The management of bilateral posterior fracture dislocations of the shoulder: a case series illustrating management options

Harpal S Uppal, Peter W Robinson, Iain Packham and Mark Crowther

Abstract

Background: Although dislocation of the shoulder is a relatively common event, the overwhelming majority of injuries are anterior. Posterior shoulder dislocation is more uncommon, comprising between 3% and 5% of all shoulder dislocations. One percent of shoulder dislocations involve a fracture, whereas only 0.9% of the 1500 cases reported by Neer (*J Bone Joint Surg Am* 1970; 52:1077–89; *J Bone Joint Surg Am* 1970; 52:1090–103) concerned posterior fracture dislocations. Bilateral posterior fracture dislocation is an even rarer event, comprising just 5% of all posterior fracture dislocations. Given the rarity and relative poor outcome often observed after these severe injuries, it is important that upper limb function is optimized.

Methods: Bilateral posterior fracture dislocations of the shoulder pose a difficult clinical challenge that requires careful management planning. To date, there have been three isolated case reports of using contralateral osteochondral humeral autograft and hemiarthroplasty. We report our experiences and clinical outcomes in managing four such cases using a variety and combination of treatments, including the first reported use of reverse shoulder arthroplasty with contralateral osteochondral humeral autografting.

Results: Shoulders reconstructed with humeral autograft demonstrated superior Oxford Shoulder Scores and an improved range of motion, as measured by a markerless machine vision system, compared to hemiarthroplasty.

Conclusions: Our results support the use of a contralateral humeral autograft in bilateral posterior shoulder fracture dislocation.

Keywords

autograft, bilateral, fracture dislocation, posterior, shoulder dislocation, shoulder hemiarthroplasty

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Introduction

Although dislocation of the shoulder is a relatively common event, with an incidence of between 10¹ and 24² per 100,000 person years, the overwhelming majority of these injuries are anterior. Posterior shoulder dislocation is more uncommon, comprising between 3% and 5% of all shoulder dislocations.^{3,4} One percent of shoulder dislocations involve a fracture,⁵ whereas only 0.9% of the 1500 cases reported by Neer^{6,7} concerned posterior fracture dislocations. Bilateral posterior fracture dislocation is an even rarer event, comprising just 5% of all posterior fracture dislocations.⁸

Posterior fracture dislocation of the glenohumeral joint is a result of more significant energy trauma than is required for anterior shoulder dislocation. Between 50% and 90% of all bilateral posterior

Shoulder Unit, North Bristol NHS Trust, Southmead Hospital, Bristol, UK

Corresponding author:

Harpal S Uppal, Shoulder Unit, North Bristol NHS Trust, Southmead Hospital, Bristol BS10 5NB, UK.
Tel: +44 (0)1179505050.
Email: harpaluppal@nhs.net

fracture dislocations are secondary to epileptic seizures,³ with 5% of injuries being caused by electric shock,⁵ and the remainder being a result of major trauma.

Given the rarity³ and relative poor outcome⁹ often observed after these severe injuries, it is important that upper limb function be optimized. The historical literature documents open and closed reduction procedures without the use of any reconstructive techniques or any implant fixation.^{10,11} The McLaughlin procedure or Neer's modification have been used to restore stability to the unstable shoulder at the expense of movement.¹² Bilateral shoulder hemiarthroplasties have been used to treat these injuries with good results in terms of stability but poor results in terms of postoperative function.¹³ The disappointing results of hemiarthroplasty, as obtained in a group of patients whose premorbid shoulder function was often normal, have driven surgeons to try to reconstruct the humeral articular surface. A variety of approaches for treating the depressed and damaged articular surfaces have been described. Gerber and Lambert¹⁴ described the use of osteochondral femoral head allograft to fill anterior segments of bone loss or impaction, the 'reverse Hill-Sachs lesion', in posterior humeral fracture dislocations. In 2008, Martinez et al.¹⁵ reported the use of humeral osteochondral allograft in six patients, four of whom went on to successfully incorporate the graft, whereas two patients suffered from avascular necrosis and subsequent collapse of the humeral head.

Bilateral injuries offer increased options for reconstruction, particularly with the availability of contralateral humeral osteochondral autograft if one side has been treated with an arthroplasty.^{4,16} There are advantages to using an osteochondral autograft compared to allograft, especially with regard to the osteogenic potential of the former. In 1997, Connor et al.¹⁶ reported the results of a single patient treated with

hemiarthroplasty and contralateral humeral osteochondral autograft. In 2007, Ivkovic et al.⁴ reported results of a similar procedure demonstrating significantly improved postoperative range of motion and function in the grafted side compared to the hemiarthroplasty. In 2012, Torrens et al.¹⁷ reported the results of a patient treated with hemiarthroplasty and contralateral osteochondral humeral autograft. Torrens et al.¹⁷ used non-absorbable suture material instead of screws to fix the graft to the host bone and successful incorporation occurred with similar good function in terms of the range of motion between the two sides.

Bilateral posterior fracture dislocations of the shoulder pose a difficult clinical challenge that requires careful management planning. To date, there have been three isolated case reports of using contralateral osteochondral humeral autograft and hemiarthroplasty. In the present study, we report our experiences in managing four such cases using a variety and combination of treatments, including the first reported use of reverse shoulder arthroplasty with contralateral osteochondral humeral autografting.

Materials and methods

Four male patients presented consecutively to the on call service at the receiving trauma centre between September 2009 and October 2014 (Table 1). Following careful patient assessment and counselling, the decision was made to proceed with surgical treatment. All patients underwent pre-operative computed tomography (CT) scans to assess the degree of articular bone loss. Analysis of the CT images determined which shoulder was treated with replacement arthroplasty and hence as donor of the autograft for the contralateral humeral head. The less damaged articular surface, which also demonstrated greater structural integrity of the tuberosities, was chosen to be the host shoulder

Table 1. Demographics and cause of injuries for all patients.

	Age at injury	Follow-up	Sex	Aetiology	Right shoulder	Left shoulder
Patient 1	75	10 months	Male	First time grand mal seizure – no cause	Reverse arthroplasty	Osteochondral graft
Patient 2	61	5 years 4 months	Male	First time seizure – no cause	Open reduction internal fixation	Hemiarthroplasty
Patient 3	69	2 years 2 months	Male	Unwitnessed blackout – no cause – presumed seizure	Osteochondral graft	Hemiarthroplasty
Patient 4	61	3 years	Male	Seizure secondary to possible ethanol withdrawal	Hemiarthroplasty	Hemiarthroplasty

for the osteochondral autograft (Fig. 1). The humeral head osteochondral autografts were prepared in a segment sized to fit the host defect using an oscillating saw. Figure 2 illustrates the prepared host site, particularly the sharp edge of the humeral articular cartilage from which damaged articular cartilage was removed. Figure 3 shows the inserted autograft which was subsequently fixed to host bone using countersunk stainless steel 2.7-mm screws (Synthes compact foot set; Synthes Inc., West Chester, PA, USA). For the hemiarthroplasty reconstructions, a standard technique was utilized. Cemented stems were used and the tuberosities were sutured with heavy non-absorbable sutures to each other and to the diaphysis via drill holes.

Outcome measures included postoperative radiographs demonstrating implant position and bone graft incorporation, clinical photographs demonstrating range of motion, range of motion measured using a machine vision system and the Oxford Shoulder Score at a minimum of 7 months following surgery. The machine vision system uses a markerless digital 'Kinect' camera (Microsoft Corp., Redmond, WA, USA). An application was written using Visual Studio 2013 (Microsoft Corp.) and Kinect SDK, version 1.8 (Microsoft Corp.) to objectively and reproducibly measure shoulder and elbow range of motion. The Kinect algorithms have been validated for measuring shoulder range of motion to within 5° of a marker based laboratory motion capture system, which is the gold standard method of assessing range of motion.¹⁸ Consent was obtained from all patients to have their case histories and clinical photographs published.

Results

Patient 1 presented with bilateral posterior shoulder fracture dislocations following an idiopathic first time

grand-mal seizure. No medical cause for his seizure could be identified by the physicians and he was started on anti-epileptic medication. He was offered contralateral humeral osteochondral autograft surgery to reconstruct his left shoulder and underwent reverse shoulder arthroplasty (Aequalis Reverse Fracture System; Tornier, Saint Martin, France) for the more severely injured right shoulder. At 7 months, both shoulders function well, with his only deficit being the loss of external rotation in the right reverse shoulder arthroplasty.

Figure 2. Prepared host humeral autograft site.

Figure 1. Computed tomography scan demonstrating bilateral humeral articular defects.

Figure 3. Implanted contralateral humeral autograft.

Patient 2 also presented with bilateral posterior shoulder fracture dislocations following an idiopathic first time grand-mal seizure. Again, no medical cause for his seizure could be identified and he was started on anti-epileptic medication. One week following his presentation, he underwent open reduction of the right shoulder with internal fixation of the displaced lesser tuberosity fracture using 3.5-mm partially threaded screws (Synthes Inc.). He underwent simultaneous left shoulder hemiarthroplasty (DePuy Global Fx; Johnson & Johnson, New Brunswick, NJ, USA). Five years following surgery, Patient 2 has poor function in the hemiarthroplasty and good function in the reconstructed shoulder. He has been offered and has declined revision surgery for the poorly functioning left shoulder hemiarthroplasty because he is able to play golf, which is his primary functional concern.

Patient 3 collapsed when driving alone with no identifiable cause. Medical investigation identified no cause for the transient loss of consciousness. A CT scan suggested that the right shoulder was reconstructable with a contralateral osteochondral humeral autograft and this was performed immediately following left shoulder hemiarthroplasty (DePuy Global Fx), 5 days after admission. At 3 years, excellent function is reported of the reconstructed right side, which is essentially normal with good pain relief but compromised function, although pain free, is reported on the left hemiarthroplasty side.

Patient 4 presented with bilateral posterior shoulder fracture dislocations following a seizure presumed secondary to ethanol withdrawal and electrolyte imbalances. His shoulders were reduced closed in the emergency department and his medical condition was optimized over a 2-week period prior to bilateral shoulder hemiarthroplasty (DePuy Global Fx). Following recovery from surgery, he has had reasonable pain relief but reports restricted function.

Table 2 documents the computer assessed shoulder range of motion and postoperative Oxford Shoulder Score of both shoulders. Forward flexion, abduction and external rotation of the adducted arm were measured by the markerless Kinect-based machine vision system for both shoulders of all patients. The patient recorded outcome scores were performed at a minimum of 10 months and a maximum of 5 years.

Table 3 demonstrates the respective clinical photographic and radiographic outcomes of all patients. Both contralateral osteochondral humeral autografts have incorporated successfully. There has been tuberosity resorption around all four hemiarthroplasties but no evidence of loosening to date. There have been no other reported complications.

Discussion

This case series reports four patients who were treated for bilateral posterior fracture dislocations of the shoulders and describes the range of outcomes for different treatment combinations. The results show that, in those shoulders that underwent joint reconstruction using contralateral osteochondral humeral autograft, function was restored to near normal as indicated by the Oxford Shoulder Score and range of motion assessment. We strongly support the use of this reconstruction technique whenever feasible. In our experience, one of the bilateral injured shoulders is often more severely damaged and thus is the preferred donor of the humeral osteochondral autograft for an isolated large anterior impaction reverse Hill-Sachs lesion.

Reverse shoulder arthroplasty has become an increasingly accepted technique, especially in preference to hemiarthroplasty, when treating unreconstructable proximal humeral fractures in older patients.¹⁹ Our series of patients with bilateral injuries reinforces the evidence base that reverse shoulder arthroplasty and reconstructive techniques can offer improved function and pain relief over hemiarthroplasty.¹⁹ Because of the rarity of this presentation, it is unlikely that even an international multicentre randomized study would be able to recruit sufficient patients to prevent type 2 error. This case series is an additional source of guidance on managing this rare but often devastating combination of injuries.

Table 2. Range of motion as measured by markerless machine vision system and patient reported outcome measures for all patients.

	Right shoulder abduction (°)	Left shoulder abduction (°)	Right shoulder forward flexion (°)	Left shoulder forward flexion (°)	Right shoulder external rotation in adduction from neutral (°)	Left shoulder external rotation in adduction from neutral (°)	Oxford Shoulder Score: right (0–48)	Oxford Shoulder Score: left (0–48)
Patient 1: Right reverse arthroplasty Left osteochondral graft	116	98	91	118	–15	20	44	37
Patient 2: Right open reduction internal fixation Left hemiarthroplasty	99	47	124	68	24	0	43	34
Patient 3: Right osteochondral graft Left hemiarthroplasty	160	75	175	125	71	41	48	45
Patient 4: Bilateral shoulder hemiarthroplasty	100	89	110	85	–18	–19	32	34

Table 3. Photographic demonstration of range of motion and post-operative radiographs.

	Abduction	External rotation in adduction	Left shoulder forward flexion	Right shoulder forward flexion	Right shoulder radiograph	Left shoulder radiograph
Patient 1 Right shoulder: reverse arthroplasty Left shoulder: osteocondral graft
Patient 2 Right shoulder: open reduction internal fixation Left shoulder: hemiarthroplasty
Patient 3 Right shoulder: osteocondral graft Left shoulder: hemiarthroplasty
Patient 4 Bilateral shoulder hemiarthroplasty

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