CLINICAL ARTICLE

Management of Locked Posterior Shoulder Dislocation with Reverse Hill–Sachs Lesions *via* Anatomical Reconstructions

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Objective: To evaluate the outcomes of locked posterior shoulder dislocation with reverse Hill–Sachs lesions in patients treated with anatomical reconstructions.

Methods: Patients who were treated at our institution between January 2016 and June 2020 were retrospectively reviewed. The demographics of the patients including gender, age, occupation, and dominant arm were recorded. Eleven cases from 10 patients qualified in this study. Nine males and one female were included. The mean age of the patients was 44.8 years (range, 33–54 years). Mechanism of injury, duration between injuries and definitive diagnosis, misdiagnosis, size of humeral head impaction, treatment maneuver, and details of operation performed were reviewed. Plain radiographs and computed tomography (CT) scan were taken to determine the size of defects preoperatively and fracture healing during follow-up. During surgery, the deltopectoral approach was employed. Anatomical reconstruction procedure including reduction, disimpaction, bone grafting, and fixation were sequentially performed. Either cancellous autograft from iliac crest or allograft were used and the fractures were anatomically reduced and stabilized by screws or plates. Visual Analog Scale (VAS) and Constant–Murley score were recorded to determine the functional outcomes preoperatively, at 3 months and 6 months postoperatively, and at the last follow-up. The range of motion in forward flexion was recorded at 6 months follow-up postoperatively.

Results: Causes of injuries included epileptic seizure in four cases, fall in three cases, and road traffic accident in three cases. Misdiagnoses occurred in five out of 10 patients. The mean time between injury and definitive treatment among those misdiagnosed was 112 days. The mean size of the impacted reverse Hill–Sachs lesions was 33.95% (range, 19.1%–42.6%). All patients received surgical management with anatomical reconstruction approach, including open reduction, disimpaction, bone grafting, and internal fixation. The mean amount of bleeding during operation was 450 mL. The mean follow-up period was 22.6 months. Fracture healing was observed by 8 weeks in all cases postoperatively and evidence of bone grafting could not be further detected on CT scan at 6 month during follow-up. VAS was significantly lower at the last follow-up (0.68 ± 0.21) in comparison to preoperative scores (4.96 ± 0.97) ($P < 0.05$). Constant–Murley was improved significantly at the last follow-up (91.7 ± 8.3) in comparison to that preoperatively (40.6 ± 10.3) ($P < 0.05$). The mean range of motion in forward flexion was $38.25° \pm 9.36°$ preoperatively and significantly improved to $162.48° \pm 12.68°$ at 6-month follow-up ($P < 0.05$).

Conclusion: The anatomical reconstruction procedure by open reduction and bone augmentation for the treatment of locked posterior shoulder dislocation with reverse Hill–Sachs lesion was promising in both fracture healing and functional outcomes.

Key words: Anatomical reconstruction; Bone grafting; Dislocation; Reverse Hill-Sachs lesion; Shoulder

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Introduction

The glenohumeral joint is most susceptible to dislocate with disruption of the balance of stability usually supported by bone structures, soft tissues, and peri-articular muscle functions[1]. While anterior shoulder dislocation is commonly seen, posterior shoulder dislocation is relatively rare, only accounting for 1%–5% of all shoulder dislocations[2–4]. Diagnosis for such lesions is challenging. The rate of misdiagnosis could be as high as 50%–79%[5]. This would consequently delay the definitive treatments performed, predispose to serious complications, and eventually compromise the functional outcomes[6,7].

Although the classic signs of posterior dislocation may include posterior fullness and rounding with subsequent prominence of the coracoid process, flattening of the anterior aspect, decreased or completely nullified external rotation with the arm in elastic internal rotation, and limited elevation of the arm, most patients do not always show characteristic symptoms and there may be minimal evidence recorded on physical examination for an inexperienced physician. Evaluation by radiographic series is then mandatory, including anteroposterior (AP) view, axillary view, and scapular lateral view (scapular-Y view). In the situation that an axillary view could not be captured because of pain and limited abduction, a scapular-Y view is recommended. On AP view, numerous signs may indicate a posterior dislocation. The "light-bulb" is a classical appearance of the humeral head, the "vacant glenoid sign" shows the void of the anterior glenoid fossa and the "rim sign" defines margins between anterior glenoid rim and humeral head over 6 mm. All these signs may be indicative, though not always specific and diagnostic[8,9]. Hence, the axillary view and scapular-Y view are crucial for diagnosis of posterior shoulder dislocation[10,11]. Cicak indicated one of the reasons for neglected diagnosis as lack of axillary or scapular-Y view radiograph[12]. Computed tomography (CT) is useful in evaluating the lesion in detail, confirming the diagnosis, defining the size of the defect and is beneficial in decision-making in treatments[13]. Magnetic resonance imaging (MRI) provides evidences of soft tissue injuries, such as lesions in labrum, rotator cuff and incarcerated long head of biceps tendon. However, in acute posterior shoulder dislocation, soft tissue injuries are not common[14–16].

Several mechanisms may result in posterior shoulder dislocation, with forced muscle contraction as in epileptic seizures, electric shock and electroconvulsive therapy being the most common causes. In addition, such injury may also occur in major trauma when an axial loading force is exerted meanwhile the arm is in a position of adduction, flexion, and internal rotation[17]. Posterior dislocations may be associated with bony or soft tissue injuries around the affected shoulder. The typical impression fracture of the antero-medial articular surface is defined as reverse Hill–Sachs lesion (RHL), which may occur in 86% of acute traumatic posterior shoulder dislocations[18]. Such lesions may cause an engagement when humeral head is dislocated, resulting in a locked posterior shoulder dislocation. It is of great clinical importance that the function and stability of the affected shoulder could be significantly compromised in respect to the size of the lesion, since the impaction lesion of the humeral head closely correlates with the stable arc of curvature of the glenohumeral articulation[12]. Furthermore, patients suffering from such lesions are always with high functional demands and any delayed or missed diagnosis may lead to unexpected difficulty in treatment and unsatisfactory outcomes, such as chronic pain, stiffness, osteoarthritis, recurrent instability, and functional disability[19,20].

As cases of posterior shoulder dislocation are rare, there is hardly an evidence-based treatment algorithm recommended. However, it is generally accepted that reverse Hill–Sachs lesion is the single most responsible factor for recurrent instability and, therefore, to restore the stability, surgical treatments for defects over 25% of the humeral head are strongly recommended[16,17,21]. Several surgical procedures have been introduced by numerous studies with satisfactory outcomes. The modified McLaughlin procedure was then introduced by Hughes and Neer, which offered bony filling *via* osteotomy of the lesser tuberosity and showed satisfactory outcomes[15,22]. Disimpaction and reconstruction of the anatomical joint with autograft or allograft in combination with internal fixation is a totally different approach to restore the contour of the articular surface and stability[4,23]. Shoulder arthroplasty is frequently considered in large defects over 40% or chronic dislocations over 6 months[15,24]. It is reasonable to determine the specific treatment option depending on lesion location, size and scale of defects, mechanisms of injury, patient's age, and required functional outcomes; however, there has been no "golden-standard" algorithm in treatment of locked posterior shoulder dislocation. Recently, there were more studies criticizing the disadvantages of the classic non-anatomical procedures, indicating that the anatomical contour of the humeral head and the native mechanism of rotation were permanently altered, in addition to additional difficulties and compromised outcomes if a secondary prosthetic reconstruction was performed[19,24]. On the other hand, the anatomical reconstruction procedure was recommended, suggesting that humeral head sphericity restoration played a key role in stability and outcomes[19,25].

The aims of this study are to: (i) summarize the demographic characteristics and main causes of reverse Hill–Sachs lesions; (ii) to explore the reasons and period of misdiagnosis; and (iii) to evaluate the outcomes of treatments of locked posterior shoulder dislocation with reverse Hill–Sachs lesions *via* anatomical reconstruction procedures in patients who were treated and followed up at our institution.

Materials and Methods

Inclusion and Exclusion Criteria

The inclusion criteria were as follows: (i) the age of patients was over 18 years; (ii) the patients were diagnosed as locked posterior shoulder dislocation with reverse Hill–Sachs lesions and treated at our institute between January 2016 and June 2020; (iii) patients had undergone both X-ray and CT scan for evaluation of lesions preoperatively and fracture healing postoperatively; and (iv) the period of follow-up was more

than 6 months. The exclusion criteria were as follows: (i) patients with bony disruption on glenoid side; (ii) patients with associated injuries.

General Information of Patients

In total, 17 cases were reviewed. Overall, 11 cases from 10 patients were included in this study, including nine males and only one female. The mean age of the patients was 44.8 years (range, 33–54 years). All of the patients were right-handed and there were seven dominant arms involved.

Mechanism of injury (epileptic seizure, electric shock, road traffic accident, or fall), duration between injury and definitive diagnosis, misdiagnosis, size of humeral head impaction, treatment maneuver, and details of operation performed (time duration, the amount of bleeding, bone grafting option, and type of implant) were reviewed.

Radiological Evaluation

An AP view in neutral position, a scapular-Y view, and either an axillary view or a modified axillary view plain radiograph were taken preoperatively and during follow-up (Fig. 1). All cases were locked posterior shoulder dislocation with reverse Hill–Sachs lesions.

All the patients were examined by CT scan with three-dimensional (3D) reconstruction, through which two senior authors (Jiang and Huang) were able to determine the average size of the reverse Hill–Sachs lesions using the method introduced by Cicak[12]. Two other CT scans were provided by 8 weeksand 6 months postoperatively to evaluate fracture healing. (Fig. 2).

Surgical Procedure

Step 1: All patients were under general anesthesia in addition with brachial plexus block. Patient was in the beach chair position.

Step 2: After draping, the deltopectoral approach was employed, cephalic vein was retracted laterally with deltoid and long head of biceps brachii located to determine the greater and lesser tuberosities.

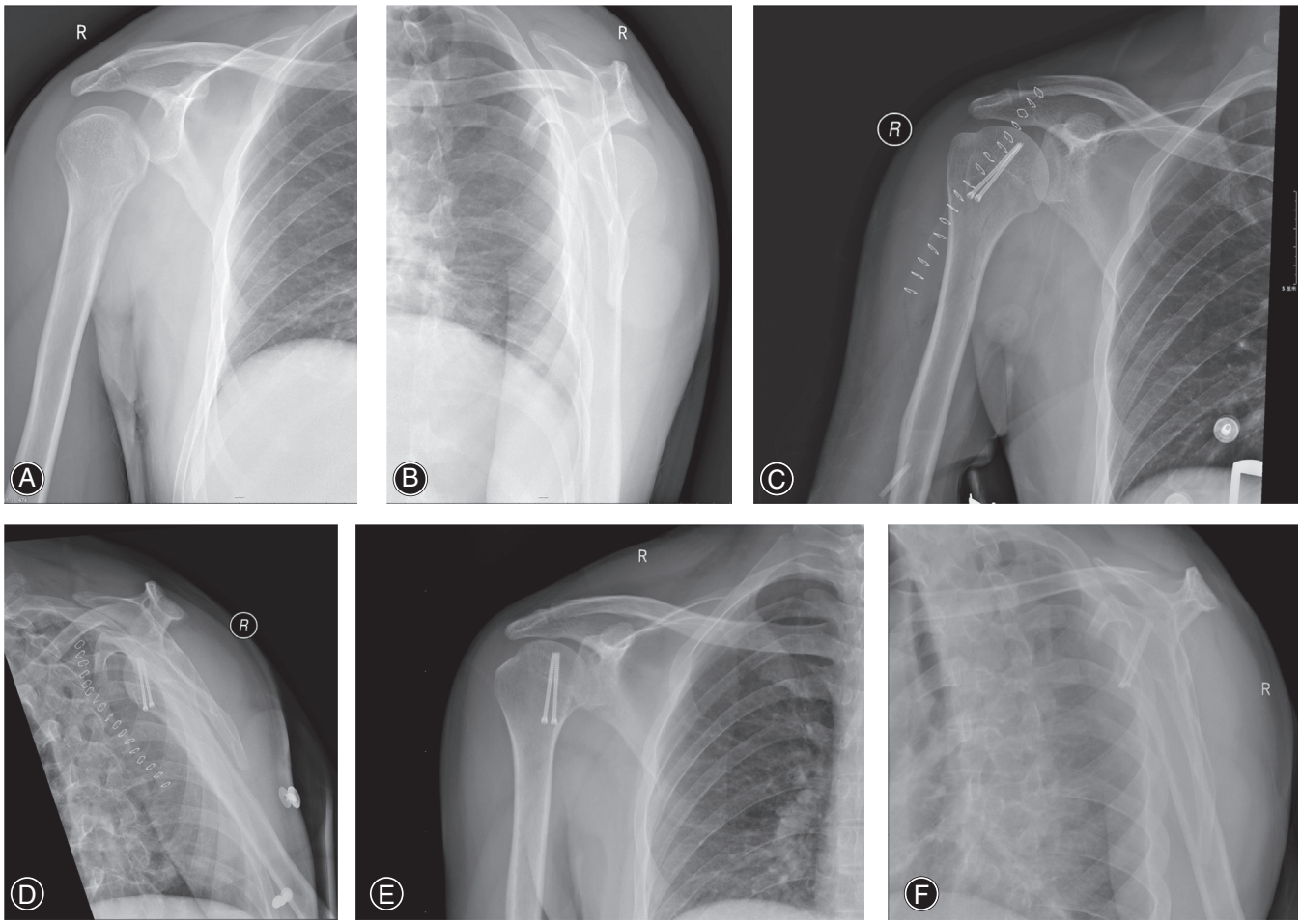

Fig. 1 AP and scapular-Y view plain radiographs. (A, B) Preoperative images; (C, D) Images immediately after operation; (E, F) 3 month postoperative images.

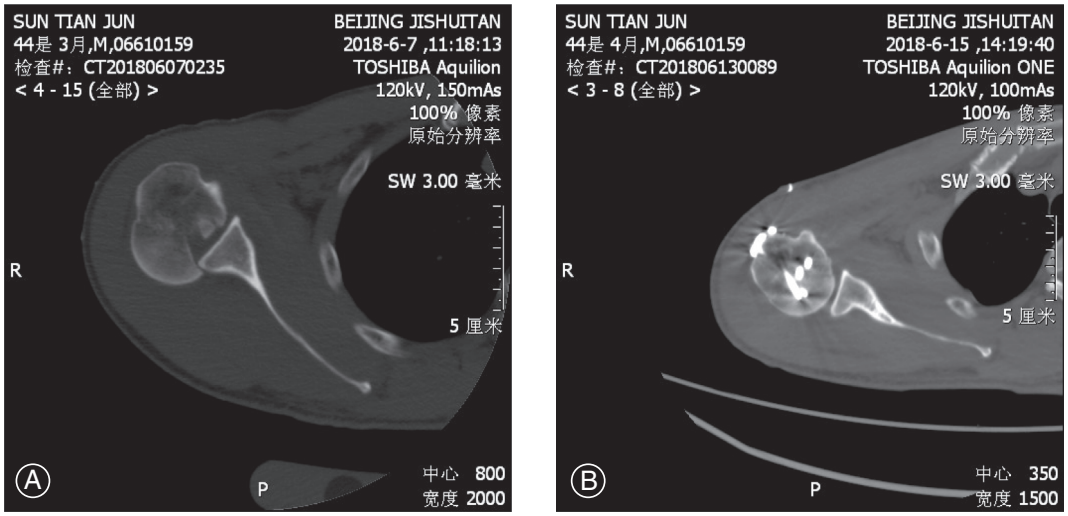

Fig. 2 CT images of reverse Hill–Sachs lesion. (A) Preoperative image showed locked posterior shoulder dislocation; (B) 8 weeks postoperative image showed fracture healing.

Step 3: Each insertion of rotator cuff tendons was marked with 5# Ethibond (Ethicon, Inc. Somerville, New Jersey), which could also be beneficial in manipulating the dislocated humeral head. Access to the humeral head was usually straight forward through the long head tendon of biceps brachii and rotator cuff interval. An elevator was inserted behind the posterior rim of the glenoid and with traction of the Ethibond prepared, reduction of the dislocated humeral head might not be that difficult in acute injuries. However, in long-lasting dislocations, especially those with a period of over 6 weeks, radical debridement and proper arthrolysis might be demanded. Subscapularis tendon could be temporarily and partially transected with three-quarters of the width at 1 cm from its insertion, so that the lesion could be detected. If there was a significant displaced fracture of lesser tuberosity, the reverse Hill–Sachs lesion could be reached through the fracture gap.

Step 4: Reduction, disimpaction, and bone grafting were sequentially performed. In acute lesions, cancellous autograft from iliac crest or allograft were the options for bone grafting. However, in old lesions, an allograft of humeral or femoral head with intact subchondral articular surface was used. Fractures were anatomically reduced and stabilized by screws after bone augmentation. If there was an associated fracture of surgical neck, K-wires were used to temporarily stabilize the fracture and definitive fixation was achieved by a plate after bone augmentation (Figs 3, 4).

Step 5: Stability of the shoulder was confirmed after fixation by adduction and internal rotation of the shoulder joint. Further confirmation of fixation and stability were acquired fluoroscopically.

Prophylactic antibiotics with second-generation cephalosporin was administered within 24 h postoperatively. The involved upper arm was positioned in a brace with 20° external rotation and mild backward extension.

Rehabilitation: Rehabilitations of strengthening and range of motion on forward flexion, internal and external rotation, and adduction started from 6 weeks postoperatively and progressed gradually. Muscle strengthening was enhanced 3 months postoperatively, as well as range of motion in all directions.

Outcome Measures

Visual Analog Scale (VAS) and Constant–Murley score were recorded preoperatively, at 3 months and 6 months postoperatively, and at the last follow-up as to evaluate the functional outcomes. The range of forward flexion was considered as a key and predictive parameter in evaluation of postoperative rehabilitation. It was recorded both preoperatively and at 6 months postoperatively during follow-up.

Fracture Healing

Fracture healing was determined radiologically with consolidation of the disimpacted cortices on CT scan. Any complication observed during follow-up was also recorded.

Visual Analog Scale (VAS)

The VAS is the most frequently used questionnaire to quantify pain. For pain intensity, the scale ranges from 0 (meaning no pain) to 10 (meaning the pain as bad as it could be). A score of 0 is considered no pain, 1–3 mild pain, 4–6 moderate pain, and 7–10 severe pain.

Constant–Murley score

Constant–Murley score is a widely accepted scoring system for shoulder function assessment[5]. The overall 100-score system consists pain (15 scores), activities of daily living (20 scores), range of motion (40 scores), and power (25 scores). A total score <70 is considered a poor, 70–79 fair, 80–89 good, and 90–100 excellent.

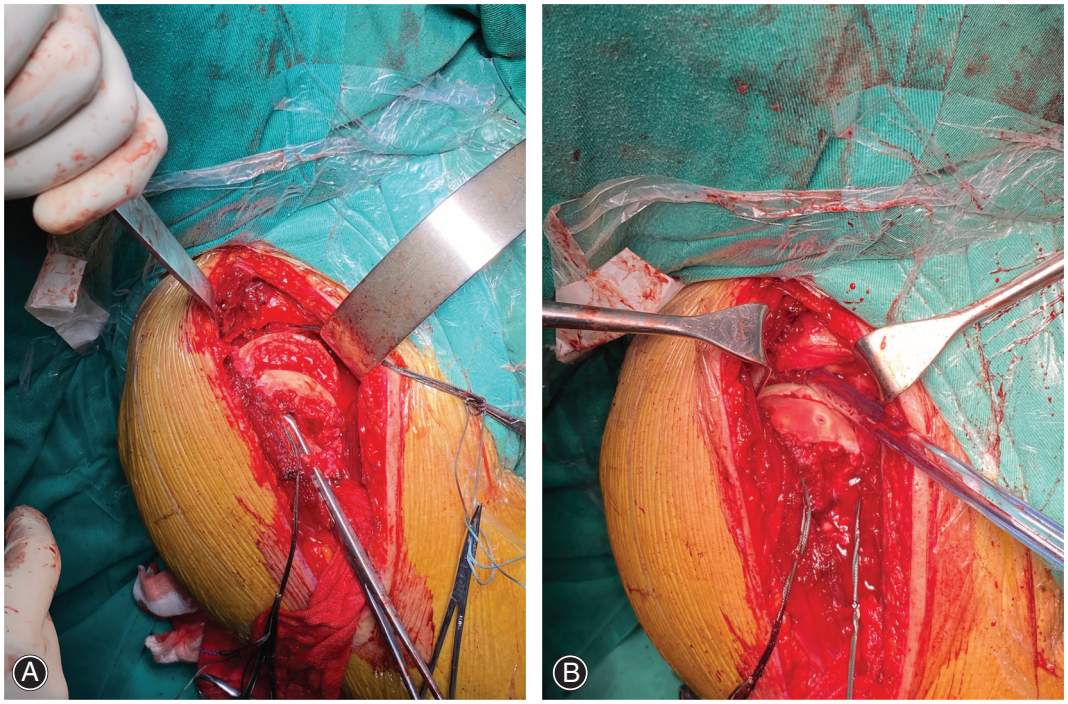

Fig. 3 Anatomical reconstruction procedure to treat reverse Hill–Sachs lesion. (A) The impacted articular surface; (B) reduction, disimpaction, bone grafting, and fixation by screws.

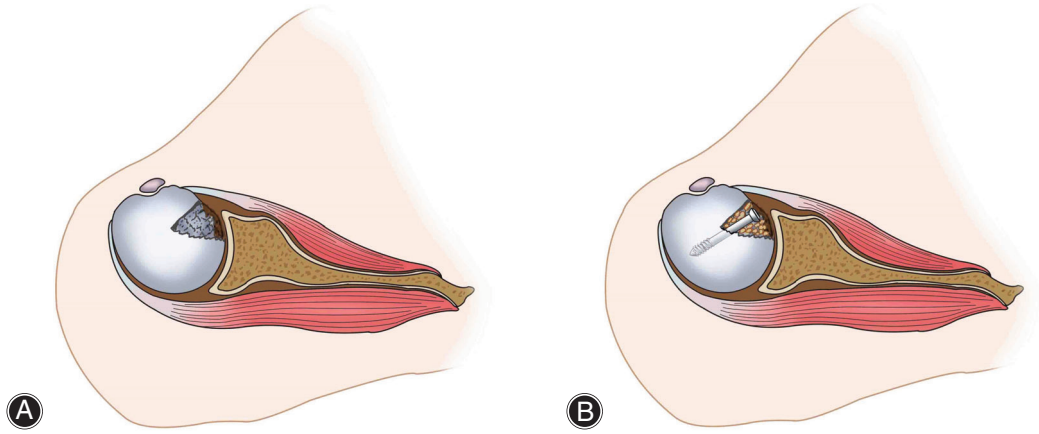

Fig. 4 Schematic illustrations of anatomical reconstruction procedure to treat reverse Hill–Sachs lesion. (A) Reduction of the dislocated humeral head, (B) disimpaction, bone grafting, and fixation by screws.

Statistical Analysis

Statistical analysis was performed in SPSS (version 20.0, SPSS Inc., Chicago, USA). Age, size of impaction, and follow-up period variables were expressed by mean and range. VAS, Constant–Murley score, and range of motion in forward flexion were expressed by mean ± SD and were analyzed by *t*-test. A *P* value <0.05 was considered statistically significant.

Results

Characteristics of Lesions

Causes of injuries were various, with epileptic seizure in four cases, fall in three cases, and road traffic accident in three cases. Misdiagnoses occurred in five out of 10 patients as proximal humerus fracture, frozen shoulder, or bone tumor. One case was misdiagnosed as proximal humerus fracture in

acute phase and was treated with "open reduction and internal fixation" leaving the shoulder dislocated posteriorly. For all the five cases which were misdiagnosed, neither a scapular-Y view nor an axillary view was taken during the first radiological evaluation. In addition, lack of CT scan was another common point for the misdiagnosed cases.

The mean time between injury and definitive treatment among those misdiagnosed was 112 days (range, 30–360 days). The mean size of the impacted reverse Hill–Sachs lesions was 33.95% (range, 19.1%–42.6%; Table 1).

Eight cases were fixed by screws while three cases were fixed by a combination of screws and one plate. The mean amount of bleeding during operation was 450 mL (range, 200–1000 mL).

Follow-up

All patients returned to our institute for follow-up postoperatively and the mean follow-up period was 22.6 months (range, 6–51 months).

Fracture healing

Fracture healing was observed by 8 weeks in all cases postoperatively and evidence of bone grafting could not be further detected on CT scan at 6 month during follow-up.

Visual analog scale

VAS was 1.34 ± 0.52 and 0.88 ± 0.42 at 3 months and 6 months postoperatively, respectively, and was significantly lower at the last follow-up (0.68 ± 0.21) in comparison to that preoperatively (4.96 ± 0.97) and there was significant difference between all three postoperative time points and the preoperative one.

Constant–Murley score

Constant–Murley was 85.5 ± 9.6 and 88.3 ± 8.2 at 3 months and 6 months postoperatively, respectively, and was improved significantly at the last follow-up (91.7 ± 8.3) in comparison to that preoperatively (40.6 ± 10.3) and there was significant difference between all three postoperative time points and the preoperative one.

The mean range of motion in forward flexion was $38.25^\circ \pm 9.36^\circ$ preoperatively and significantly improved to $162.48^\circ \pm 12.68^\circ$ at 6 months during follow-up, and there was significant difference at two time points ($P < 0.05$).

All but one patient returned to their previous careers. This patient, who was once an occupational driver, was no longer allowed to drive due to epileptic history. With the excellent functional outcomes, he started a new career with satisfaction.

Complication

Postoperative subluxation was detected only in one patient (No.7) during CT scan before discharge. A supplementary and temporary stabilization of the glenohumeral joint was performed with three K-wires, which were removed after 3 weeks and no dislocation or subluxation was observed at that point. This patient recovered uneventfully with satisfactory functional outcomes.

Discussion

Posterior dislocation occurs when there is an imbalance between internal rotators and external rotators during sudden powerful contractions and while the arm involved is in a flexed, adducted, and internal rotated position[12,13,16,26,27]. Posterior shoulder dislocation, though rare in morbidity, is a crucial issue of great clinical significance.

Accurate Diagnosis of Posterior Shoulder Dislocation

The rate of misdiagnosis is up to 79% in practice[5], and still it remains challenging in treatments of delayed-diagnosed posterior shoulder dislocation to achieve favorable outcomes. Through careful history taking and physical examination, some evidences may be detected, including a history of epileptic seizure or electric shock, arms being held in an internal rotated position, a prominence of coracoid process, or axillary fullness by palpation[16,27,28]. All of these would help to

TABLE 1 Patient characteristics

Case No.	Gender	Age (years)	Dominant arm	Side of injury	Mechanism of injury	Duration between injury and definitive diagnosis (days)	Misdiagnosis	Impaction (%)
1	Male	37	R	R	Fall	7	No	26.8
2	Male	33	R	L	RTA	40	Yes	26.2
3	Male	44	R	R	RTA	9	No	32.7
4	Male	46	R	L	Seizure	46	Yes	39.2
				R				42.1
5	Female	41	R	L	Fall	30	Yes	19.1
6	Male	49	R	L	Fall	7	No	42.6
7	Male	53	R	R	Seizure	360	Yes	38.1
8	Male	54	R	R	Seizure	86	Yes	41.1
9	Male	43	R	R	RTA	3	No	36.8
10	Male	48	R	R	Seizure	10	No	28.8

L, center; R, right.

raise the suspicion of a possible posterior dislocation so that some specific imaging assessments could be provided. An AP view, a scapular Y view, and axillary view could provide important information on the shoulder, so they are mandatory for evaluation. In some cases of posterior shoulder dislocation, the extent of pain may not be that severe, and a "routine" evaluation may include merely an AP view X-ray. Since significant upward or downward posterior dislocation is rarely seen and misdiagnosis may occur when scapular Y view and axillary view are not taken. In geriatric patients with posterior shoulder dislocation, the bone density of the humeral head may be extremely low. In addition, with the bony defect in humeral head, some cases may be misdiagnosed as bone tumor on X-ray. CT scan could be more beneficial, since the dislocation or subluxation, minor fractures, impactions, and size of any bony defect, which may occur on humeral head as a reverse Hill–Sachs lesion or on glenoid side as a reverse Bankart lesion, could be determined accurately.

Treatment Options for Reverse Hill–Sachs Lesions

Length of time from injury to definitive diagnosis, site of the associated fracture, size of the associated bone defect, and severity of the disrupted articular surface all contribute to the decision-making in treatments of locked posterior shoulder dislocation. For acute injury with the size of defect less than 20%, closed reduction may be attempted[27]. If failed, an open reduction with or without fixation could be considered. If the size of defect is over 50%, shoulder arthroplasty is recommended[29], leaving the management of those with defects between 25%–50% to be of great challenge and controversy. However, since posterior shoulder dislocation mostly occurs in the younger population, the functional outcome demanded is emphasized and long-term results after arthroplasty are questioned. Hence, for defects with size over 50% and those chronic lesions, various open reduction procedures have been introduced. Recently, however, some classic procedures were criticized for compromising the anatomical structure of both soft tissue and bone. This acted as a barrier to achieve a satisfactory outcome in the second stage arthroplasty[19,24].

On the other hand, reconstructions with bone grafting were advocated, by which the anatomical contour of the humeral head could be restored, particularly in posterior dislocation associated with reverse Hill–Sachs lesions[19,25]. Moreover, some studies further demonstrated that anatomical reconstructions could be incredibly beneficial to those chronic cases with size even larger than 50% with satisfactory outcome[25,30]. The mean impaction size introduced in our study was 34.2%, with 42.6% as the maximum size. Noteworthy, favorable radiological and functional outcomes were achieved in all cases in our study. One case with an impaction size of 38.1% had been misdiagnosed for almost 1 year and was admitted and open reduction, disimpaction, bone grafting, and internal fixation were performed. A trend of subluxation was detected through radiological study immediately after operation. Long-term posterior soft tissue contracture and lack of sufficient arthrolysis during operation might lead to imbalance of the soft tissue around the involved shoulder. An additional short-period K-wire stabilization of the humeral head and glenoid helped to rebuild the balance and maintain the congruency of the joint. The wires were removed in 3 weeks and there were no indications of pin-tract infection and no evidence of subluxation. The patient recovered uneventfully with no pain.

Surgical Details in Anatomical Reconstruction Procedure

The aim of performing an anatomical reconstruction is to restore the joint surface. In acute lesions, most of the articular cartilage is viable, and supporting the subchondral areas and restoring the articular surface are crucial. Thus, cancellous autograft harvested from iliac crest or allograft were reasonable options. However, in relatively old lesions, most of the cartilage is unviable, either significantly comminuted or attritional resulting in great difficulty in restoring the articular surface. In such situations, an allograft of humeral head with intact articular surface was used. Osteotomy of the lesser tuberosity should be avoided, as the procedure may result in further injury and weaken the strength of subscapularis. Instead, subscapularis tendon could be temporarily and partially transected 1 cm from its insertion, so that the lesion can be detected, and reconstruction of the humeral head can be achieved. There were also studies on frozen and fresh allografts in treatment of posterior shoulder dislocations[4,31–33]. Fresh allograft was advocated with demonstration of chondrocyte viability[33], and if the void was filled by press-fit technique, hardware use could be avoided. However, there were still concerns about the ethical issues and safety considerations on fresh allograft usage.

Limitations

There were some limitations in this study. The number of cases included was small and the follow-up period was not long enough to evaluate the long-term outcomes.

Conclusion

In this study, we could suggest that through anatomical reconstruction with open reduction, disimpaction, bone grafting, and internal fixation, satisfactory outcomes could be achieved in locked posterior shoulder dislocation with reverse Hill–Sachs lesion. A prospective cohort study will be conducted to systematically demonstrate the advantages of this procedure.

References

1. Murray IR, Goudie EB, Petrigliano FA, Robinson CM. Functional anatomy and biomechanics of shoulder stability in the athlete. Clin Sports Med, 2013, 32: 607–624.

2. Blasier RB, Burkus JK. Management of posterior fracture-dislocations of the shoulder. Clin Orthop Relat Res, 1988, 232: 197–204.

3. Diaz HJ, Ruiz MA, Ruiz DR, Moros MS, Gutierrez JC, Valencia M. The posterior unstable shoulder: natural history, clinical evaluation and imaging. Open Orthop J, 2017, 11: 972–978.
4. Kokkalis ZT, Iliopoulos ID, Antoniou G, Antoniadou T, Mavrogenis AF, Panagiotopoulos E. Posterior shoulder fracture-dislocation: an update with treatment algorithm. Eur J Orthop Surg Traumatol, 2017, 27: 285–294.
5. Constant CR, Murley AH. A clinical method of functional assessment of the shoulder. Clin Orthop Relat Res, 1987, 214: 160–164.
6. DeLong JM, Jiang K, Bradley JP. Posterior instability of the shoulder: a systematic review and meta-analysis of clinical outcomes. Am J Sports Med, 2015, 43: 1805–1817.
7. Robinson CM, Seah M, Akhtar MA. The epidemiology, risk of recurrence, and functional outcome after an acute traumatic posterior dislocation of the shoulder. J Bone Joint Surg Am, 2011, 93: 1605–1613.
8. Arndt JH, Sears AD. Posterior dislocation of the shoulder. Am J Roentgenol Radium Ther Nucl Med, 1965, 94: 639–645.
9. Dorgan JA. Posterior dislocation of the shoulder. Am J Surg, 1955, 89: 890–900.
10. Clough TM, Bale RS. Bilateral posterior shoulder dislocation: the importance of the axillary radiographic view. Eur J Emerg Med, 2001, 8: 161–163.
11. Wallace WA, Hellier M. Improving radiographs of the injured shoulder. Radiography, 1983, 49: 229–233.
12. Cicak N. Posterior dislocation of the shoulder. J Bone Joint Surg Br, 2004, 86: 324–332.
13. Rouleau DM, Hebert-Davies J. Incidence of associated injury in posterior shoulder dislocation: systematic review of the literature. J Orthop Trauma, 2012, 26: 246–251.
14. Hatzis N, Kaar TK, Wirth MA, Rockwood CA Jr. The often overlooked posterior dislocation of the shoulder. Tex Med, 2001, 97: 62–67.
15. Hawkins RJ, Neer CS 2nd, Pianta RM, Mendoza FX. Locked posterior dislocation of the shoulder. J Bone Joint Surg Am, 1987, 69: 9–18.
16. Kowalsky MS, Levine WN. Traumatic posterior glenohumeral dislocation: classification, pathoanatomy, diagnosis, and treatment. Orthop Clin North Am, 2008, 39: 519–533 viii.
17. Sheehan SE, Gaviola G, Gordon R, Sacks A, Shi LL, Smith SE. Traumatic shoulder injuries: a force mechanism analysis-glenohumeral dislocation and instability. AJR Am J Roentgenol, 2013, 201: 378–393.
18. Saupe N, White LM, Bleakney R, *et al*. Acute traumatic posterior shoulder dislocation: MR findings. Radiology, 2008, 248: 185–193.
19. Bock P, Kluger R, Hintermann B. Anatomical reconstruction for Reverse Hill-Sachs lesions after posterior locked shoulder dislocation fracture: a case series of six patients. Arch Orthop Trauma Surg, 2007, 127: 543–548.
20. Castagna A, Delle Rose G, Borroni M, *et al*. Modified MacLaughlin procedure in the treatment of neglected posterior dislocation of the shoulder. Chir Organi Mov, 2009, 93: 1–5.
21. Loebenberg MI, Cuomo F. The treatment of chronic anterior and posterior dislocations of the glenohumeral joint and associated articular surface defects. Orthop Clin North Am, 2000, 31: 23–34.
22. Hughes M, Neer CS 2nd. Glenohumeral joint replacement and postoperative rehabilitation. Phys Ther, 1975, 55: 850–858.
23. Dubousset J. Posterior dislocations of the shoulder. Rev Chir Orthop Reparatrice Appar Mot, 1967, 53: 65–85.
24. Checchia SL, Santos PD, Miyazaki AN. Surgical treatment of acute and chronic posterior fracture-dislocation of the shoulder. J Shoulder Elbow Surg, 1998, 7: 53–65.
25. Diklic ID, Ganic ZD, Blagojevic ZD, Nho SJ, Romeo AA. Treatment of locked chronic posterior dislocation of the shoulder by reconstruction of the defect in the humeral head with an allograft. J Bone Joint Surg Br, 2010, 92: 71–76.
26. Perron AD, Jones RL. Posterior shoulder dislocation: avoiding a missed diagnosis. Am J Emerg Med, 2000, 18: 189–191.
27. Rouleau DM, Hebert-Davies J, Robinson CM. Acute traumatic posterior shoulder dislocation. J Am Acad Orthop Surg, 2014, 22: 145–152.
28. Bahu NJ, Adams CP. An unexpected posterior shoulder dislocation. J Emerg Med, 2001, 21: 435–436.
29. Charalambous CP, Gullett TK, Ravenscroft MJ. A modification of the McLaughlin procedure for persistent posterior shoulder instability: technical note. Arch Orthop Trauma Surg, 2009, 129: 753–755.
30. Gerber C, Catanzaro S, Jundt-Ecker M, Farshad M. Long-term outcome of segmental reconstruction of the humeral head for the treatment of locked posterior dislocation of the shoulder. J Shoulder Elbow Surg, 2014, 23: 1682–1690.
31. Black LO, Ko JK, Quilici SM, Crawford DC. Fresh osteochondral allograft to the humeral head for treatment of an engaging Reverse Hill-Sachs lesion: technical case report and literature review. Orthop J Sports Med, 2016, 4: 2325967116670376.
32. Martinez AA, Navarro E, Iglesias D, Domingo J, Calvo A, Carbonel I. Long-term follow-up of allograft reconstruction of segmental defects of the humeral head associated with posterior dislocation of the shoulder. Injury, 2013, 44: 488–491.
33. Martinez AA, Calvo A, Domingo J, Cuenca J, Herrera A, Malillos M. Allograft reconstruction of segmental defects of the humeral head associated with posterior dislocations of the shoulder. Injury, 2008, 39: 319–322.