Enhanced T1w axial MRI. **3B:** Inverted. **3D:** Transversal T2w TSE with spectral fat saturation. Arrows: Erosion of cartilage and bone destructions, arrow heads: synovial thickening and synovialitis, asterisk: effusion with haematoma.

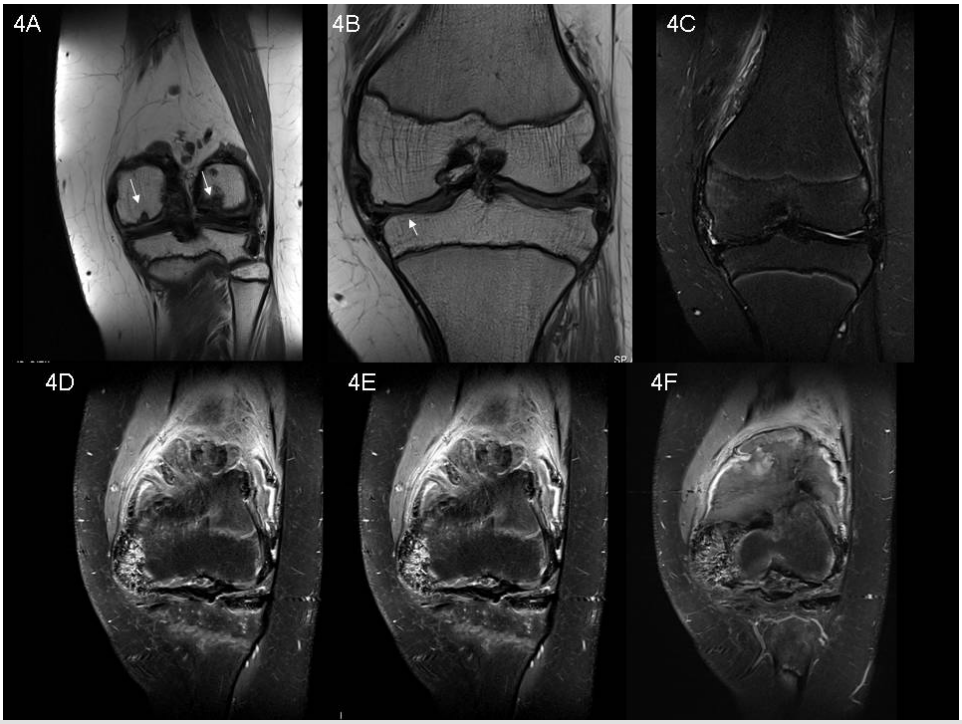

Figure 4A: Coronal T1w SE showing erosion of the femur condyles. **4B:** Thinning of tibial cartilage (arrow). **4C:** Coronal TIRM showing regular bone marrow and epiphyseal fusion within normal age-related range. **4D-F:** Enhanced T1w with fat saturation revealing extensive synovialitis.

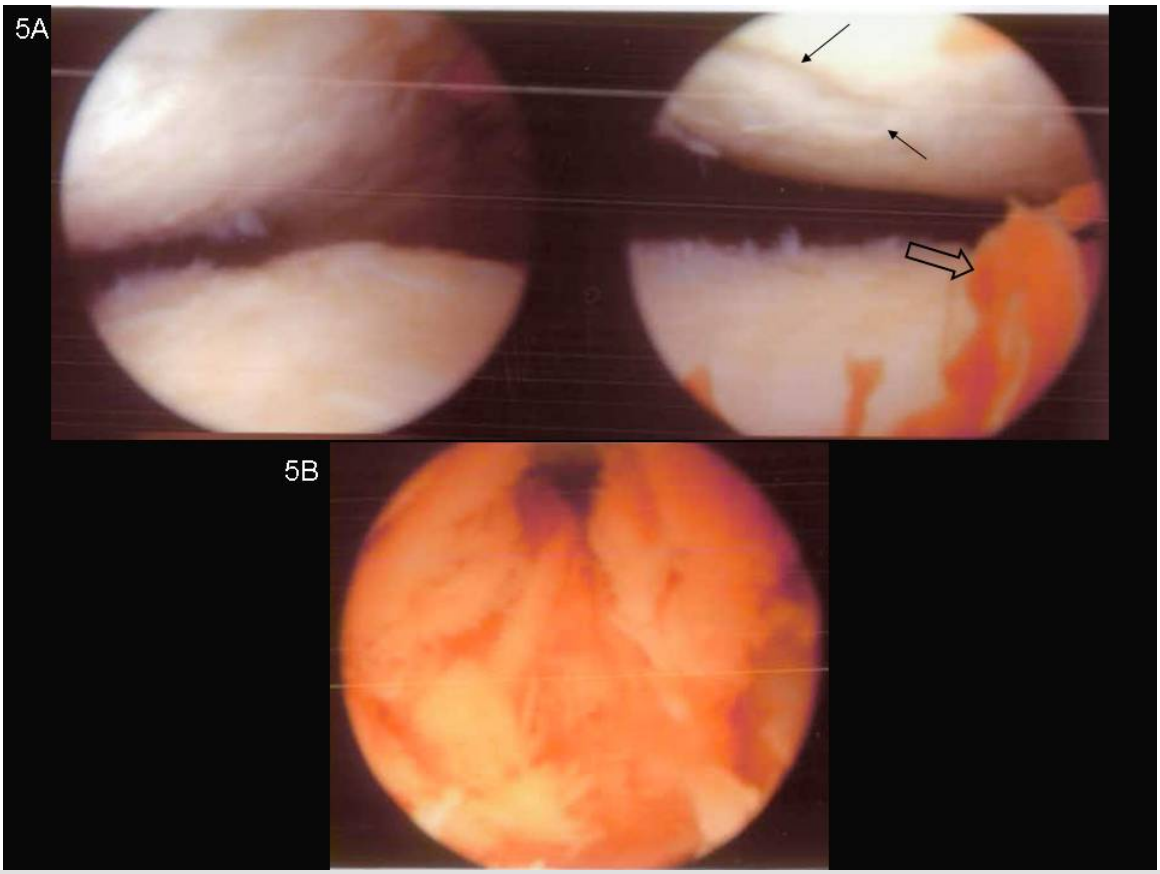

Figure 5: Arthroscopic images (courtesy of Tobias Gotterbarm, MD; Dept. of Orthopedics and Trauma Surgery, University Hospital Heidelberg, Germany).
5A: Multiple lesions of the femoral and tibial cartilage (arrows).
5B: Extensive synovialitis (open arrow in Fig. 5A).

Imaging findings

Findings of severe haemarthrosis include clear synovial thickening and enhancement as a sign of intense proliferation of the synovia. Effusion contains also solid-appearing containments as well as T1w iso- and slightly hyperintense areas. These findings are consistent with older haematoma. Erosions of the cartilage can be found in both joint compartments including thinning of the tibial cartilage. In addition, erosion of the cartilage and bone can also be found in the retropatellar joint. Epiphyseal fusion and bone marrow are age-related and without suspicious findings. No signs of fracture are visible and ligaments as well as menisci are within normal range. However, as already suspected through conventional x-ray, MRI shows also small osteophytes as sign of secondary arthrotic osseous changes.

Conclusion

In this case of haemarthrosis in a patient with recurrent bleedings, MRI at high field-strength (3T) and in combination with dedicated high-density coils is an invaluable tool for the evaluation of joints in childhood and adolescence within a reasonable time-frame and with superb image resolution, resulting in most accurate assessment of joint damage and extension of synovialitis. It is already known that in cases of haemophilia implementing MRI for assessment of joint involvement changes the patient management (Pergantou et al.). However, the appropriate selection of MR imaging techniques as well as the appropriate translation of MRI findings into scoring systems are subject of ongoing debate (Doria et al., Lundin et al.). In clinical routine the availability of MR scan time and the requirements for fast and highly-resolved imaging hampers the wide usage of MRI. So the implementation of a 3T open-bore system in our department and as a consequence shorter scan times at higher quality has significantly improved the acceptance of MR by patients and referring physicians.

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