

■ CASE REPORT

Repair of a post-traumatic cartilage defect with a cell-free polymer-based cartilage implant

A FOLLOW-UP AT TWO YEARS BY MRI AND HISTOLOGICAL REVIEW

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of Bone and Joint Surgery
doi:10.1302/0301-620X.92B8.
24341 \$2.00

J Bone Joint Surg [Br]
2010;92-B:1160-3.
Received 23 December 2009;
Accepted after revision 23
March 2010

Microfracture is frequently used as the first line of treatment for the repair of traumatic cartilage defects. We present the clinical and histological results 18 months to two-years after treatment in a 26-year-old male with a post-traumatic chondral defect of the medial femoral condyle managed by microfracture covered with chondrotissue, a cell-free cartilage implant made of a resorbable polyglycolic acid felt and hyaluronic acid.

Traumatic and degenerative cartilage defects occur frequently in the knee joint. Techniques to stimulate the bone marrow such as drilling, abrasion or microfracture are often used as initial treatment.¹⁻³ Microfracture may be used to treat defects up to 8 cm² in size. It can be undertaken with a minimal exposure, and is technically relatively simple and cost-effective. Penetration of the subchondral bone plate allows an influx of bone marrow blood, containing pluripotent marrow-derived stem cells that are able to form cartilaginous repair tissue in the defect.³⁻⁵

The technique of microfracture may be improved by covering the defect with the cell-free sterile matrix chondrotissue (BioTissue AG, Zurich, Switzerland), which consists of an absorbable non-woven polyglycolic acid textile treated with hyaluronic acid. Hyaluronic acid has been shown to induce mesenchymal progenitor cells from the bone marrow to differentiate along the chondrogenic lineage.⁶ The textile scaffold is like a sponge which may hold the blood clot and progenitor cells within the defect, inducing haemostasis and protecting the underlying tissue. The mechanical stability of the scaffolds allows for easy handling and secure fixation in the defect by fibrin glue, cartilage or trans-osseous suture, or by resorbable pins.^{7,8} In the ovine model of a joint defect, covering a full-thickness cartilage defect with the chondrotissue matrix after microfracture has been shown to improve cartilage repair compared to microfracture alone.⁹ In this case report we present the clinical outcome two years after treatment of a cartilage defect of the femoral condyle managed by this method.

Case report

A 26-year-old male with a post-traumatic defect of the cartilage of the medial femoral condyle was treated with microfracture in combination with the new cell-free chondrotissue matrix. Pre-operative assessment by MRI showed that the defect was approximately 6 cm² (2 cm × 3 cm) in size (Fig. 1) and a grade IV defect according to the Outerbridge classification.¹⁰ A standard mini-open arthroscopy was used. The defective cartilage was carefully debrided down to the subchondral bone. A standard microfracture procedure was then performed. A freeze-dried chondrotissue matrix measuring 2 cm × 3 cm was immersed in 3 ml autologous serum for ten minutes and placed into the defect. For trans-osseous fixation of the matrix resorbable threads were secured with threefold knots to act as anchors to the subchondral bone.¹¹

The defect was covered in this way except for a small fissure approximately 2 mm in width adjacent to the medial cartilage rim. It was not in the weight-bearing area. He underwent standard rehabilitation⁴ with continuous passive motion directly after surgery and mobilisation with partial weight-bearing for six weeks. He regained a full painfree range of movement of the knee.

At 18 months after operation a second-look arthroscopy was undertaken and the defect was found to be filled with tough hyaline-like cartilage repair tissue (Fig. 2a). Aspects of the small fissure of 1 mm to 2 mm in diameter which had not been covered could still be seen in the untreated border of the defect (Fig. 2b, white arrow). A sample of the cartilage repair

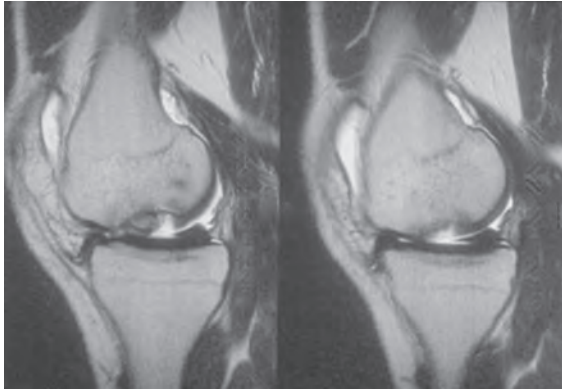


Fig. 1a

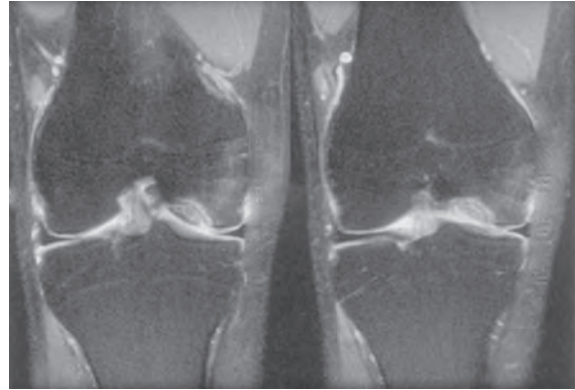


Fig. 1b

Sagittal a) and coronal b) pre-operative MR scans of the cartilage defect in the right medial femoral condyle.

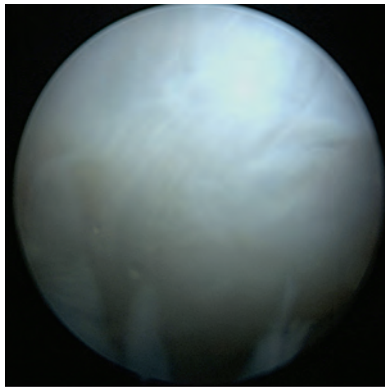


Fig. 2a

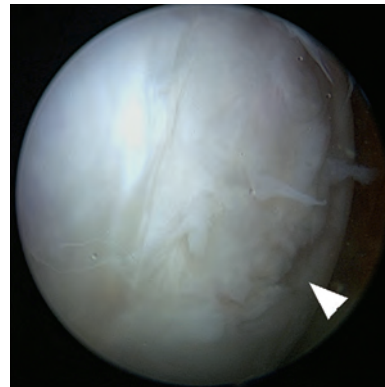


Fig. 2b

Second-look arthroscopy after 18 months showing a) good filling and covering of the defect and b) a small fissure of 1 mm to 2 mm in diameter that was not covered with the matrix is still visible (white arrow).

tissue was taken for histological analysis and stained with haematoxylin and eosin (Fig. 3). It was homogenous and rich in round-shaped cells. A small area of the superficial part of the biopsy showed some fibrous tissue (Fig. 3a), while the remainder (Fig. 3b) was a hyaline-like tissue with round chondrocytic cells, evenly distributed in the tissue, insular or forming clusters (Fig. 3c, black arrows). A few flattened cells were present (Fig. 3c, white arrows). The deeper part showed chondral cell structures typical of hyaline cartilage (Fig. 3d, white arrows). There were no signs of a foreign-body reaction, no infection, no allergic reaction and no abnormal calcification or formation of fibrous connective tissue. Neither necrosis of the tissue nor apoptosis of cells were evident. There was no residual chondrotissue matrix.

MRI at this time showed that the repair tissue was hyper- to isointensive compared to that of the surrounding cartilage (Fig. 4). The repair tissue showed good integration into the subchondral bone and the surrounding cartilage. Filling and covering of the defect was good to

excellent. However, the fissure at the border of the defect was still visible (Fig. 4b, white arrow), but did not need to be treated. For evaluation of the clinical outcome, the Knee Injury and Osteoarthritis Outcome Score¹² was used pre-operatively and two years after the operation. Pre-operatively, in the sub-category 'pain' this score was 56, in knee-related 'symptoms' 46, in 'activities of daily living' 65, in 'sports and recreation' 35, and in the category 'quality of life' it was 31. Two years after the operation, the patient remained free of pain with full knee function. In every sub-category, the Knee Injury and Osteoarthritis Outcome score was 100.

Discussion

This case report describes the clinical outcome after the treatment of a large cartilage defect with microfracture in combination with a chondrotissue matrix, which was used to cover the defect and to protect the subchondral bone. The mesenchymal stem cells derived from bone marrow which are flushed into the cartilage defect by the

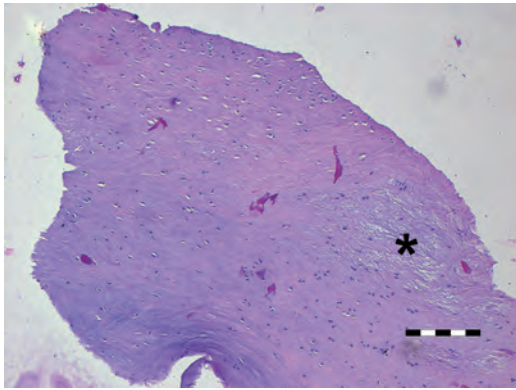


Fig. 3a

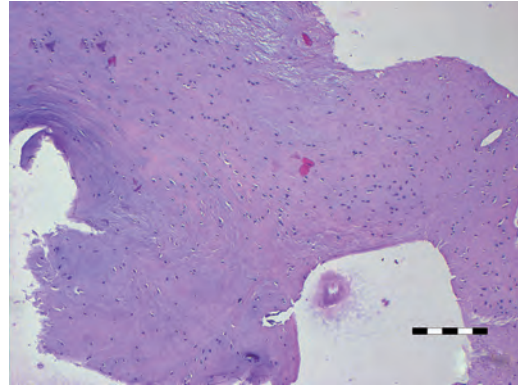


Fig. 3b

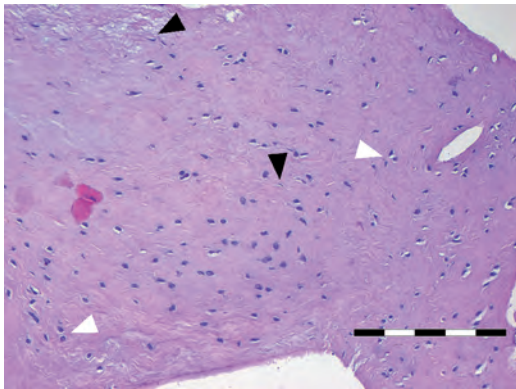


Fig. 3c

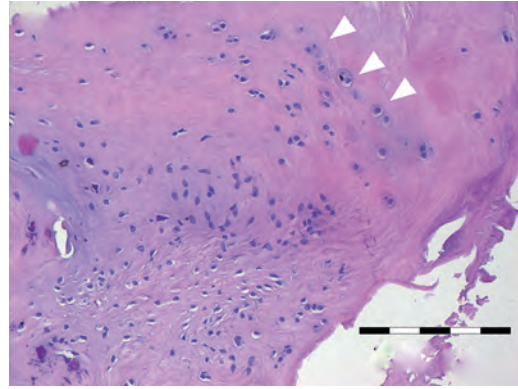


Fig. 3d

Histological evaluation of the biopsy of the repair tissue 18 months after surgery (haematoxylin and eosin staining). Figure 3a – A small region of fibrous tissue was evident in the superficial area of the biopsy (black asterisk). Figure 3b – the tissue was rich in cells and showed predominantly round-shaped chondrocytic cells and a hyaline-like cartilaginous matrix. Figure 3c – The tissue showed round, evenly distributed cells, insular and in clusters (white arrows) as well as some flattened cells (black arrows). Figure 3d – Tissue from deeper areas of the biopsy showed chondrocytes in chondrons (white arrows). Scale bars represent 200 µm.



Fig. 3a



Fig. 4b

MRI taken after 24 months showing a) good to excellent filling of the defect and b) the uncovered fissure adjacent to the cartilage rim is still visible (white arrow).

blood flow after microfracture are kept in a visco-elastic environment and are enriched in the defect by the scaffold,

while their differentiation into chondrocytic cells is supported by the hyaluronic acid. The textile implant is a one-step procedure, is easy to handle and can be securely fixed to the defect. The matrix structure allows defects which lack an intact cartilage rim to be treated with microfracture. In the ovine model, the combination of a resorbable textile scaffold and hyaluronan have been shown to accelerate and improve repair with cartilage matrix rich in type II collagen, compared with microfracture alone.^{9,13}

Our experiences are similar to those described in the first clinical application of the matrix fixed with resorbable pins in smaller (3 cm² to 4 cm²) cartilage defects which showed excellent filling as assessed by MRI at one year.¹⁴ The combination of microfracture and chondrotissue is a promising option for the treatment of large cartilage defects. The results suggest that this technique may improve the quality of chondral repair. However, further prospective, comparative studies are needed.

No benefits in any form have been received or will be received from a commercial party related directly or indirectly to the subject of this article.

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