Original article

Fresh frozen femoral head osteochondral allograft reconstruction of the humeral head reverse hill sachs lesion

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1. Introduction

Posterior glenohumeral dislocations account for 1–4% of all shoulder dislocations.¹ Neer described several associated fracture patterns including an impression fracture of the anteromedial humeral head, the “reverse Hill Sachs” lesion.² These account for more than half of the associated fractures. These bony injuries are associated with a higher rate of recurrent shoulder instability, by creating an articular arc mismatch and a small jump distance. They also contribute to both avascular necrosis and osteoarthritis of the glenohumeral joint.²

The management of these injuries is often determined based on the size of the humeral head defect.³ Large defects pose a significant challenge to the orthopaedic surgeon when attempting to restore normal glenohumeral biomechanics and prevent recurrent instability. Defects with more than 50% humeral head involvement may require an arthroplasty procedure. For smaller defects combined with posterior instability, optimal treatment is controversial. McLaughlin described transfer of the subscapularis tendon into the defect followed by Neer, who modified this with addition of the lesser tuberosity. However these are non-anatomical reconstructions, altering glenohumeral biomechanics and potentially limiting range of movement.^{2,4}

Reconstruction of the humeral head using fresh frozen allograft is a recognized treatment option for moderate to large defects.⁵ This approach allows restoration of the articular surface and fills the subchondral bony defect preventing further engagement of the Hill Sachs lesion and recurrent instability. Geber and Lambert were the first to describe using osteochondral allograft contoured to fit the sphericity of the humeral head and defect size.⁵ Due to the rarity of this injury, and recent introduction of the surgical technique combined with poor

availability of fresh- frozen allograft, there are only a small number of studies in literature describing this procedure.⁶

Our aim was to evaluate both radiographic and functional outcomes of patients who underwent this procedure in our unit.

2. Patients and methods

We prospectively identified 5 patients (3 male, 2 female) who underwent this procedure between 2005 and 2016. Patients were identified from theatre logs and cross-referenced with the bone bank register. Average patient age was 53.4 years. Three patients sustained the injury during a seizure (1 epileptic, 2 alcohol related withdrawal seizures) and two sustained the injury from falls (both medium energy). The mean time from injury to diagnosis was 4 days. Closed reduction under general anaesthetic was attempted in all cases, one was irreducible and four were recurrently unstable. All patients proceeded to a timed open reduction and femoral head allograft reconstruction by a single surgeon. Pre-operative CT evaluation was performed in all patients. The size of humeral head defect ranged from 30% to 50% as measured on 2 mm axial cuts.

A deltoid approach was utilized in all cases, with stay sutures placed in the subscapularis tendon and a lateral capsulotomy performed (Fig. 1). The humeral head was dislocated anteriorly and defect inspected and sized (Fig. 2). Small fresh frozen femoral heads were ordered from the regional bone to act as a structural osteochondral allograft. A segment was then cut from the femoral head to match the defect and radius of curvature of the patients humeral head. (Fig. 3). The graft was then secured in place with the use of two headless compression screws (Fig. 4). All patients were placed in a polysling for

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Fig. 1. Stay sutures in subscapularis tendon.

Fig. 2. Humeral head defect.

Fig. 3. Allograft segment matching the defect.

Fig. 4. Graft secured with headless compression screws.

4 weeks before undergoing a standardized physiotherapy program.

3. Results

All patients were followed up in the outpatient setting. Radiological and functional outcomes were assessed at latest review (mean 34 months).

Three patients showed full and normal preservation of the humeral head surface. One patient showed graft incorporation with partial flattening of the articular surface of the graft and one although fully incorporated developed articular retraction of the graft. 2mm axial cut CT scans were performed and analysed by measuring the length of integration divided by the length of segment for each cut. Figs. 5 and 6 demonstrate full graft incorporation and preservation of the articular surface.

Four patients had no restriction of ADLs and three had no pain. No patient displayed instability. The Constant- Murley score was used to assess functional outcome. Mean Constant-Murley score at latest review was 83 (45–96). Patient outcomes are shown in Table 1.

Fig. 5. Axial CT cut showing graft incorporation.

Fig. 6. AP radiograph showing preservation of the articular surface.

Table 1

Patient Outcomes.

PATIENT	GRAFT INCORPORATION ON 2mm Axial cut CT SCAN	RESTRICTION OF ADLs	PAIN	CONSTANT –MURLEY SCORE
1	YES	NO	YES	86
2	YES	NO	NO	96
3	YES	YES	YES	45
4	YES	NO	NO	94
5	YES	NO	NO	94

The patient with articular retraction has developed secondary osteoarthritis and is awaiting shoulder resurfacing as the graft is fully incorporated.

4. Discussion

Osteochondral allograft reconstruction of reverse Hill Sachs lesions is rarely mentioned in literature. A systematic review performed by Saltzman et al. (2015) found only 12 studies including 4 case series and 8 case reports.⁶

Posterior shoulder dislocations are a rare injury and according to many authors they are often missed on initial presentation.⁷ However in our series the mean time from presentation to diagnosis was 4 days. This may be due to the efficient radiology reporting service within our unit and this may be an important factor in both the radiological and functional outcomes for this patient group.

The size of the anteromedial humeral head defect is the main determinant of the degree of instability. It re-engages early with the posterior glenoid and pivots on the rim. It is this shortened rotational arc length of the humeral head on the glenoid that leads to recurrent instability via a short jump distance.⁴

Moderate sized Hill Sachs lesions provide a difficult management issue for shoulder surgeons. This is particularly true in the young to middle aged, functionally active patient where preservation of the humeral head is preferred to an arthroplasty procedure. In our study defect size ranged from 30%–50% of the humeral head (as measured on the 2 mm axial CT cuts), which is comparable to other studies in literature (25–50%).^{6,8,9} Addressing both the instability as well as the articular cartilage defect is difficult without altering the anatomy and

biomechanics of the proximal humerus. This can lead to difficulties if prosthetic reconstruction is required at a later date.

Osteochondral allograft reconstruction of articular defects in weight-bearing joints such as the knee have been described with good patient outcomes.^{10,11} In comparison to joints such as the knee and ankle, the shoulder carries a smaller weight-bearing load. Therefore the primary aim of allograft reconstruction of the humeral head is to improve joint congruency and decrease the risk of recurrent instability as opposed to load distribution and restoration of normal contact pressures.⁵

Gerber and Lambert first described using a segment of femoral head allograft in the treatment of 4 patients with chronic locked posterior shoulder dislocations. Three of these patients had a good outcome and one developed avascular necrosis with collapse of the graft.⁵ Diklic et al have the largest case series in current literature with 13 patients in their treatment group. Functional outcomes were good with 9 having no pain or restriction of activities, no patient had instability with a mean Constant-Murley score of 86.8.⁸ These results are comparable to our own cohort with a mean Constant-Murley score of 83.

Graft resorption is a potential complication following this procedure and this occurred in one patient in our cohort. Diklic et al reported graft incorporation with partial flattening in 7 out of the 13 patients however functional outcomes were good.⁸ Saltzman et al reported a graft resorption rate of 36%. Why this occurs is unknown, however it has been suggested that the use of frozen acellular graft is linked to the resorption and that fresh osteochondral allografts may provide better radiological outcomes.⁶ In our study, the patient with partial graft resorption was able to proceed to bone preserving resurfacing arthroplasty due to the satisfactory graft incorporation, another substantial benefit to this procedure.

Long term follow up of patients undergoing this procedure are scarce. Martinez et al had a mean follow up of 122 months for a case series of 6 patients (in comparison to 34 months in our study). Three patients had both a good functional and radiographic outcome. Of the other three patients all developed flattening and re-sorption of the graft, leading to osteoarthritis. These required a salvage procedure in the form of shoulder arthroplasty at 8 and 10 years post operatively.¹²

Again this emphasises the importance of preservation of normal gleno-humeral anatomy in the young, active patient. Even if the procedure fails, a salvage procedure such as prosthetic replacement of the joint is easier to perform if there is no altered anatomy. It also buys the younger patient more time before prosthetic replacement is necessary.

We acknowledge the limitations of this paper in terms of small patient numbers and limited follow up. However we feel that it adds to the current knowledge of the procedure with both proven CT incorporation of the graft and functional outcomes measures. Our results are comparable to other groups and show this procedure is in our opinion the optimal solution to a difficult and rare injury.

5. Conclusion

Reconstruction of the humeral head with fresh frozen femoral head allograft provides shoulder stability and good functional outcome scores. Our study has shown that the allografts incorporate well, however graft retraction is a potential complication. Due to excellent graft incorporation bone preserving revision arthroplasty surgery is possible. This is particularly important for young and functionally active patients. There are only a few studies in literature that describe this procedure, due to the rarity of this injury and the local availability of quality structural allografts. Our results would support its use with good radiological and functional outcomes. This is in keeping with studies in literature. Further refinement of this technique is possible with the use of templating via medical imaging software to detail the exact dimensions of the segment required to reconstruct the humeral head.

Conflict of interest

None.

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