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CASE REPORT

7 months clinical follow-up after arthrotomic implantation of chondrotissue® in a cartilage lesion of the lateral talus

Fallbeispiel: Arthrotomische Implantation von chondrotissue® in eine Knorpelläsion des lateralen Talus – 7 Monate klinische Folgebetrachtung

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SCHLÜSSELWÖRTER
Knorpelläsion;
Mikrofrakturierung;
Lateraler Talus;
Defektabdeckung;
Knorpelregeneration

KEY WORDS
Cartilage lesion;
Microfracture technique;
Lateral talus;
Cell-free chondroinductive implant;
Defect cover;
Cartilage regeneration

Zusammenfassung

Hier wird erstmalig die Behandlung eines Knorpeldefektes im lateralen Talus durch die Implantation von einer chondrotissue® Matrix durchgeführt. In diesem Fallbeispiel werden die klinischen Ergebnisse einer neuen Kombinationsbehandlung aus arthrotomisch durchgeführter Mikrofrakturierung und chondrotissue® nach 7 Monaten gezeigt. Dabei handelt es sich um eine neue zellfreie und chondroinduktive Defektabdeckung aus einem bioresorbierbaren Polymer und Hyaluronsäure, Diese Abdeckung wird nach der Mikrofrakturierung mit einer 6,0-Vicral-Naht im Defekt fixiert und hat die Vorteile, dass sie das darunter liegende Gewebe schützt und die Hämostase im Defekt induziert. Nach einer klinischen Folgebetrachtungszeit von 7 Monaten führt die Kombination aus chondrotissue® und Mikrofrakturierung zu einer guten Defektfüllung mit knorpelartigem Ersatzgewebe und verbessert dadurch die Knorpelregeneration im Talusdefekt.

Summary

Here, we show for the first time the implantation of chondrotissue®, a cell-free chondroinductive implant, into a cartilage defect of the lateral talus. In this case study the 7 months outcome after treatment with common microfracture improved by the application of chondrotissue® is reported. In a standard arthrotomic procedure the cartilage lesion is debrided down to the subchondral bone and

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microfracture is performed. Additionally to this technique chondrotissue®, a defect cover consisting of a new cell-free bioresorbable polymer and sodium-hyaluronan is introduced into the joint to induce hemostasis and to protect the underlying tissue. The fixation of the chondrotissue® is achieved by a 6.0-vicryl-suture. The combination of the common microfracture technique with the implantation of chondrotissue® leads to a good defect filling with cartilaginous repair tissue after 7 months clinical follow-up and therefore improves cartilage regeneration in the talus defect.

Introduction

Cartilage lesions of the talus are a serious incidence, which often accures as a concomitant indisposition associated with other injuries of the foot and ankle. They are frequently diagnosed in the active population after ankle sprains and are known to cause chronic ankle pain. Two common types of talar chondral lesions are anterolateral dome lesions and posteromedial lesions [2]. Flick and Gould reviewed that 98% of lateral dome lesions and 70% of medial dome lesions were caused by trauma [4].

Because of the poor spontaneous repair potential of the articular cartilage, a variety of reparative techniques with the aim of covering the defect and the subsequent formation of cartilaginous repair tissue were developed. Bone marrow stimulating techniques like drilling, abrasion or microfracturing are often used surgical treatment options for cartilage defects in the joint [3] and in the talus [6]. In this therapeutic field microfracturing is one of the frequently used technique to repair smaller symptomatic articular cartilage defects ($<8\,cm^2$) [8]. The method induces a healing response in the cartilage defect by the penetration of the subchondral bone plate. This provides a bone marrow blood influx into the defect, containing pluripotent marrow-derived stem cells, which are able to produce cartilaginous repair tissue. Using microfracturing to treat full-thickness defects in patients aged 40–45 or younger resulted in good to excellent clinical outcome with reduction of pain, functional improvement and a hyaline to fibrous repair tissue [3]. To improve the formation of cartilaginous repair tissue with collagen type II-rich matrix after microfracture treatment, methods for the advancement of this technique were developed. Therefore, the clinical application of biocompatible graft-stabilizing scaffolds based on hyaluronan, collagen or synthetic polymers was introduced [3].

In this report we show a matrix-covered microfracturing technique using chondrotissue®, a new cell-free chondroinductive cover, which consists of a resorbable polymer felt and sodium-hyaluronan. By the application of chondrotissue®, hemostasis is induced and the protection of the underlying tissue is assured [7]. Additionally, the penetrated blood from the bone marrow after microfracturing is hold in place of the lesion and a formation of cartilaginous repair tissue in the defect is promoted. The combination of the common microfracture technique with the implantation of the cell-free implant improves cartilage regeneration in the defect as shown in an ovine model before [3]. The aim of this case report is to document the effectiveness of the chondrotissue® matrix-covered microfracture technique for the repair of human cartilage lesions of the talus.

Material and Methods

A 43 year old male patient with a cartilage lesion at the lateral talus was treated with common microfracture technique in combination with a new cell-free defect cover (chondrotissue® matrix, BioTissue AG) consisting of a resorbable polymer felt and hyaluronan [7].

The cartilage defect of $0{,}7\,cm^2$ in size and outerbridge-classification 4 (Fig. 1, white arrow) was treated in a standard arthrotomic procedure together with a fibula ligament reconstruction as a concomitant procedure. During arthrotomy the subtalar joint was opened and the chondral lesion was carefully debrided down to the subchondral bone. Next, standard microfracture procedure was performed. To cover the defect, the chondrotissue® matrix was immersed in 3 ml autologous serum for 10 min and adapted to the size of the defect. In the next step, the chondrotissue® was placed into the defect and fixed with a 6,0-vicryl-suture. The patient underwent the standard rehabilitation program after microfracture [7].

Results

After 3 month postoperatively, the patient did not show any pain or discomfort. After 7 months, MRI showed 75–100% volume filling of the defect

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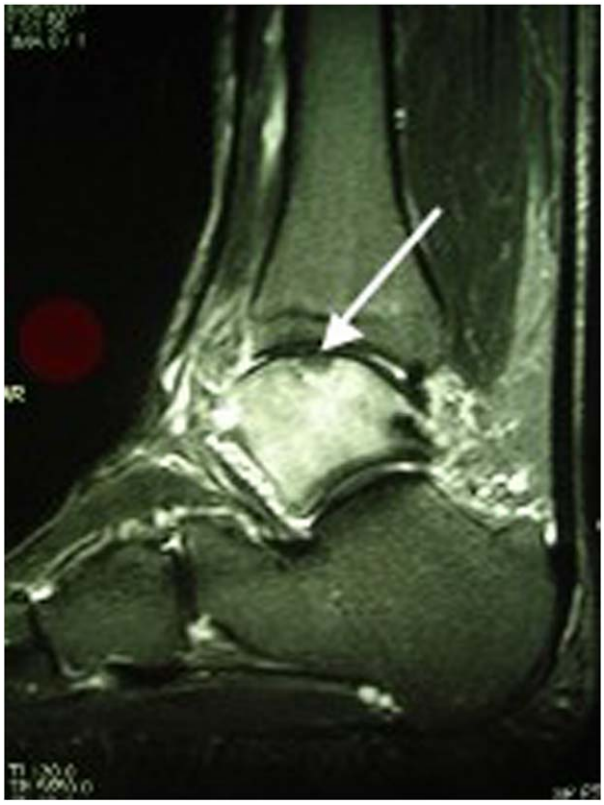

Figure 1. Deep cartilage erosion (outerbridge-classification 4, white arrow) at the lateral talus.

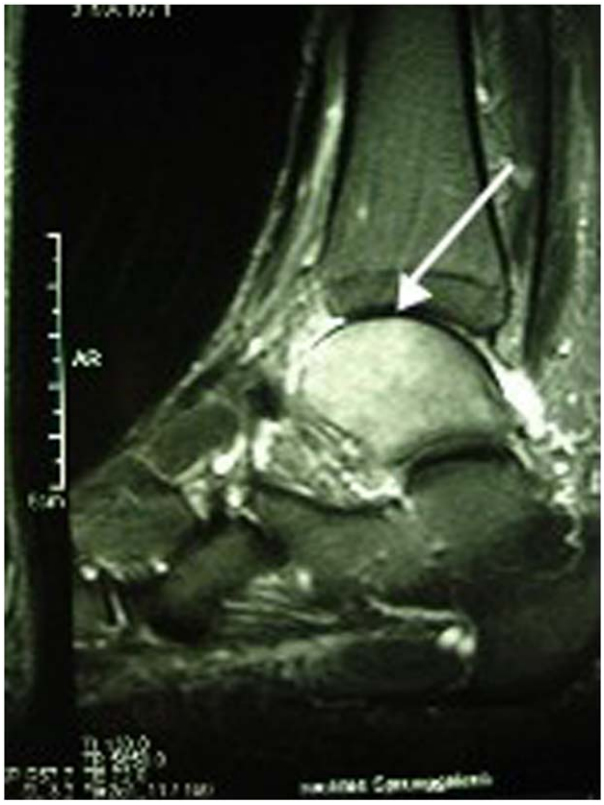

Figure 2. Cartilage repair in the lateral talus 7 months postoperatively.

with hyperintense repair tissue and good peripheral integration (Fig. 2, white arrow). Volume filling with cartilaginous repair tissue was measured by the use of coronal and sagittal images and was graded on the basis of the percentage of the defect. No osseous overgrowth of the subchondral bone with resultant relative thinning of the overlaying repair cartilage could be detected and no infection, irritation or allergic reaction accured. The 6,0-vicryl-suture fixation of the chondrotissue® matrix was stable and the implant did not show any ablation or loosening over the time.

Discussion

In this report we present a new cell-free implant (chondrotissue®) to cover a cartilage defect of the lateral talus after microfracture. In 2005 the implantation of a cell-free matrix consisting of Collagen I/III for the treatment of local cartilage defects in the knee joint after microfracture was introduced for the first time [1]. This implant served as a defect cover and three-dimensional scaffold for the bone marrow stem cells [1]. In contrast to this collagen I/III matrix, chondrotissue® recruits mesenchymal stem cells (MSC) from the microfractured subchondral bone by using human autologous serum and induces the chondrogenic differentation of MSC by hyaluronan. The recruitment of mesenchymal progenitor cells by blood serum was already demonstrated by the investigators [3]. Additionally it was shown by Hegewald et al., that hyaluronan has a positive effect on the re-differentiation of MSC in three-dimensional culture *in vitro* [5].

The bioresorbable chondrotissue® matrix combined with this recruitment and differentiation factors will help to keep the MSC directly in the defect and prevents bleeding into the joint space. Furthermore, the differentiation of MSC into the chondrogenic lineage and the subsequent formation of repair tissue will be supported. The use of chondrotissue® to cover the microfractured area may hold the blood clot in place, induce hemostasis and protect the underlying tissue.

The clinical outcome after 7 months showed the formation of cartilaginous repair tissue after implantation of chondrotissue® pre-treated with microfracture as recently described in an animal study in sheep [3]. For this patient a good defect filling of 75–100% in the deep cartilage erosion of the lateral talus was achieved. In comparison to the

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implantation of other cell-based grafts like the ACI in a two-step procedure, the implantation of the cell-free chondrotissue® just needs one surgical intervention and therefore avoids donor site morbidity. Three months after surgery the patient was already free of pain or discomfort and the application of chondrotissue® after microfracture showed no side effects like wound infections, inflammations or other complications postoperatively. A stable and safe fixation of the chondrotissue® matrix was achieved by suturing and the implant did not show any ablation or loosening over the observation time.

Additionally, cell-free defect covers like chondrotissue® show other benefits in contrast to cell-based grafts. First mentioned are storable, have a longer shelf time and therefore they can be used directly on demand for the treatment of cartilage lesions. In summary, there are some evidents that the advanced microfracture technique using chondrotissue® as a defect cover might improve cartilage tissue regeneration. In a standard arthrotomic procedure this combined technique may be a promising approach to cover and regenerate deep cartilage erosions at the lateral talus.

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