

# Case Reports:

# Musculoskeletal MRI

# in Sports Medicine

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## Background

In contrast to its role in oncology, for example, MR imaging in sports medicine deals primarily with healthy and young individuals. This imaging technique is an invaluable tool in sports medicine, not only because of its excellent soft tissue contrast but also because of its non-invasive and non-ionizing nature. While imaging in recreational sports is mainly limited to an evaluation of the effects of severe traumatic events, such as a skiing accident, the role of musculoskeletal MRI in case of competitive sports is much more extensive. For example, following an injury, MRI is also used to assist in the detailed evaluation of the degree of performance impairment of the athlete – with direct impact on treatment / training actions taken for effective fast and full recovery. This implies that time-to-diagnosis and the easy access and availability of MRI scan time (also for follow-up exams) is important for these athletes. One should also take into account that the pattern and severity of injuries can differ between recreational and competitive sports. This has a direct impact on the indication to MRI and the required knowledge of technologists and radiologists. But also non-traumatic pain and limitation of mobility,

and as a consequence insufficient training and competitive performances, of athletes can have various causes and are one of the main indications for MRI. Because of the importance of the results of such MR exams to the athlete, the interdisciplinary approach is one of the key elements for optimal and responsible treatment and support. Consequently, all cases shown in this article were examined at and treated by an association of different facilities including the Department of Sports Medicine at Tuebingen University and the Olympic Training Center Stuttgart.

In this article, we present a selection of cases. Whilst not being a representative selection, they do reflect very well the variety and range of musculoskeletal imaging in sports medicine: in cases 1 and 2, MRI was used to support the clinical diagnoses of ligamental tear / rupture. Cases 3 through 5 show typical patterns of muscular tears and haematoma after trauma. In these patients, MRI was used to evaluate the involvement and extension of the different muscles to evaluate and quantify the degree of performance impairment and to provide information for further rehabilitation training. And finally, in cases 6 and 7, the images of two young athletes

with pain at training but without corresponding trauma are shown. All MRI exams shown in this article were performed at 1.5 Tesla (MAGNETOM Avanto).

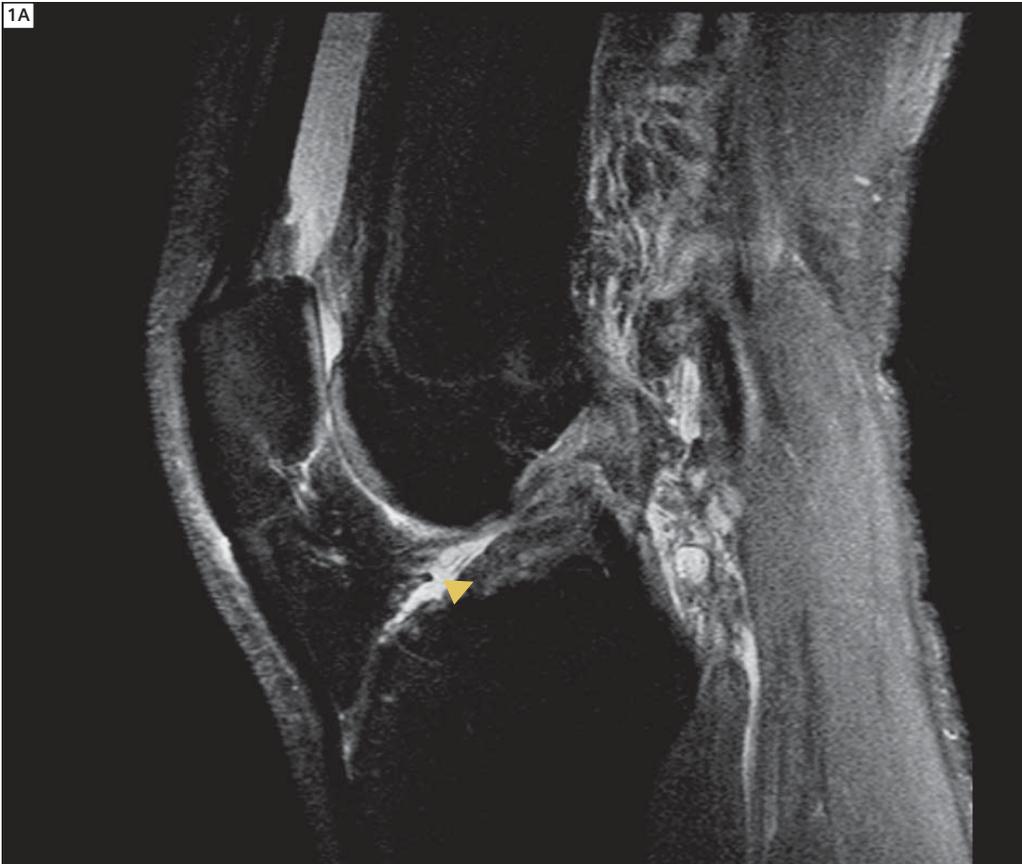
## Case 1

22-year-old male soccer player with severe knee pain after traumatic knee injury.

An extensive effusion is obvious. Already suspected by clinical signs, oedema and tear of the anterior cruciate ligament supports the diagnosis of a complete rupture of the ligament (arrowhead in Fig. 1A). In addition, a horizontally shaped oedema within the dorsal medial meniscus supports the suspicion of a horizontal (smaller) meniscal tear (arrow in Fig. 1B).

Images were acquired with the dedicated CP extremity coil. Sequence parameters for the shown images were:

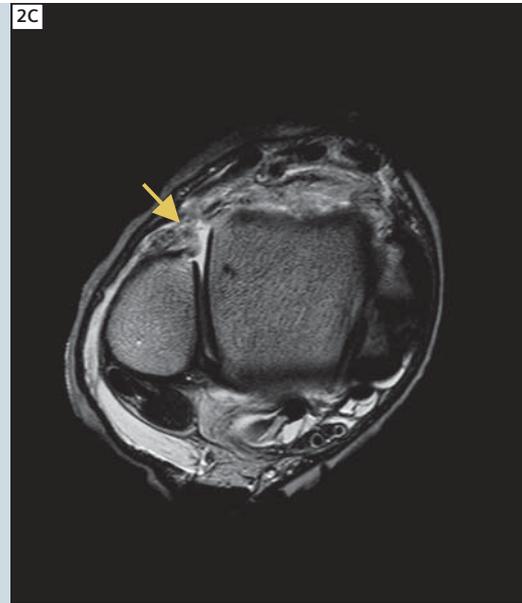
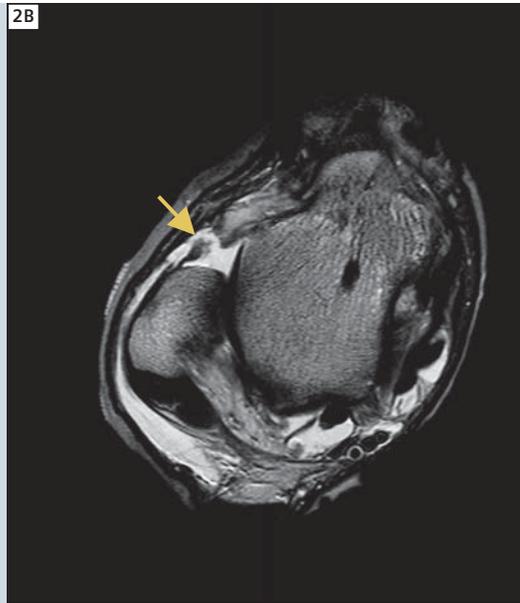
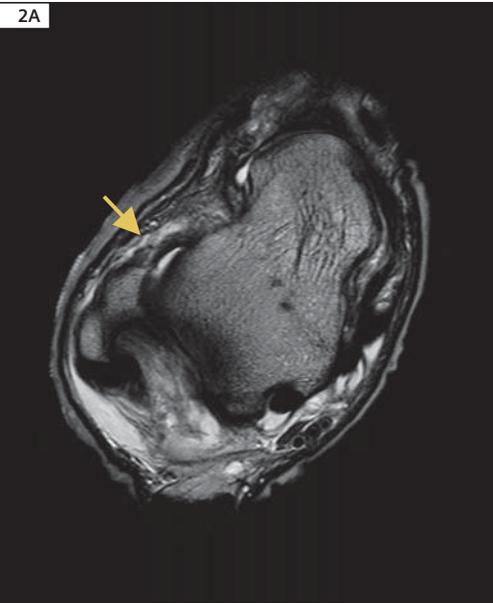
- Sagittal PDw TSE with spectral fat suppression: TR / TE = 3754 / 37 ms, SL 1.5 mm, FOV 140 x 140 mm, Matrix 269 x 384 px
- Coronal PDw TSE with spectral fat suppression: TR / TE = 3754 / 37 ms, SL 1.5 mm, FOV 140 x 140 mm, Matrix 269 x 384 px



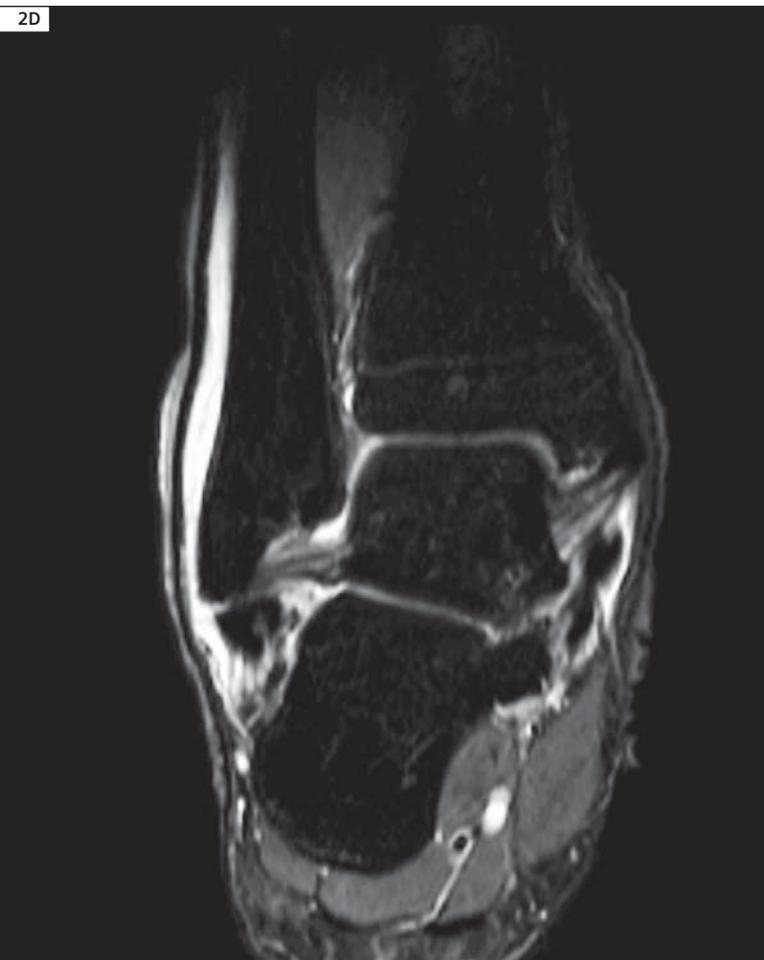
**1A** Sagittal PDw STIR.



**1B** Coronal PDw STIR.



2A-C 1<sup>st</sup> trauma: transversal T2w TSE.



2D 1<sup>st</sup> trauma: coronal PDw STIR.



2E 1<sup>st</sup> trauma: coronal T1w TSE.

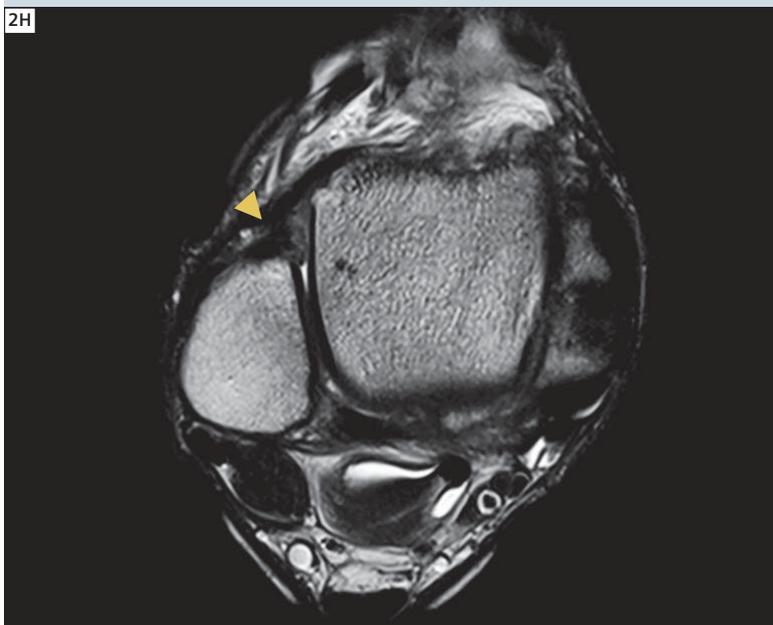
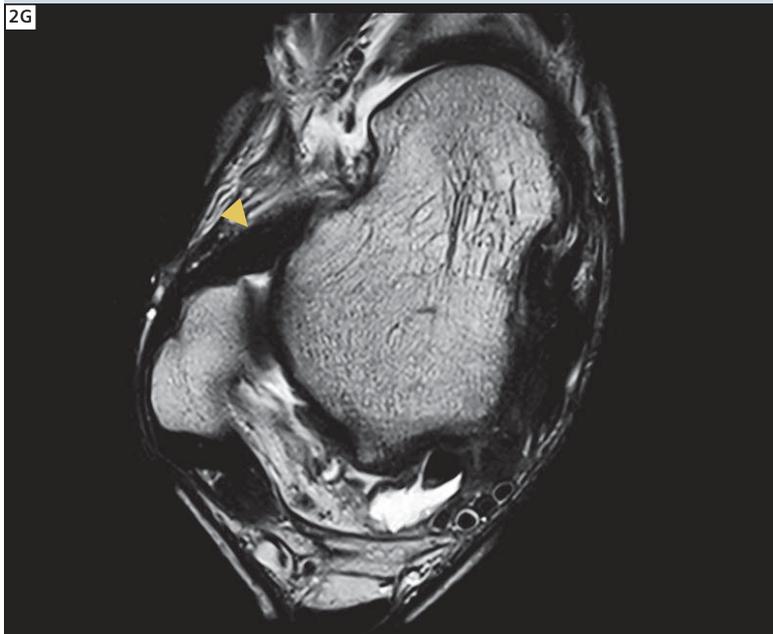
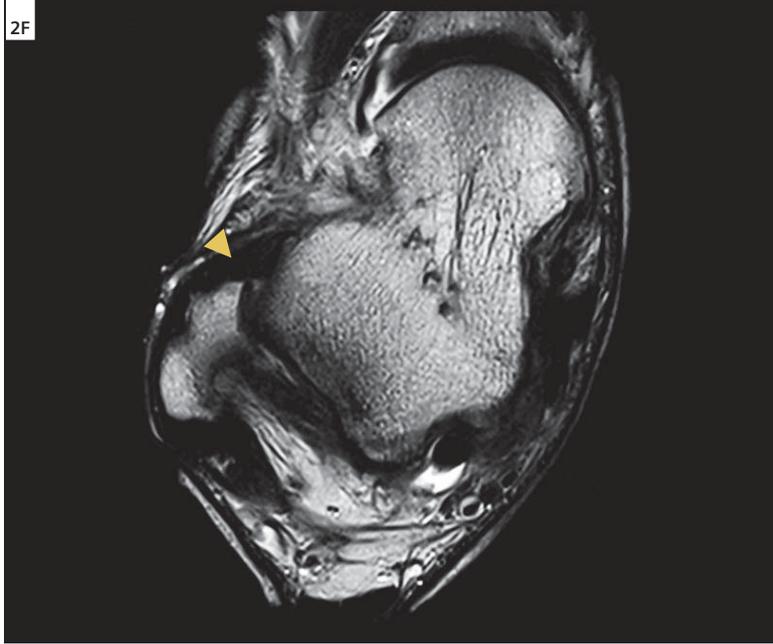
## Case 2

23-year-old male soccer player after traumatic ankle injury.

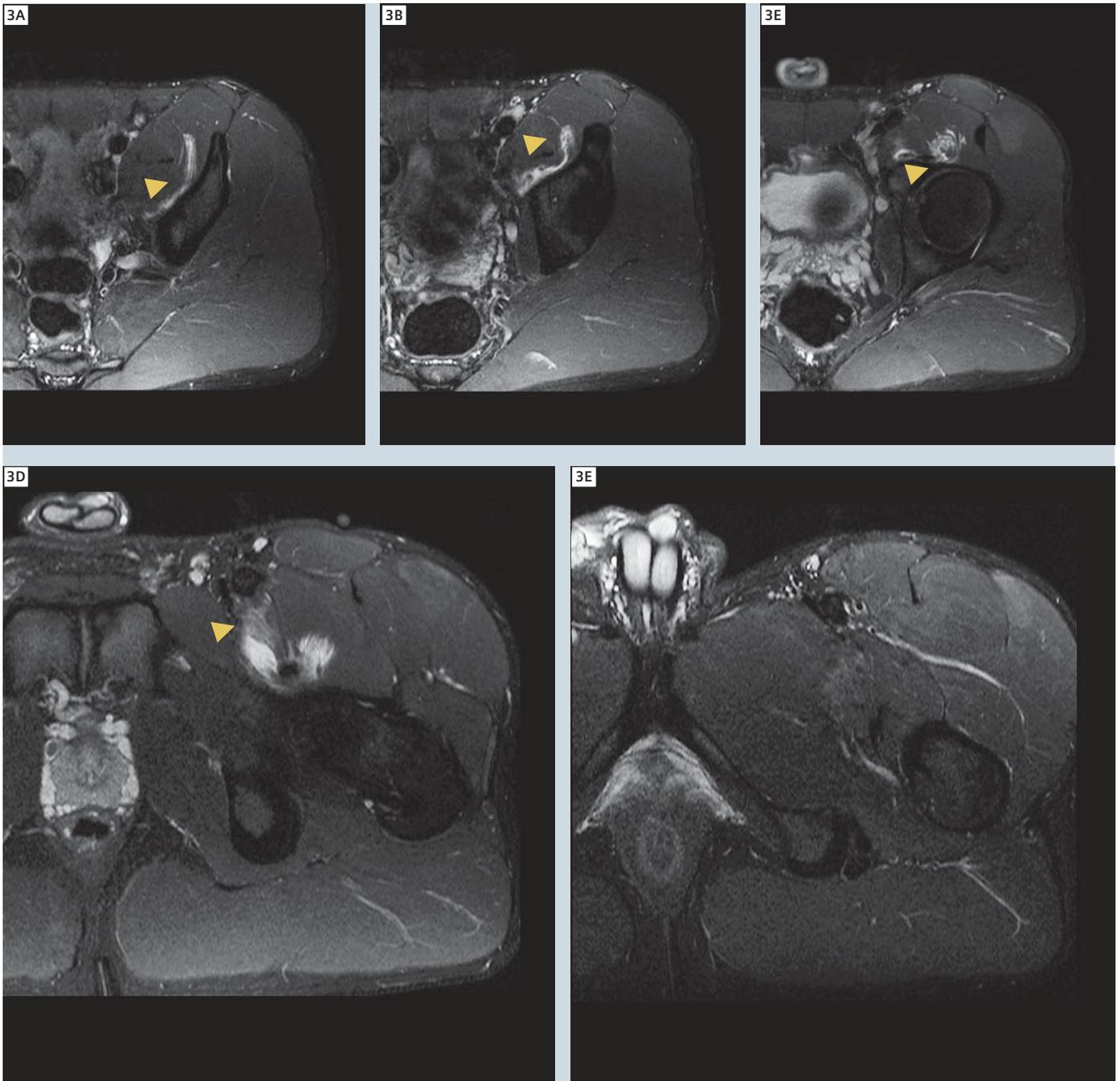
MRI demonstrates a complete rupture of the anterior fibulotalar ligament (arrow in Figs. 2A–C). In addition, a partial rupture of the anterior syndesmosis ligament is present and an extensive oedema and haemorrhage of the surrounding soft tissue can also be observed (Figs. 2D and E). 7 months after the initial traumatic event, another trauma of similar type occurred. Follow-up MRI showed a thickened but now continuous fibulotalar ligament and ventral syndesmosis (arrowheads in Figs. 2D–F); no re-rupture was found.

Images were acquired with the 4-channel flex coil. Sequence parameters for the shown images were:

- Transversal T2w TSE: TR / TE = 5259 / 85 ms, SL 3 mm, FOV 140 x 140 mm, Matrix 269 x 448 px
- Coronal PDw STIR: TR / TE / TI = 6500 / 29 / 160 ms, SL 3 mm, FOV 160 x 160 mm, Matrix 169 x 256 px
- Coronal T1w TSE: TR / TE = 537 / 9.5 ms, SL 3 mm, FOV 111 x 160 mm, Matrix 250 x 448 px, TA
- Follow-up MRI transversal T2w TSE: TR / TE = 4110 / 105 ms, SL 3 mm, FOV 110 x 110 mm, Matrix 512 x 512 px



**2F–H** 2<sup>nd</sup> trauma: transversal T2w TSE.



3A-E Transversal PDw STIR.

### Case 3

22-year-old male soccer player after trauma of the left upper leg. Tear of the fascia of the left iliac muscle at the ventral border of the acetabulum and less prominent tear of the iliac muscle itself (arrowheads in Fig. 3). Images were acquired with the Spine

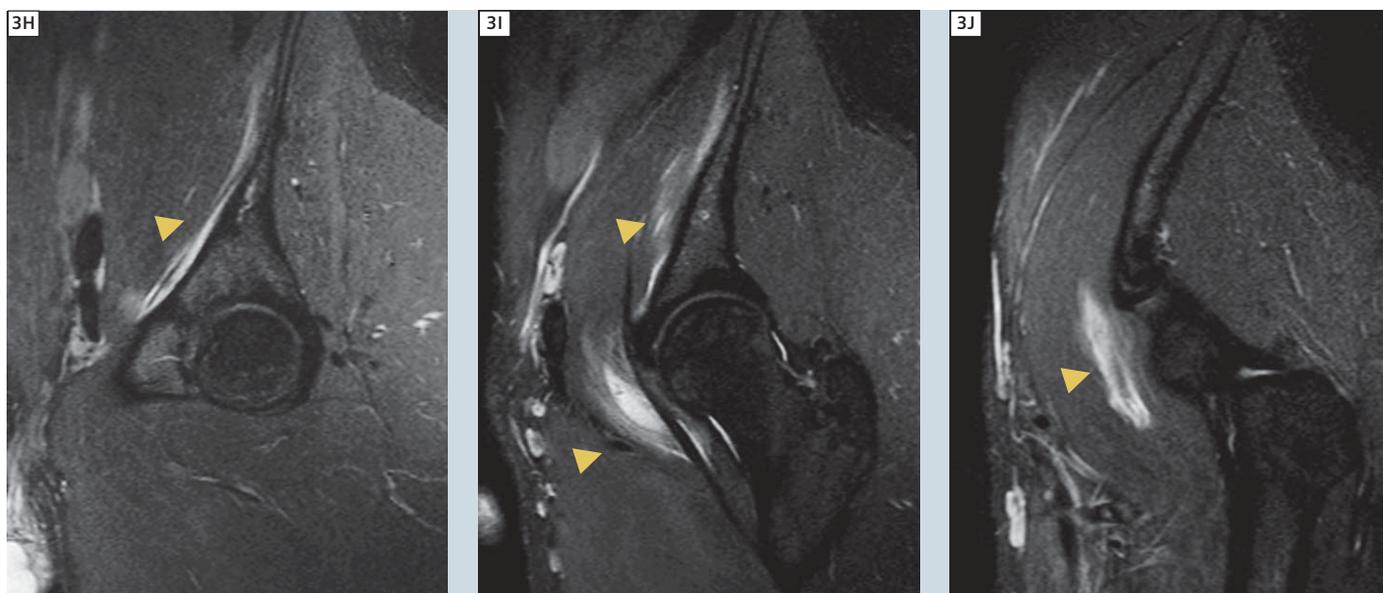
and Body Matrix coil. Sequence parameters for the shown images were:

- Transversal PDw STIR: TR / TE / TI = 5390 / 29 / 160 ms, SL 4 mm, FOV 220 x 200 mm, Matrix 224 x 320 px
- Oblique coronal PDw TSE with spectral fat saturation: TR / TE = 4340 / 13 ms,

- Obliques sagittal PDw STIR: TR / TE / TI = 7540 / 29 / 160 ms, SL 4 mm, FOV 189 x 270 mm, Matrix 157 x 320 px



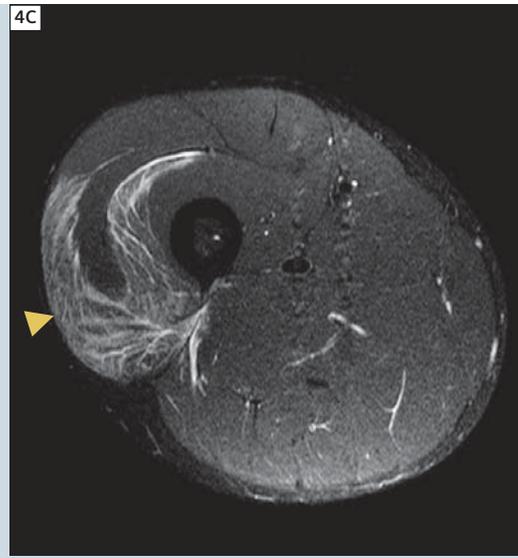
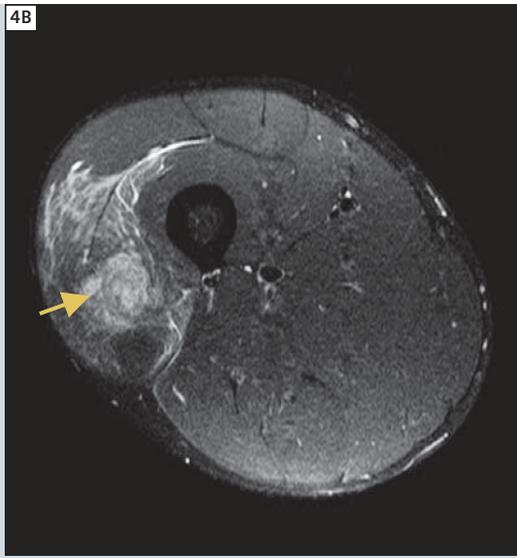
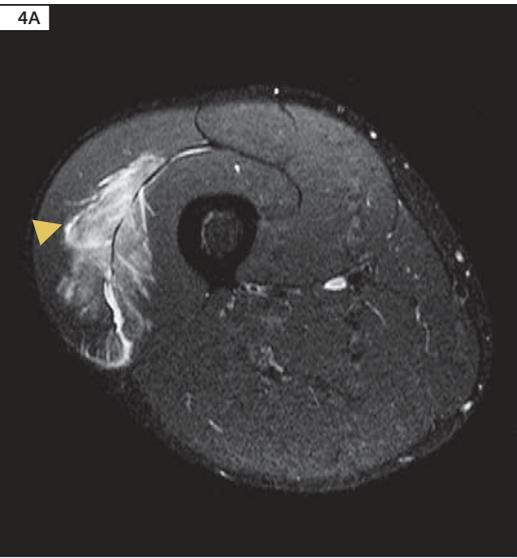
**3F-G** Oblique coronal PDw STIR.



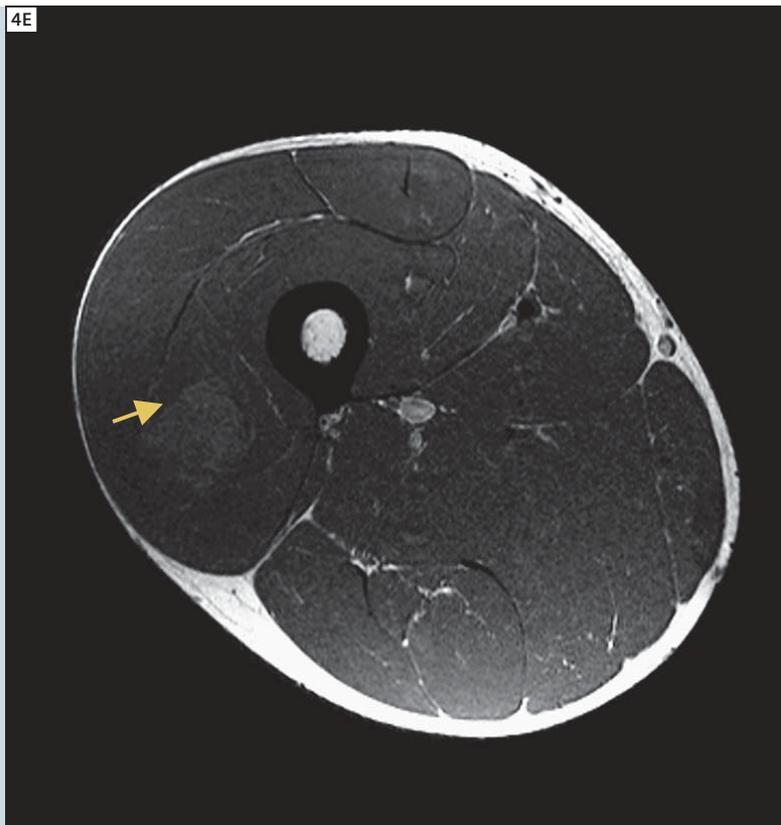
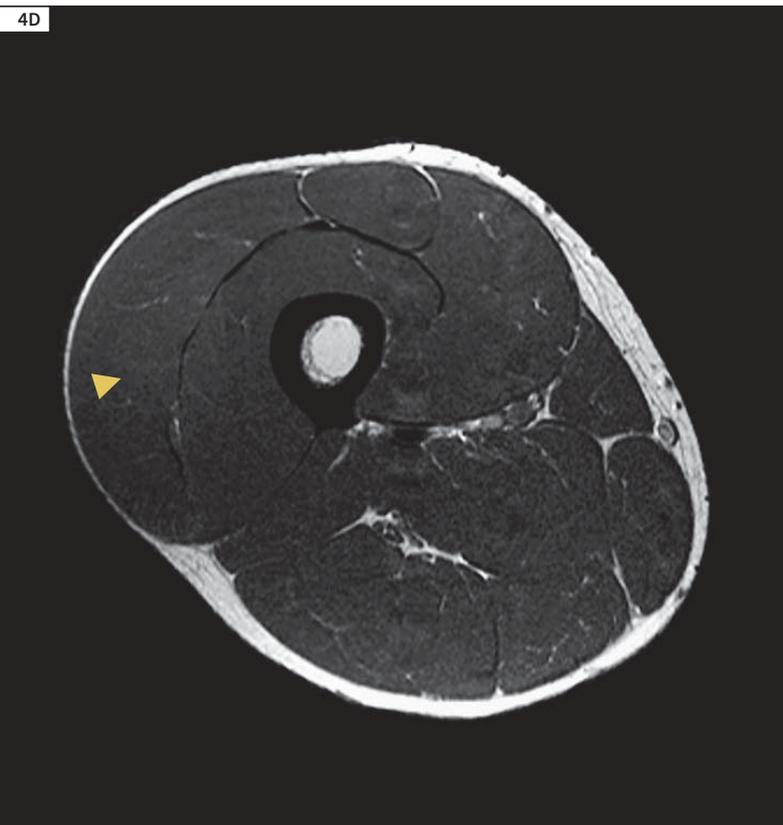
**3H-J** Oblique sagittal PDw STIR.



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4A-C Transversal PDw STIR.



4D-E Transversal T1w TSE.

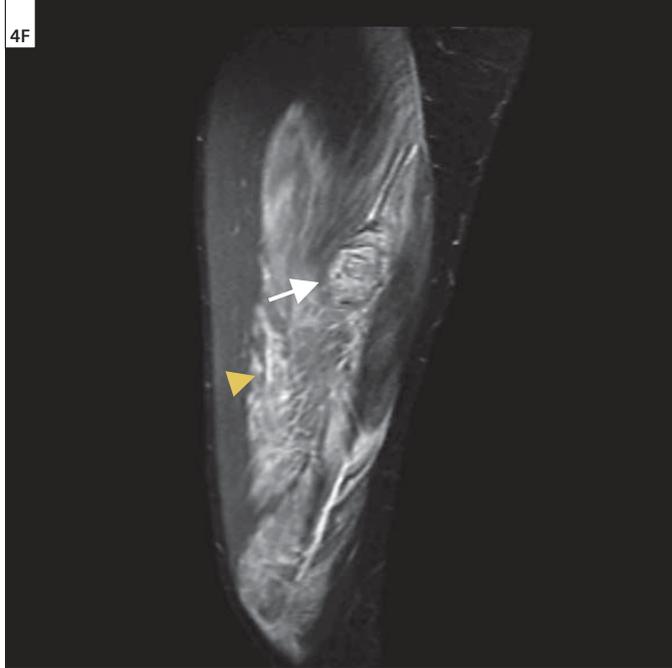
## Case 4

24-year-old male soccer player after direct trauma (pound on right upper leg). On T2w images, a space occupying lesion within the lateral vastus muscle (arrow) and slight increased signal intensities on T1w images was seen, representing an extensive haematoma. Also a surrounding haemorrhage (arrowheads) was obvious. There were no clear signs of a tear in the muscles. The femur showed neither a fracture nor abnormalities of the signal intensities of the bone marrow.

Images were acquired using the Spine and Body Matrix coil. Sequence parameters for the shown images were:

- Transversal PDw STIR: TR / TE / TI = 8073 / 29 / 160 ms, SL 4 mm, FOV 220 x 220 mm, Matrix 224 x 320 px
- Transversal T1w TSE: TR / TE = 580 / 13 ms, SL 4 mm, FOV 200 x 200 mm, Matrix 256 x 320 px
- Sagittal PDw STIR: TR / TE / TI = 4580 / 29 / 160 ms, SL 4 mm, FOV 280 x 400 mm, Matrix 157 x 320 px
- Coronal T2w TSE: TR / TE = 7130 / 86 ms, SL 4 mm, FOV 281 x 399 mm, Matrix 216 x 384 px

4F



4F-G Sagittal PDw STIR.

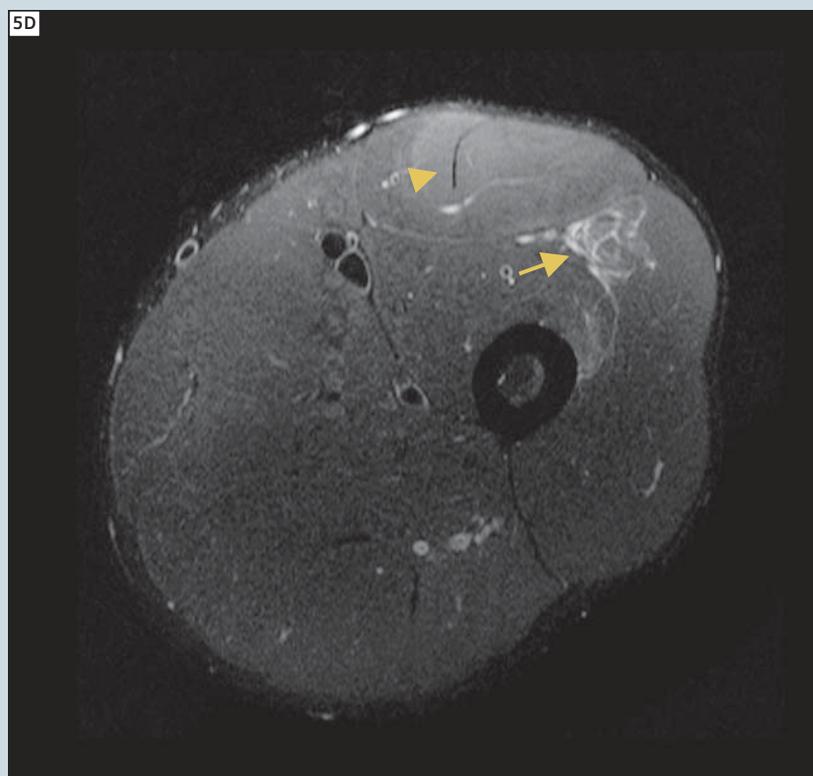
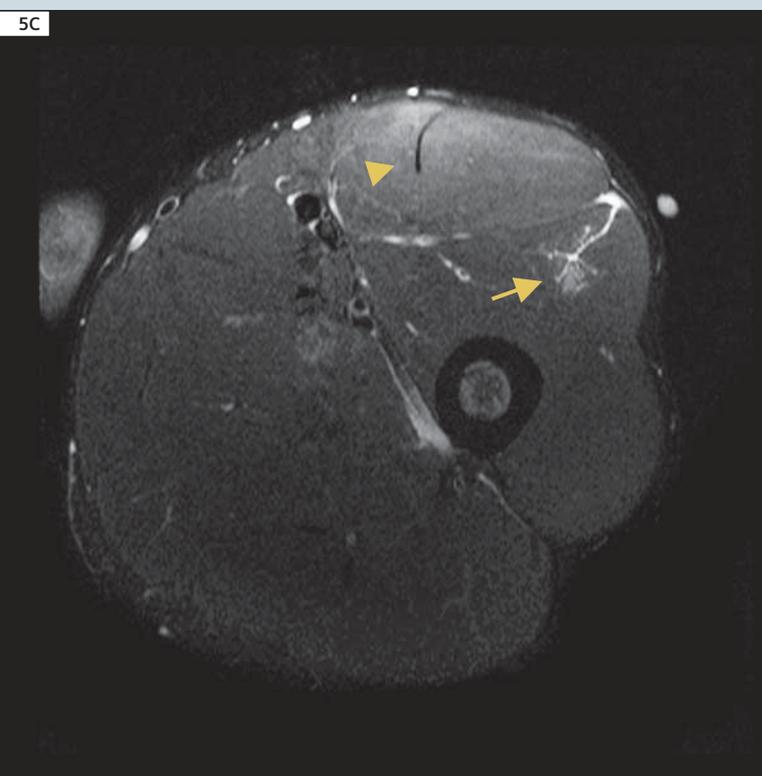
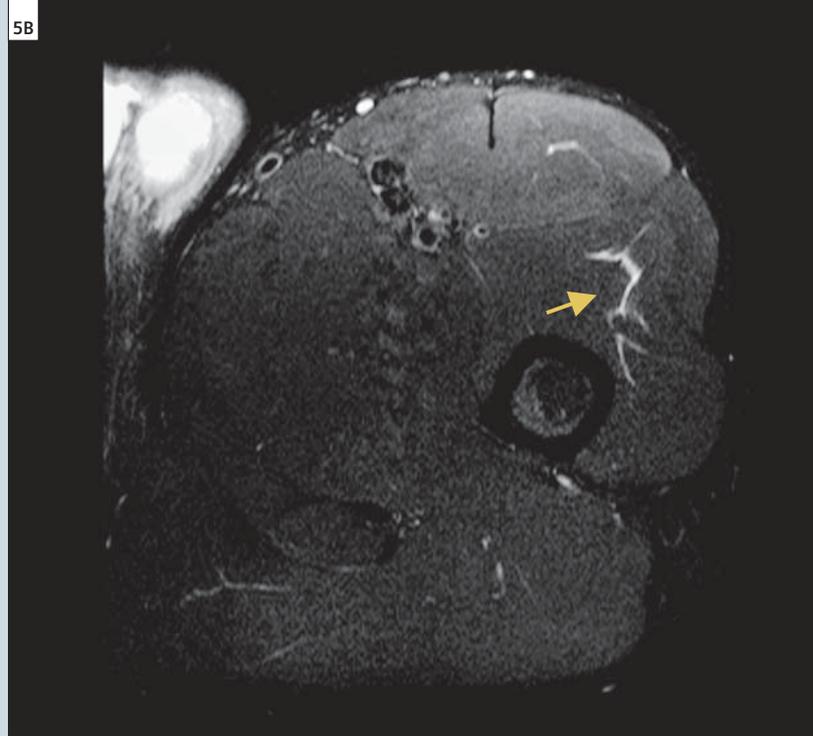
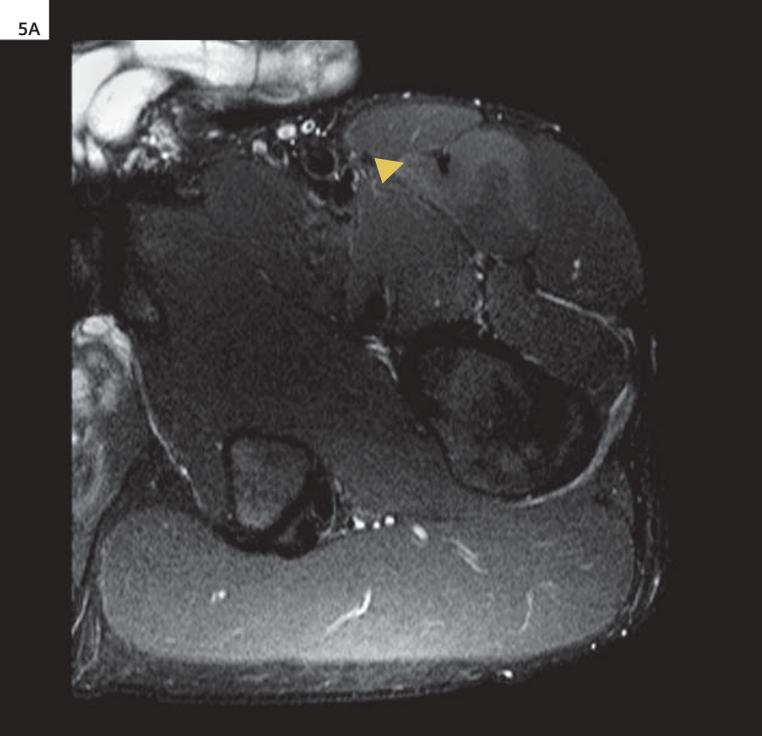
4G



4H



4H Coronal T2w TSE.



5A-D Transversal PDw STIR.

## Case 5

24-year-old male soccer player after trauma.

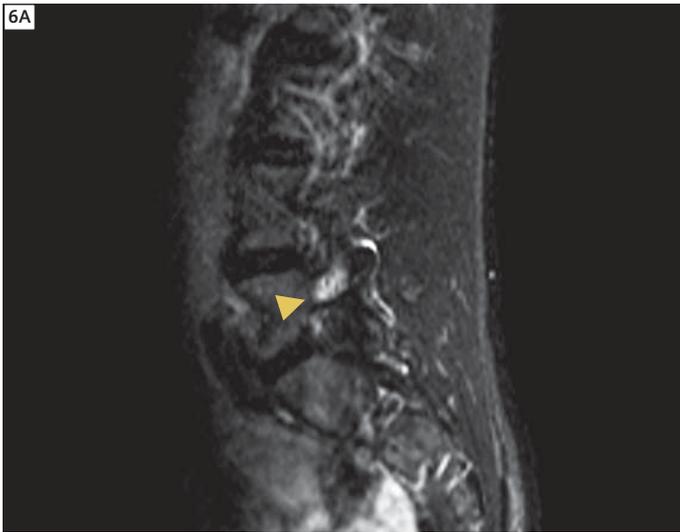
In contrast to case 4, an approximate 15 mm long acute tear of the lateral vastus muscle (arrow) was seen in this patient but there were no signs of a dehiscence

of the muscles. Slight increase of the signal intensities on PDw images within the vastus intermedius and rectus femoris muscles were rated as a strain.

The patient was positioned feet first and the images were acquired with the Spine

and Body Matrix coil. Sequence parameters for the shown images were:

■ Transversal PDw STIR: TR / TE / TI = 5390 / 29 / 160 ms, SL 4 mm, FOV 220 x 220 mm, Matrix 224 x 320 px



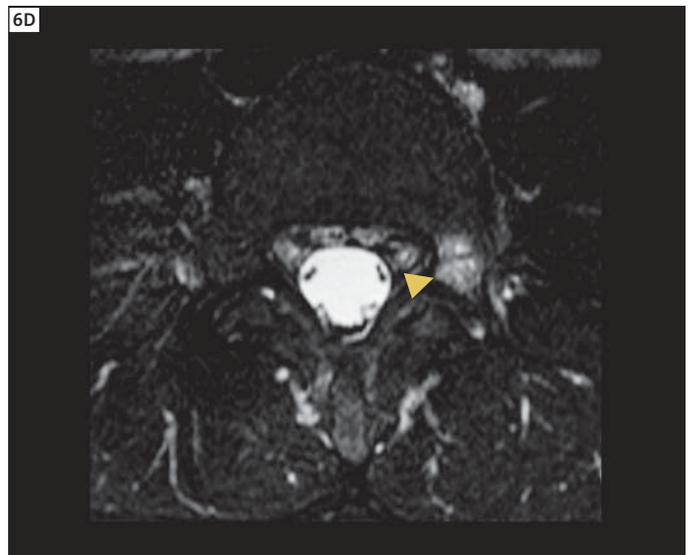
6A Sagittal T2w STIR.



6B Sagittal T2w TSE.



6C Sagittal T1w TSE.



6D Oblique transversal T2w STIR.

## Case 6

16-year-old female high-jumper with consistent pain during training sessions and while making sudden jerky movements.

High signal intensity within the bone marrow of the left pedicle of the 5<sup>th</sup> vertebra could be seen. Within this oedema, a continuous hypointense line was crossing the pedicle. This finding

was rated as a 1<sup>st</sup> degree spondylolysis without signs of listhesis or cleft. Images were acquired using the spine coil. Sequence parameters for the shown images were:

- Oblique transversal T2w TSE with spectral fat saturation: TR / TE = 3800 / 105 ms, SL 3 mm, FOV 180 x 180 mm, Matrix 192 x 256 px

- Sagittal T2w STIR: TR / TE / TI = 7300 / 63 / 150 ms, SL 3 mm, FOV 300 x 300 mm, Matrix 195 x 256 px

- Sagittal T1w TSE: TR / TE = 621 / 12 ms, SL 3 mm, FOV 280 x 280 mm, Matrix 269 x 384 px

- Sagittal T2w TSE: TR / TE = 8660 / 120 ms, SL 3 mm, FOV 280 x 280 mm, Matrix 269 x 384 px

## Case 7

13-year-old female soccer player with pain within the right forefoot but without adequate corresponding trauma. Caudal of the epiphyseal line of the second metatarsal bone, an oedema of the bone marrow and very apical loss of shape of the bone and compression of bone trabeculae. The epiphyseal line is of regular shape. The caudal head of the metacarpal bone is also surrounded by oedema and an effusion of the joint was present, too. These findings were concordant with an osteonecrosis in the sta-

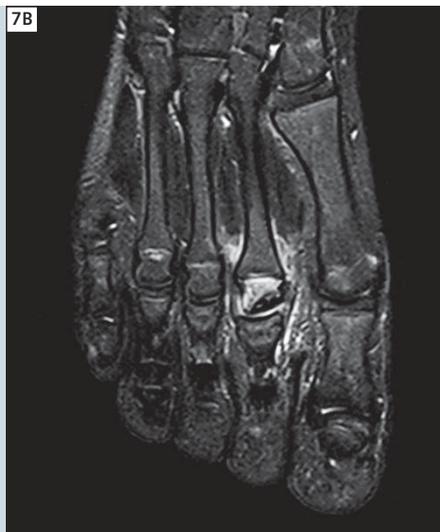
dium of vitrification (Morbus Köhler-Freiberg / Morbus Köhler II). Images were acquired with the 4-channel flex coil. Sequence parameters for the shown images were:

- Coronal T2w STIR: TR / TE / TI = 4180 / 70 / 140 ms, SL 2 mm, FOV 140 x 140 mm, Matrix 460 x 512 px
- Coronal T1w TSE: TR / TE = 684 / 13 ms, SL 2 mm, FOV 140 x 140 mm, Matrix 256 x 512 px
- Sagittal T2w STIR: TR / TE / TI = 3700 / 70 / 140 ms, SL 2 mm, FOV 140 x 140 mm, Matrix 460 x 512 px

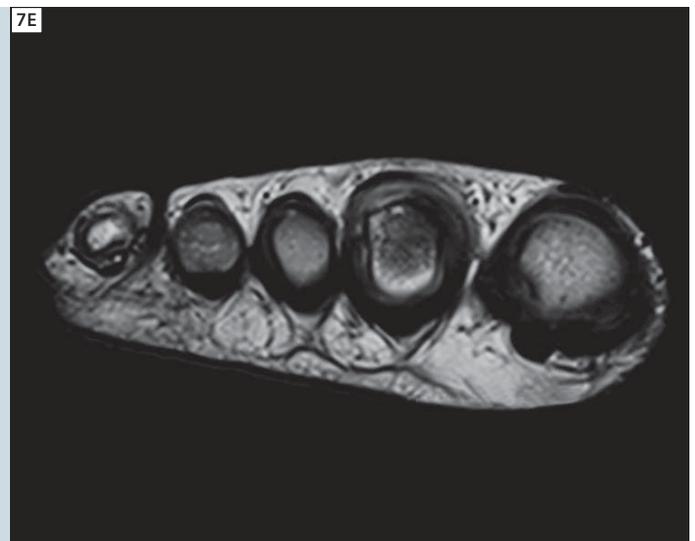
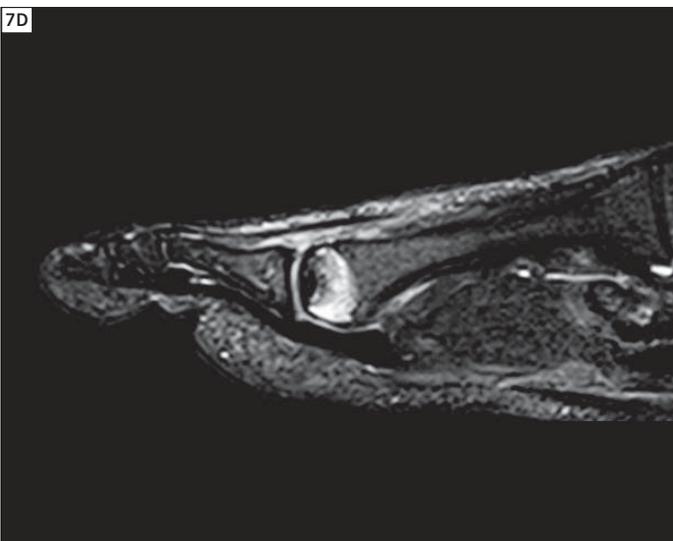
- Transversal T2w TSE: TR / TE = 3880 / 103 ms, SL 3 mm, FOV 89 x 130 mm, Matrix 352 x 512 px

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7A-C A and B: Coronal T2w STIR. C: Coronal T1w TSE.



7D-E D: Sagittal T2w STIR. E: Transversal T2w TSE.