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Original Article

Use of large osteochondral allografts in reconstruction of traumatic uncontained distal femoral defects

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ABSTRACT

Large osteoarticular injuries with subchondral bone loss involving the knee in young active patients often result in significant morbidity and loss of normal joint function. A review of the current literature reveals that multiple surgical management options are currently employed, however there is no consensus on standard of care. Osteochondral allografting provides an attractive alternative treatment option for the repair of large articular defects of the knee.

Methods: In this article we present the case of a young male who suffered traumatic intraarticular bone loss secondary to a grade IIIA distal femoral fracture and subsequently underwent reconstruction of his medial femoral condyle using a fresh-frozen osteochondral allograft.

Results: We present the radiographic and functional outcome of this patient at two years post-operative. The range of motion of the knee was 0–130° and the patient's post-operative functional outcome was evaluated using the Knee injury and Osteoarthritis Outcome Score (KOOS), which was 76%.

Conclusions: While further research is required, the results of our case study concur with the current body of literature supporting the use of fresh-frozen osteochondral allograft as a reconstructive option for treating large traumatic intraarticular lesions involving the distal femur.

1. Introduction

Large osteoarticular injuries with subchondral bone loss involving the knee in young active patients often result in significant morbidity and loss of normal joint function. Due to the young age and high activity level of this patient demographic, these injuries pose a major treatment challenge to orthopedic surgeons. A review of the current literature reveals that multiple surgical management options are currently

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employed, however there is no consensus on standard of care.[1] Procedures used in the past such as arthrodesis, arthroplasty and unloading osteotomy are generally not considered appropriate options for these individuals.[2] Knee arthrodesis results in significant joint dysfunction and therefore is not a reasonable treatment option in these patients. Arthroplasty is a suitable option in older patients, however in young highly active patients, prosthetic loosening and failure requiring revision is inevitable. Unloading osteotomy, while potentially providing some symptomatic relief, does not address the repair of the osteoarticular defect. Furthermore, unloading osteotomy in the knee may result in ligamentous redundancy with excess loading of the contralateral joint compartment contributing to early degenerative changes.[3,4] The poor outcomes associated with the above treatment options has led to the development of biological treatment options used for reconstruction and repair of osteochondral defects in young active individuals.

Biological options aim to restore articular surface congruity as well as reestablish normal joint kinematics. Abrasion arthroplasty and autologous chondrocyte implantation are effective options for the treatment of chondral and small osteochondral defects in the knee. These techniques do not address the repair of underlying bone defects and therefore are not suitable treatment options for lesions with concomitant bone loss.[1,5] Mosaicplasty has shown promising results as a reconstructive option for the treatment of small focal osteochondral defects, however this technique is restricted to defects less then 3 cm in diameter and one cm in depth. This is due to the limited amount of non-articulating cartilage available for graft harvesting. Concerns regarding donor site morbidity associated with this procedure must also be considered when using this surgical approach.[6,7]

Osteochondral allografting provides an attractive alternative treatment option for the repair of large articular defects of the knee. Advantages of this method include the ability to resurface large areas of damaged articular cartilage with mature hyaline cartilage. Furthermore, allografting allows for the reconstruction of any associated subchondral bone loss in the same operation.[2,8,9] Osteochondral allografting has also been shown to be effective for use in the reconstruction of large uncontained lesions. Currently, three types of allografts are available including fresh allografts, cryopreserved allografts and fresh frozen allografts.

Fresh osteochondral allografts are harvested from donors and stored at 4 °C or 37 °C and are typically used within 14–21 days after procurement.[10] Fresh allografts have been shown to have better chondrocyte viability compared to cryopreserved and fresh frozen grafts.[11–15] Multiple studies have shown promising long-term outcomes using these allografts in post-traumatic osteochondral reconstruction of the knee.[2,9,16–20] Despite these encouraging results limitations and concerns regarding the use of fresh allografts exist. Major limitations include availability of grafts, increased immunogenicity of fresh grafts as well as increased risk of disease transmission from the donor.[16]

Cryopreserved osteochondral allografts utilize DMSO or glycerol in an attempt to enhance chondrocyte viability while still allowing the graft to be stored at −80 °C. Studies investigating chondrocyte viability have shown chondrocyte survival to vary from 20% to 70%.[10] These grafts have been used to a limited extent for the repair of post-traumatic osteochondral injuries; however, they have showed inferior result when compared to fresh osteochondral grafts.[21,22]

Fresh-frozen osteochondral allografts are harvested from donors and stored at −80 °C. Although these grafts have the lowest chondrocyte viability of the available grafts, fresh-frozen grafts are the least immunogenic and therefore have been proposed to be more appropriate for major osseous reconstructions.[10,23] Fresh-frozen grafts have been successfully used for reconstruction following tumor resection, however only 6 cases exist in the literature describing its use for post-traumatic osteoarticular reconstruction.[24–27]

In this article we present the case of a young male who suffered traumatic intraarticular bone loss secondary to a grade IIIA distal femoral fracture and subsequently underwent reconstruction of his medial femoral condyle using a fresh-frozen osteochondral allograft.

2. Case report

An otherwise healthy 19-year-old male was involved in a motor vehicle accident in which the patient, a pedestrian, was struck by a motor vehicle and dragged a significant distance resulting in a grade IIIa open femoral fracture with concurrent

Fig. 1 – Anteroposterior radiograph showing a large medial femoral condylar defect after initial trauma.