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ANKLE

# Autologous chondrocyte transplantation for the treatment of massive cartilage lesion of the distal tibia: a case report with 8-year follow-up

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**Abstract** We report on the 8-year follow-up outcome after autologous chondrocyte transplantation in a case of massive cartilage lesion of the distal tibia in a young patient after intraarticular fracture. To our knowledge, this is the first case report in which autologous chondrocyte transplantation was performed in the distal tibial chondral lesion. Long-term clinical success was achieved by this method of treatment in a patient too young to be treated with arthrodesis.

**Keywords** Autologous chondrocyte transplantation · Distal tibia · Articular cartilage · Ankle joint

## Introduction

Full thickness chondral or osteochondral injury to the articular surface is considered a risk factor for more extensive joint damage because articular cartilage has very limited intrinsic healing capacity. Some surgical treatments, including debridement combined with drilling [5] or microfracture [13], have been performed with the intention of recruiting mesenchymal stromal cells. However, these treatments have not achieved efficient healing with long-lasting hyaline cartilage. Therefore, interest has focused on the techniques designed to restore hyaline cartilage, particularly for vast and deep cartilage lesions. These techniques include autologous osteochondral graft [7] and autologous chondrocyte transplantation [3]. Although all modern cartilage repair techniques have focused on chondral and osteochondral lesions in the knee joint, they are now in use in other joints.

Recently, orthopedic surgeons have diverted their attention to chondral and osteochondral lesions in the ankle joint, partly because of the development of ankle arthroscopy. Especially, osteochondral lesions of the talus have been well described, and modern cartilage repair techniques for the lesions have been reported to have good results [1, 2, 11, 15]. However, much less is known about the surgical treatment of distal tibial chondral and osteochondral lesions. We report on the 8-year follow-up outcome after autologous chondrocyte transplantation in a case of massive cartilage lesion of the distal tibia in a young patient after intraarticular fracture.

## Case report

A 13-year-old female sustained an axial twisting load through the right foot when she fell 1 m from a roof when landing. She was brought to the emergency hospital, and physical examination showed severe swelling of the right ankle and foot, without an open wound. X-rays demonstrated a fracture of the distal fibula and an intraarticular fracture of the tibial plafond, which was classified as a Type-B according to the Rüedi and Allgöwer classification [12]. The patient was then taken immediately to the operating room. After reduction under general anesthesia, the

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lateral malleolus was stabilized with a plate and screws. The fragments of the distal tibia were fixed with Kirchner wires and the syndesmosis was stabilized with loop-wiring. Little attention to the articular surface was paid during the surgery. After surgery, the ankle joint was immobilized for 6 weeks. The plate, screws and wires were removed 6 months after surgery. Due to lasting severe right ankle pain, the patient was introduced to one of the senior authors 9 months after primary surgery. X-rays of her right ankle at this time showed joint space narrowing, although bone union was achieved. The treatment options were discussed including ankle arthrodesis. However, even though she had severe pain and reduced function, she did not consent to arthrodesis.

Two years after the injury, it was decided to perform autologous chondrocyte transplantation with the agreement of the patient and her parents. A cartilage biopsy specimen was harvested from the outer edge of the superior medial femoral condyle of the ipsilateral knee joint under arthroscopy. The wet weight of the cartilage pieces was ~300 mg, and they were sent to Genzyme Tissue Repair (Cambridge, MA, USA) for cartilage cell culturing. The cultivated chondrocytes were received after 4 weeks, at which time the autologous chondrocyte transplantation was performed. The chondral lesion was approached through a medial malleolar osteotomy and debrided as far as the surrounding normal cartilage until subchondral bone was exposed. The size of the defect of articular cartilage was ~75% of the joint surface of the tibial plafond. Next, the entire defect was covered with a periosteal patch taken from the proximal tibia, and the margins of the flap were sutured with 6–0 absorbable sutures (Vicryl, Ethicon, Somerville, NJ, USA). Talus was dislocated with the osteotomized medial malleolus during this process. Fibrin glue was applied to further seal the suture line. After the cultured cells were injected underneath the patch with a catheter, the small remaining opening was closed with two sutures and fibrin glue. The osteotomized medial malleolus was fixed to the anatomic position with metal screws in predrilled holes. The tourniquet time was 150 min in all divided in two periods. No complications occurred during surgery or in the post-operative period.

An ankle brace was applied immediately after surgery and restricted range-of-motion exercise (from –10° to 10°) was started. CPM was used 4 days in the hospital. Partial weight bearing (20 kg) was allowed at 8 weeks after surgery and full weight bearing was permitted from 10 weeks after surgery. Her body weight was 55 kg. Union of the osteotomy site was detected radiographically by 3 months. Although she experienced pain in her right ankle joint for 18 months, the ankle pain decreased by degrees and she returned to recreational sports at 24 months after autologous chondrocyte transplantation. At 8 years after surgery, she had no pain in her daily activities. She was working as a teacher. At clinical examination, the range of motion of the ankle was ~0° of dorsiflexion and 40° of plantar flexion. Radiographs demonstrated sufficient joint space, albeit with some osteophytes and sclerosis (Fig. 1). Magnetic resonance imaging of the ankle joint showed irregularity of the surface but integration of the graft with the subchondral bone (Fig. 2). In 2005, she performed a 75 km-cross-country ski trip across the Norwegian mountains.

## Discussion

Small defects of the articular cartilage in the ankle joint may cause less symptoms, however, large defects are problematic, causing persistent pain and disruption of daily and sports activities. In addition, it is supposed that disturbances in load transmission through the subchondral bone caused by cartilage defects are important mechanical determinants of post-traumatic arthritis, particularly in the ankle joint [8]. The damage to the articular surface is most likely a precursor of ankle osteoarthritis and consequently the tibial plafond fractures are difficult problems for orthopaedic surgeons. To prevent early joint degeneration, various surgical treatments have been performed for cartilage injuries. Recently, autologous chondrocyte transplantation has been gaining much attention in the

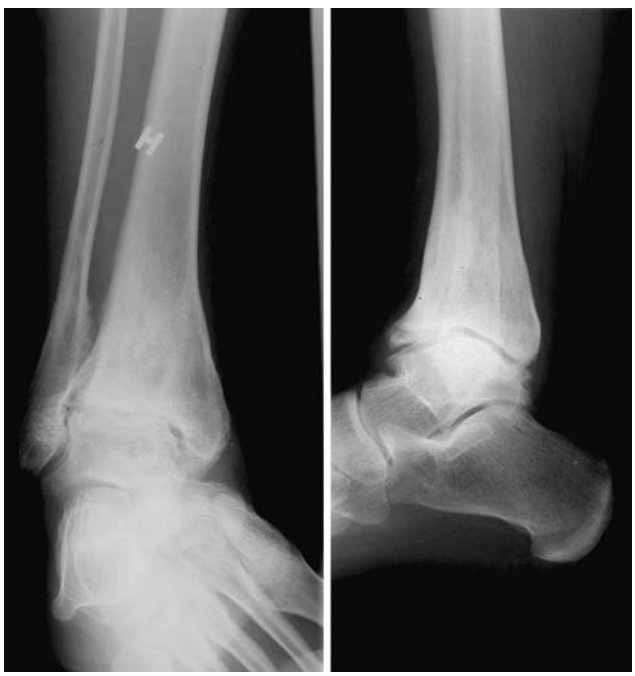

**Fig. 1** Radiographs 8 years after autologous chondrocyte transplantation showing sufficient joint space, albeit with some osteophytes and sclerosis

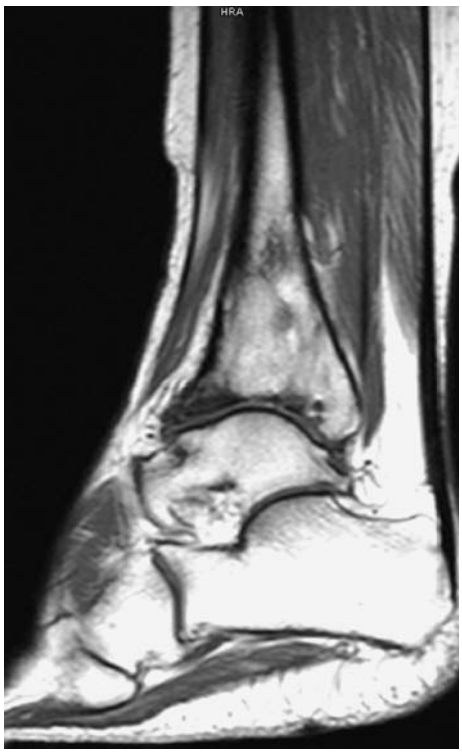

**Fig. 2** Sagittal magnetic resonance imaging of the ankle joint showing irregularity of the surface but integration of the graft with the subchondral bone

orthopedic field [3, 6, 9–11]. Although there are several reports on autologous chondrocyte transplantation to repair osteochondral defects of the talus [1, 2, 11, 15], much less is known about the long-term clinical outcome of this method for the treatment of distal tibial chondral and osteochondral lesions. To our knowledge, this is the first case report in which autologous chondrocyte transplantation was performed in the distal tibial chondral lesion. Long-term clinical success was achieved by this method of treatment in a patient too young to be treated with arthrodesis.

Ankle arthrodesis is considered to be the standard operative treatment for severe ankle osteoarthritis. This method may provide a painless and stable foot. However, ankle arthrodesis is not a desirable method for young patients because it is known that ankle arthrodesis is associated with occurrence of later symptomatic osteoarthritis in the foot joints on the ipsilateral side [4]. An alternative method of treatment for severe articular cartilage injury is autologous chondrocyte transplantation with a periosteal graft. In 1994, Brittberg et al. [3] introduced this new cell technology to repair articular cartilage defects in the knee. To date, good intermediate- to long-term results of autologous chondrocyte transplantation have been reported [9–11]. This technique has been used for the treatment of talar cartilage lesions. Subjective improvement after autologous chondrocyte transplantation has been reported [1, 2, 11, 15]. The other technique designed to restore hyaline cartilage is an autologous osteochondral graft [7]. Ueblacker et al. [14] described two cases of retrograde autologous osteochondral graft for the treatment of isolated osteochondral lesions of the distal tibia. Autologous osteochondral graft has the advantage of immediate transplantation of articular cartilage. However, it is not appropriate to harvest many osteochondral plugs to repair large osteochondral lesions like our case because of the donor site problem.

In conclusion, autologous chondrocyte transplantation can be a good treatment option for young patients with massive chondral and osteochondral lesions in the ankle joint. This patient did not undergo second-look arthroscopy because she was doing well clinically. Although the clinical outcome of 8-year follow-up was very encouraging, longer follow-up is necessary in order to fully assess the advantages of this procedure.

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