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Casuistics

Identification by MRI

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Summary. A semi-skeletted water-lodged corpse was supposed to be an 82-year-old missed man. Fifteen years ago this person had underwent an operation of a trimalleolar fracture of the left ankle joint. Conventional X-ray photograms of the left ankle joint of the water-lodged corpse showed no evidence of an operation. A T-1 weightened spin-echo sequence revealed the entire aspect of the osteosynthesis as documented in the previously performed post-operative X-ray photograms.

Key word: Identification by MRI

Zusammenfassung. Eine zur Identifikation übergebene, teilskelettierte Wasserleiche soll die eines seit ca. 4 Monaten vermißten, 82jährigen Mannes sein. Bei dem Vermißten war vor 15 Jahren eine trimalleoläre OSG-Fraktur links osteosynthetisch versorgt worden. Bilder der Versorgung lagen vor. Neu angefertigte Röntgenbilder des linken oberen Sprunggelenks der Wasserleiche ließen keine Eingriffsfolgen und keine alten Frakturen erkennen. Eine SE-Sequenz, T-1 gewichtet ließ die gesamte ostesynthetische Versorgung, wie sie auf den alten Bildern von 1973 dokumentiert ist, erkennen.

Schlüsselwort: Identifikation durch Kernspintomographie

Introduction

Identification of water-lodged corpi as of charred bodies is often limited to the skeletal remains only [8]. As congential osseous malformations seem to be more rarely as survived bone surgery, the detection of individual postsurgical findings, i.e, oesteosynthesis is a promising method of identification. Frequently, no more information could be obtained by conventional X-raying if bone union per primam intentionem without dislocation occurred. The detection of metal traces in operation arrangement is therefore a desired technique for identifying investigations.

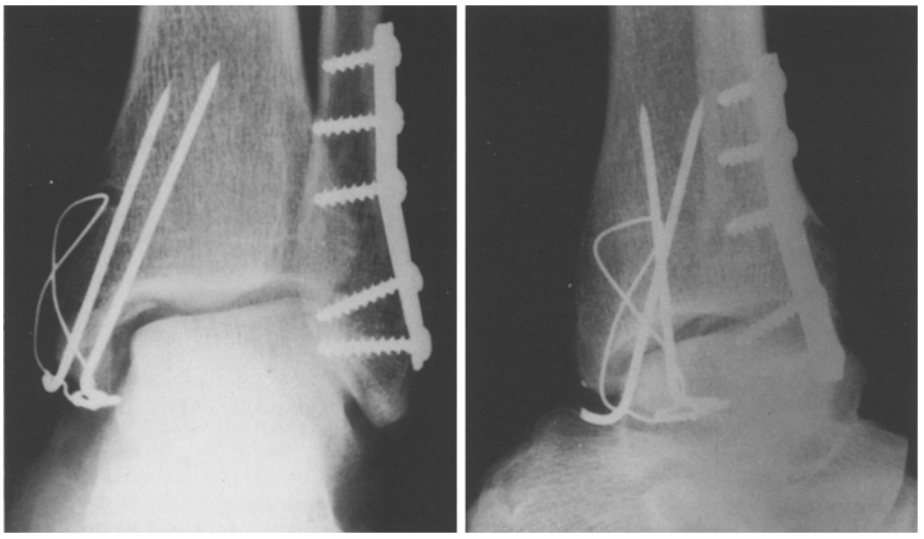

Fig. 1. Post-operative X-ray photogram of the left ankle joint (1973)

Fig. 2. Recent X-ray photogram (1988): no metallic remains, no identifiable marks as compared with Fig. 1

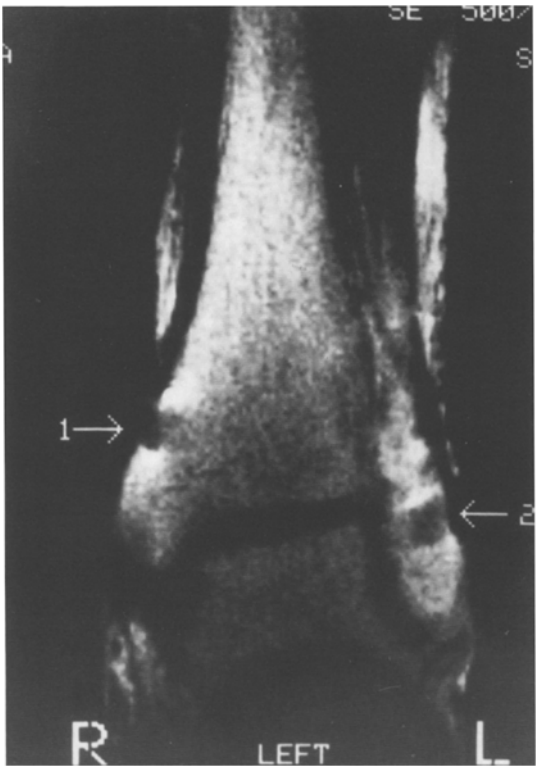

Fig. 3. MR-image, first examination −20°C. T-1 weightened coronal cutting: two metallic artifacts in this slice at the inner malleolus and fibula

Case

A semi-skeletted water-lodged corpse was submitted (180/88) for identification at the end of May 1988. No fingerprints were to be obtained, the mandible was toothless. The male corpse was taken for a person aged 82 years who had been missed since the beginning of February. This person had had an ostheosynthesis of the left ankle joint about 15 years ago (Fig. 1).

Advanced putrescence and the water-soaked skin of the left leg gave no hint as to a former operation. A comparison of recently taken conventional X-ray photograms with the former images did not show any identifiable marks. No metallic substances were detectable. Only a subcortical translucence with circular calcification could be regarded as a possible former position of a cerclage wire at the inner malleolus (Fig. 2). For this could not be judged as a mark of identification, an MRI was performed (Praxis Dr. Fürmaier, radiologist Freiburg/Brsg., FRG).

An MRI system was used with a supraconductive magnet (ELSCINT GYREX 5000) operating at 0.5 Tesla. First, a spin-echo T-1 weightened sequence (TE 27 ms, TR 500 ms) was performed. Two-dimensional Fourier transform imaging, 256 × 256 acquisition data matrix, 18 cm field of view, extremity coil, coronal and sagittal cutting. The first examination was made with the frozen leg with regard to olfactorial irritation of the patients. For at −20°C the rotation of the molecules is more slowly, the relaxation time increased and statistics went bad (Fig. 3) [2]. In a second session the exarticulated formolfixed tibia and fibula were examined at +20°C in T-1 and T-2 weightened SE-sequences with coronal and sagittal cutting as mentioned above (Figs. 4, 5).

The coronal slices of the T-1 weightened SE-sequence showed at the inner malleolus an intensive, irregularly shaped signal. Laterally, also intensive irregular shapes in the distal

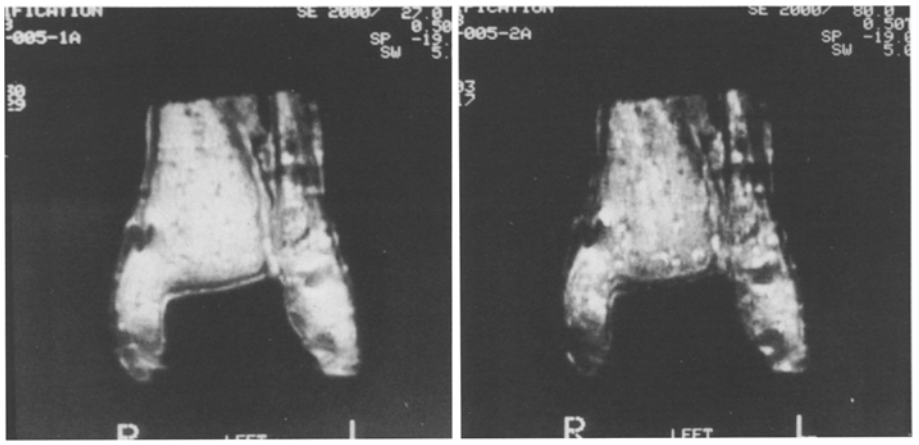

Fig. 4. MR-image, second examination +20°C, T-2 weightened coronal cutting: metallic artifacts at the inner malleolus and at the fibula

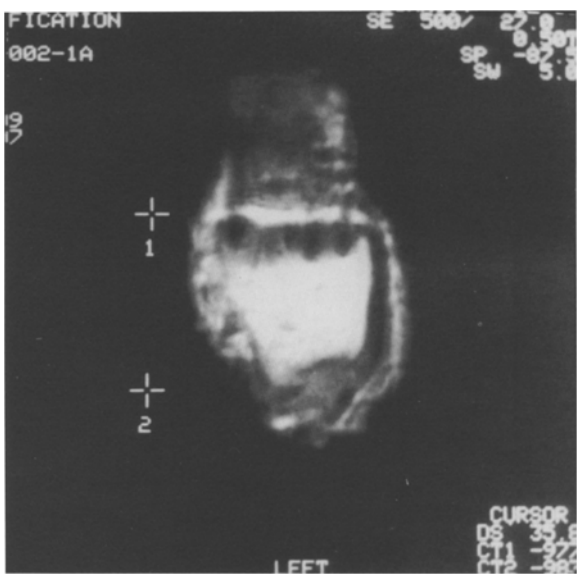

Fig. 5. MR-image, second examination +20°C, T-1 weightened sagittal cutting: metallic artifact at the inner malleolus at 35 mm distance from the tip

fibula were observed (Fig. 3). Several slices showed five irregular signal intensities in the fibula and one at the medial malleolus. The irregular signal intensities were congruent with the position of the bone drills, chisels, and cerclage wire of the post-operative X-ray photograms. The fixing of the cerclage wire is at 35 mm distance from the tip of the inner malleolus in the post-operative X-rays (Fig. 1). Also the signal intensity at the medial malleolus is about 35 mm from the tip in the MR-images (Fig. 5).

To estimate the concentration of the metallic remains, a CT (ELSCINT EXEL 2400, 5 mm slices, 145 KV, 1200 mAs) was performed additionally. The images showed no metallic densities.

Table 1. Types of magnetic behavior [3]

Classes	Susceptibility[a]
Diamagnetism	-10^{-6}
Paramagnetism	$+10^{-1}$
Ferromagnetism	$+10^{+2}$

[a] cm^3G^{-1} at 20°C

Discussion

MRI is a method with an outstanding susceptibility for metals. Several ppm of dia- and paramagnetic substances have only a small effect on a magnetic field, whereas ferromagnetic substances have a 10^5 to 10^8 times stronger effect (Table 1) [2, 4, 5]. The contents of surgical instruments (esp. iron and nickel, less so chrome [6] have a strong effect on a magnetic field in a small concentation [3]. This concentration can be assumed by abrasion of instruments and of temporary metallic implants in bones. The artifact seen in the MR-images is produced by induction of a local field inhomogenity [1, 4]. The varying extent and geometric distorsion is due to the irregular disturbance of the parallel static field [1, 3, 4, 6, 7]. The artifacts visible in the MR-images of the water-lodged corpse were caused by minute metallic particles resulting from the metallic implants seen in Fig. 1.

Conclusion

As demonstrated above, small concentrations of substances with high magnetic susceptibility could cause observable effects. Artifacts due to minute metallic particles from surgical intervention could be detected many years later. No other imaging system but MRI was able to show the findings. This suggests that MRI is a valuable technique in the postmortem assessment of specimens questioned to bare traces of metal in an individual pattern.

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