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Case Report

MRI follow up of bilateral partial meniscal substitution with a demineralized bone block. A case report[☆]

Sven Behrendt, MD

Practice for Knee- and Shoulder Surgery, Hoher Wall 14, 44137 Dortmund, Germany

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ABSTRACT

The case of a 60-year-old male is described, who presented in 2020 with a symptomatic degenerative bilateral posterior horn lesion of the medial meniscus. On MRI both lesions appeared identical as 60%-70% incomplete radial tears in the posterior horn of the medial meniscus with a flap tear component. The patient was arthroscopically treated with bilateral implantation of a demineralized bone block as a partial medial meniscus substitute. A complete isointense and homogenous signal was recorded after 16 weeks and 12 months on the right knee and after 12 weeks on the left knee, indicating a complete ingrowth and remodeling of the implant. KOOS and IKDC score improved from 81 and 66% presurgery to 94 and 93%, respectively, 6 months after the second partial medial meniscus substitution on the left knee.

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Introduction

The treatment of symptomatic meniscal lesions after failed conservative treatment is partial meniscectomy. This procedure, although highly effective in the short term, leads to an increased risk of early onset of osteoarthritis despite excellent functional outcomes [1–3]. Delaying the meniscal allograft transplantation was shown to progress to higher Kellgren-Lawrence grade on radiographs [4].

Meniscal substitution with the Collagen Meniscus Implant (CMI), which acts as a scaffold for the regeneration of menis-

cal tissue, had been the preferred method for the treatment of meniscal lesions to reduce the risk of developing degenerative changes [5]. Despite good to excellent clinical results after 3–7 years, the CMI showed an ongoing remodeling with increased signal intensity and decreased size about 5 years after implantation [6], an inhomogeneous signal intensity and irregular margins of the early postoperative CMI [7]. Similar results were described recently by Reale et al. [8]. A slightly hyperintense signal was reported in 81% of patients at long-term follow-up [7]. Using the Spongioflex[®] implant for partial meniscal substitution is a new technique. The CMI was retracted from the market, thus there is no

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E-mail address: s.behrendt@dokom.net

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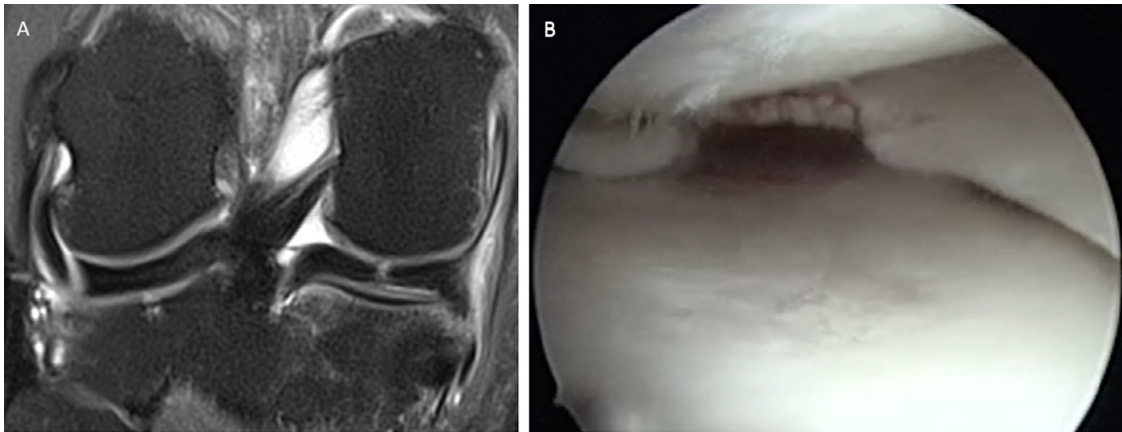


Fig. 1 – MRI of the right knee presurgical. (A) 60 to 70% incomplete radial/flap tears in the posterior horn of the medial meniscus with a flap tear component in direction to the pars intermedia. (B) Arthroscopic evaluation of the right knee after partial meniscectomy with the 18 × 8 mm defect.

alternative for treating meniscal defects with a biological implant. Generally, the surgical technique of meniscus partial substitution is less complex than the technique for meniscal allograft transplantation since it avoids problems of implant sizing [5]. The substitute has only to be sutured into the defect.

Case presentation

The case of a 60-year-old male with a normal BMI (24.6 kg/m²) is described, who presented in 2020 with a symptomatic degenerative bilateral posterior horn lesion of the medial meniscus. The KOOS score was 81 and IKDC 66%. On MRI both lesions appeared identical as 60 to 70% incomplete radial/flap tears in the posterior horn of the medial meniscus with a flap tear component which was confirmed during arthroscopy. The right knee was treated first because of more complaints.

The patient was informed, that data concerning the case would be submitted for publication, and he provided consent.

Case presentation of the right knee

Fig. 1A shows the MRI of the right knee presurgery. Fig. 1B shows the right knee after partial meniscectomy with the 18 × 8 mm defect.

The radiographs of the whole leg showed on the right side a varus of 4.9°. As proposed by others [9], varus or valgus malalignment has to be treated simultaneous with the meniscal repair/replacement in an attempt to increase graft survival [9].

Surgical procedure of the right knee

In a first step, in January 2021 on the right leg, a High Tibial Osteotomy (HTO, with TomoFix™, DePuy Synthes, Oberdorf, Switzerland) was performed and at the same time, af-

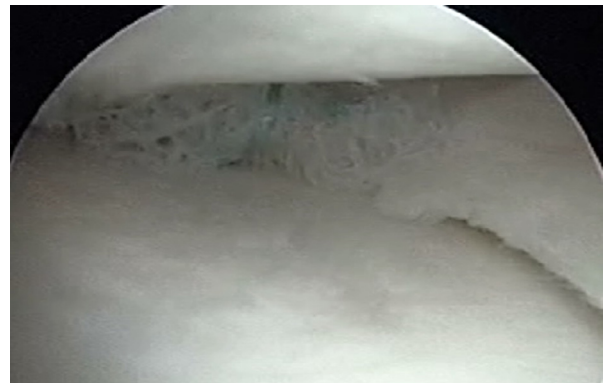


Fig. 2 – Demineralized bone block in situ after fixation on the right knee.

ter partial meniscectomy (Fig. 1B) the patient was arthroscopically treated with implantation of a demineralized bone block (Spongioflex[®], 18×10×6mm, DIZG gGmbH, Berlin, Germany) as a partial medial meniscus substitute (Fig. 2). The block was secured with 4 inside-out sutures (Etibond 0, Ethicon, Somerville, NJ). Partial meniscal substitution was performed additionally to the HTO to try to restore normal anatomy.

Postoperative rehabilitation of the right knee

Rehabilitation consisted of 5 weeks partial weight bearing, range of motion was restricted for the first 3 weeks to 30° flexion, 4th week 60°, 5th week 90°, then full range of motion exercises were allowed.

Results of the right knee

Follow up MRI on the right knee was performed as scheduled after 7 weeks, 16 weeks, and 1 year postoperatively. MRI examination on the right knee, 7 weeks (Fig. 3) after surgery, showed

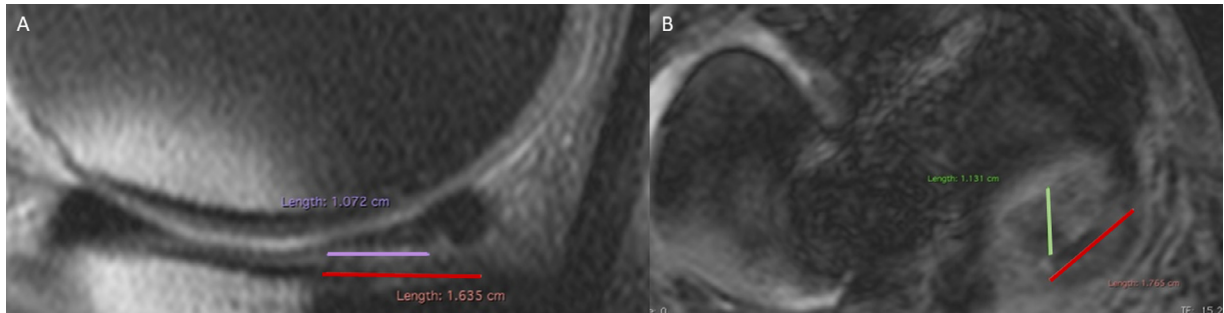


Fig. 3 – MRI of the right knee 7 weeks after surgery. (A) Slight hyperintense signal of the implant; violet line: implant length; red line: whole length of meniscus in sagittal plane; (B) axial reconstruction showing the sagittal plane level (green line: AP-implant length) of A, red line: length of the block.

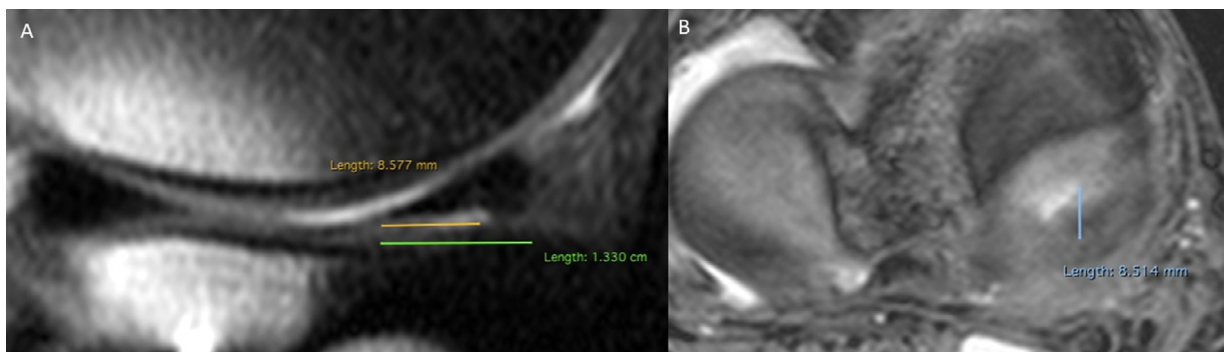


Fig. 4 – MRI of the right knee 16 weeks after surgery. (A) Isointense signal of the implant, yellow line. Implant length, green line: whole meniscus length in sagittal plane; (B) axial reconstruction showing the sagittal plane level (blue line) of A.

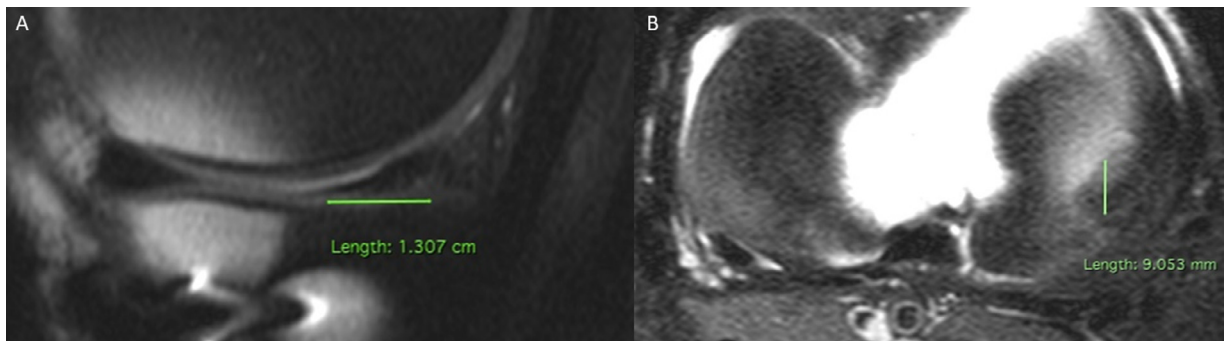


Fig 5 – MRI of the right knee 12 months after surgery. (A) Isointense signal of the implant compared to the anterior horn, green line: whole length meniscus, implant not any more visible. (B) Axial reconstruction showing the sagittal plane level (green line) of A.

only a slight hyperintense signal with no visible reduction of the implant size.

After 16 weeks (Fig. 4) the MRI showed an isointense signal with a reduction of implant size of about 1.5 mm in anterior-posterior length in the sagittal plane and 3 mm in the axial plane (axial reconstruction).

After 12 months (Fig. 5) MRI of the right knee showed no further reduction in size with an isointense signal of the whole posterior horn compared to the anterior horn.

Axial reconstruction of the implant was done in all MRIs 7 and 16 weeks and 12 months after surgery. Four- and 12 months postsurgery, it was not possible to distinguish the implant and native meniscal tissue in the sagittal plane, because of the isointense signal (Figs. 4 and 5). The size of the posterior horn (length) was the same after 4 months and after 1 year.

The patient was symptom free 12 months postsurgery for daily-life activities in the right knee with a VAS-scores of 0 for the right knee.

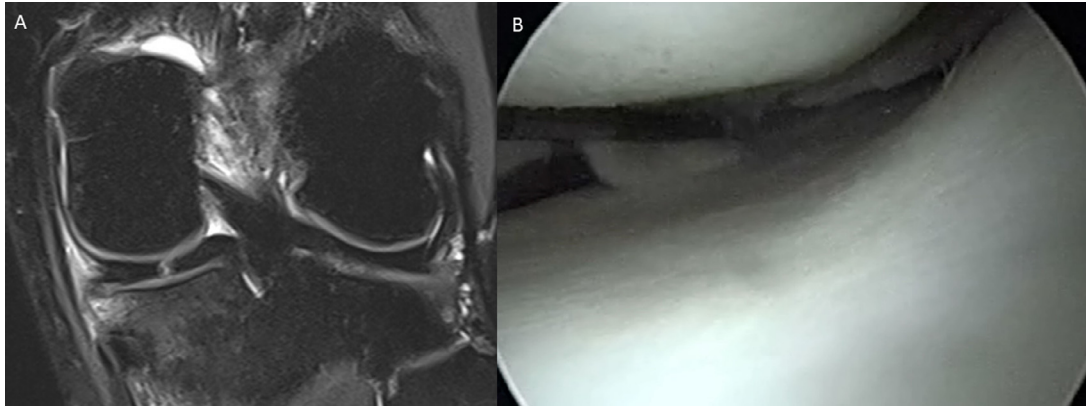


Fig 6 – MRI of the left knee presurgical. (A) 60 to 70% incomplete radial/flap tears in the posterior horn of the medial meniscus with a flap tear component in direction to the pars intermedia. (B) Arthroscopic evaluation of the right knee after partial meniscectomy with the 13 × 10 mm defect.

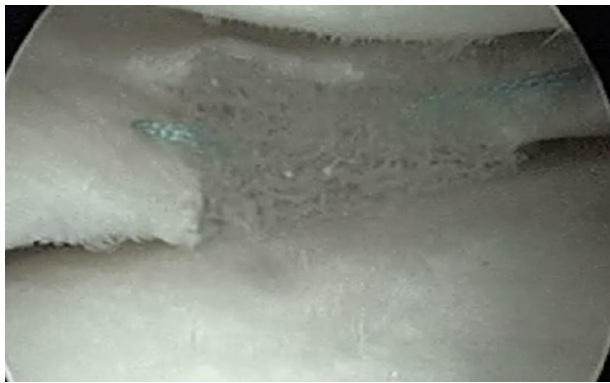


Fig. 7 – Demineralized bone block in situ after fixation on the left knee.

Case presentation of the left knee

Fig. 6A shows MRI of the left knee presurgical and Fig. 6B the left meniscus after partial meniscectomy. The left leg has a varus of 2.1°, which was not treated.

Surgical procedure of the left knee

As a second step, in February 2022, on the left knee, the same procedure was performed. After partial meniscectomy (Fig. 6B), a demineralized bone block (13 × 10 × 6 mm, Spongioflex®, Fig. 7) was implanted into the defect of the posterior horn (no HTO performed). The block was secured with 4 inside-out sutures (Etibond 0) as described above (Fig. 7).

Postoperative rehabilitation of the left knee

Rehabilitation for the left knee was the same as for the right knee.

Results of the left knee

Follow up MRI on the left knee was performed 6- and 12 weeks postsurgery up to now. The MRI of the left knee, 6 weeks (Fig. 8) and 3 months (Fig. 9) postsurgery showed an isointense signal of the posterior horn of the medial meniscus. It was not possible to distinguish the implant and native meniscal tissue in the sagittal plane. Instead, the implant was clearly visible in the axial reconstruction after 12 weeks (Fig. 9). The radial tear was visible after 6 but less after 12 weeks, Figs. 8 and 9, respectively.

The patient was symptom free for daily-life activities in both knees 3 months postsurgery of the second knee with a VAS-scores of 0 for both knees. Before surgery the VAS score was 4.

KOOS scores improved from 81 to 94 and IKDC improved from 66% to 93%, 6 months after the second partial medial meniscus substitution. He returned to sport (jogging) 6 months after the second knee was treated.

Discussion

The most important finding of the presented case was the obvious fast ingrowth of the implant after 12 weeks, when MRI was used for evaluation, with little reduction in size between week 7 and 16 and an isointense signal in both knees after 12/16 weeks.

Literature is sparse in respect to partial meniscal substitution. The comparison with CMI, though retracted from the market, is the only way to evaluate the performance of Spongioflex® for partial meniscal substitution. The CMI did not provide any apparent benefit for patients with an acute injury when compared to a control group treated by means of meniscectomy through 5 years [10]. Therefore, midterm results of partial substitution are shown to be better than partial meniscectomy [10]. Genovese et al. [11] described in 2007, a decreasing number of patients with time with an isointense signal with a CMI implant with identical shape and size to the

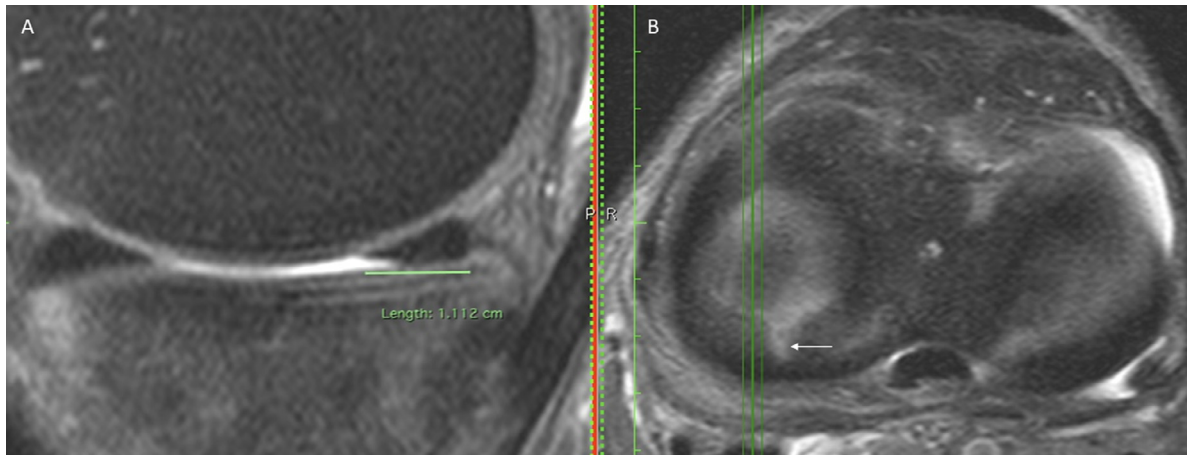


Fig 8 – MRI of the left knee 6 weeks after surgery. (A) Isointense signal of the posterior horn, green line: whole length meniscus, implant not any more visible. (B) Axial reconstruction showing the sagittal plane level of A. Radial tear still visible (white arrow).

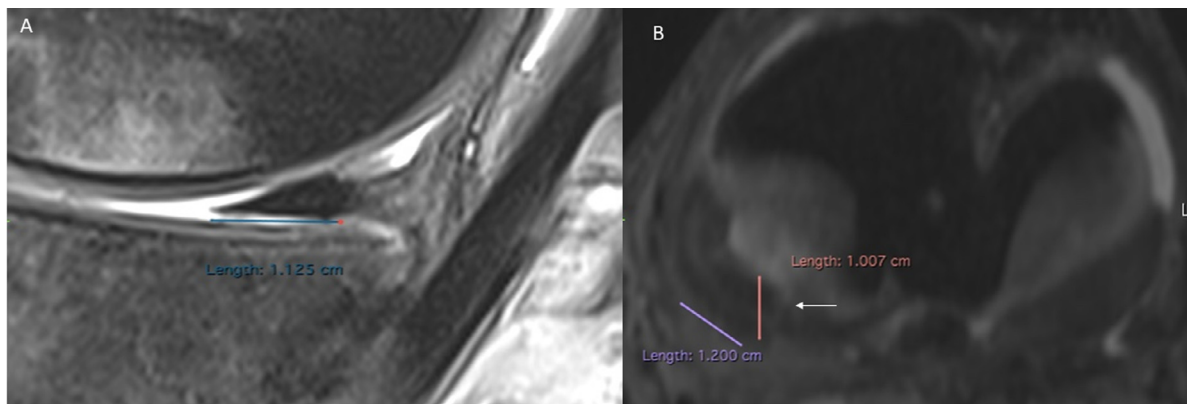


Fig 9 – MRI of the left knee 12 weeks after surgery. (A) Isointense signal of the posterior horn, blue line: whole length meniscus, implant not any more visible. (B) Axial re-construction showing the implant and the plane level of A, radial tear less visible than after 6 weeks (white arrow), violet line: block length of implant; red line: whole length meniscus, implant block visible in this axial reconstruction.

normal meniscus (Type 3) with 87% after 6 months decreasing to 56% after 2 years, showing a missing complete remodeling of the new tissue after this time. Kovacs et al. [7] showed that the signal intensity of the CMI changed to normal in only 13% of the patients, 3-8 years after surgery. Schenk et al. [6] described a reduction of the size of the CMI, ongoing for about 5 years. Doing only an HTO would have improved the situation of the patient in the short run but would not restore normal anatomy and results of HTO deteriorate with time [12]. With the additional partial substitution, the meniscus has the potential to regenerate and probably provide improvement for the patient over a longer time period.

With the measured size of the posterior horn of the medial meniscus in the left knee after 6 and 12 weeks, and the right knee after 7 weeks, 16 weeks, and 12 months it can be assumed, that most of the remodeling process of the Spongioflex® partial implant takes place between week 6 and 16. This is also underlined by the isointense signal after 12 and 16 weeks in both knees.

The method described here, using the demineralized bone block Spongioflex®, shows a substantial difference to the ingrowth process of the CMI with a much faster remodeling and ingrowth of this human allograft demineralized bone block. The structure of the Spongioflex allows the migration of cells into the implant from the remaining host meniscus.

Additionally to the encouraging radiologic findings, IKDC and KOOS after surgery were in the range of values described in the literature after meniscal allograft transplantation [4,9] and was higher than reported after using the CMI for partial substitution [8].

The strength of this case report is that the short-term follow-up (up to 1 year) MRI of both knees of one patient shows already the full ingrowth of the implant, which gives a distinct view on the maturation of this biologic implant. The advantage of this procedure is that it uses a biological scaffold for partial meniscal substitution, cells can grow in, and the tissue can regenerate.

Limitations of this study: This is a short follow-up of one patient. The patient has a normal BMI. It cannot be predicted that it works as well in overweight patients.

Conclusions

Compared with the literature, in this case report it is shown that a demineralized bone block leads to a fast ingrowth of the implant so that after 2-3 months the biologic remodeling process seems to be almost completed. A complete isointense and homogenous signal was recorded after 3-4 and 12 months. These first promising results demand further studies.

Institutional review board statement

The study was conducted in accordance with the Declaration of Helsinki, an Institutional Review Board approval is not provided for case reports in Germany, patients consent for publication is mandatory.

Data availability statement

All Data available are presented in the case report.

Patient consent

I hereby certify that I obtained the patient consent for publication on 7th of June 2022.

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