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Treatment of chronic locked posterior dislocation of the shoulder with the modified McLaughlin procedure

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Background: Locked posterior dislocation of the shoulder (LPDS) is a challenging condition for the orthopedic surgeon. The problem with cases of chronic LPDS is that they may result in worse clinical outcomes because the size of the reverse Hill-Sachs lesion and cartilage damage can increase over time. Multiple treatment strategies have been reported in the literature for the treatment of chronic cases. The purpose of this study was to report our experience with the modified McLaughlin technique for the treatment of chronic LPDS and evaluate the mid- and long-term functional outcomes.

Methods: This was a retrospective single-center study including a consecutive series of 10 patients who underwent the modified McLaughlin procedure for the treatment of chronic LPDS. The time between dislocation and treatment ranged from 6 weeks to 14 months (mean, 20.9 weeks). Postoperative imaging and functional evaluation were performed with a minimum of 2 years' follow-up (range, 24-110 months). Functional outcomes were assessed by means of a visual analog scale score for pain and patient satisfaction regarding the operation, the Constant-Murley score, and the University of California, Los Angeles shoulder rating scale.

Results: The mean follow-up period was 59.4 months (range, 24-110 months). Range of motion improved significantly after surgery: Mean forward flexion improved from 71° ± 5° to 126°± 37° ($P < .001$), mean external rotation improved from 7°± 7° to 52° ± 18° ($P = .012$), and mean internal rotation improved from gluteal region ± 1 vertebral level to L1 ± 4 vertebral levels ($P = .001$). Functional outcome measures demonstrated significant improvements: The mean Constant-Murley score improved from 22 ± 2.4 (range, 20-26) to 65 ± 21.5 ($P < .001$); the mean University of California, Los Angeles score improved from 9.8 ± 1.3 (range, 8-12) to 27 ± 9.7 ($P < .001$); and the mean visual analog scale score improved from 4.6 ± 0.8 (range, 3-6) to 2.4 ± 2.3 ($P < .001$). Of the patients, 8 (80%) were satisfied with the procedure. The 2 remaining cases had a delay from injury to diagnosis > 6 months and evolved with poor functional outcomes and severe glenohumeral degenerative joint disease. There were no cases of recurrent dislocation, infection, or neurologic injury during the follow-up.

Conclusion: Our study findings demonstrated that the modified McLaughlin procedure showed good results over a 2-year minimum follow-up period. The clinical outcomes of this procedure are worse when there is a delay from injury to diagnosis > 6 months.

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Locked posterior dislocation of the shoulder (LPDS) is a challenging condition for the orthopedic surgeon. The diagnosis is often missed because of inadequate imaging and physical examinations and can become chronic.[2,6,5,29,30] One should have a high index of suspicion after seizure, electric shock, or high-energy trauma.[3,4,9,12] There is no consensus in the literature as to what defines an acute or chronic injury, with some debate between 3 and 6 weeks.[2,5,10,19,22,23] The concern with chronic LPDS is that recurrent posterior instability, osteonecrosis, chondrolysis, and osteoarthritis (OA) may develop because the size of the defect (reverse Hill-Sachs lesion) and cartilage damage can increase over time.[5,22,24]

Deciding on the appropriate treatment depends on the time from injury, presence of associated fracture, and size of the reverse Hill-Sachs lesion.[3,4,10,22] Multiple treatment strategies have been reported in the literature for the treatment of chronic posterior shoulder dislocations. These include nonoperative management, open reduction and filling of the humeral head defect with either autograft or allograft, rotational osteotomy of the proximal humerus, repair of posterior lesions, and shoulder arthroplasty.[1,4,5,8] The purpose of this study was to report our experience with the modified McLaughlin technique for the treatment of chronic LPDS and evaluate the mid- to long-term functional outcomes.

Materials and methods

This was a retrospective single-center study reporting on a consecutive case series of patients who underwent the modified McLaughlin procedure for the treatment of chronic LPDS. We defined a chronic dislocation as a time from injury $>$ 6 weeks. The decision to perform the modified McLaughlin procedure was made in cases with LPDS and a reverse Hill-Sachs defect involving $<$40% of the humeral head as determined by preoperative imaging. Patients with associated fractures of the surgical neck of the humerus or the tuberosities or cases undergoing shoulder arthroplasty were excluded.

Between 2011 and 2018, the modified McLaughlin procedure was performed in 10 patients for the treatment of isolated chronic LPDS. We excluded 4 patients who underwent shoulder arthroplasty. The demographic data of the patients were collected from clinical notes. Preoperatively and postoperatively, all patients underwent clinical and imaging examinations that included radiographs (true anteroposterior, scapular Y, and axillary views) and computed tomography. Measurement of the humeral head defect was performed as described by Gerber et al[19] (Fig. 1). Patients were called back for a final follow-up visit, which occurred $\geq$2 years after surgery (range, 24-110 months) and postoperative imaging (radiographs) and functional evaluations were performed. The degree of radiologic OA in the glenohumeral joint was rated using the Samilson-Prieto classification system.[32] Functional outcomes were assessed by means of a visual analog scale score for pain and patient satisfaction regarding the operation, the Constant-Murley score (CMS), and the University of California, Los Angeles (UCLA) shoulder rating scale.

Surgical procedure

All surgical procedures were performed by the first author. The operation is performed with the patient under general anesthesia combined with an interscalene block. The patient is placed in the beach-chair position. The skin incision starts just proximal to the coracoid and extends distally over the deltopectoral interval. Because of the posterior dislocation of the humeral head, the coracoid process becomes prominent at the skin. The deltopectoral interval is developed medial to the cephalic vein. The subacromial and subdeltoid spaces are then fully freed of scar tissue to further facilitate exposure of the proximal humerus. The biceps tendon is identified and detached from its origin at the glenoid, and tenodesis is performed at the upper edge of the pectoralis major tendon with 2 nonabsorbable sutures (No. 2 Ethibond; Ethicon, Somerville, NJ, USA). The upper border of the subscapularis tendon is identified by finding the rotator interval and the lower border by the anterior circumflex vessels. Lesser tuberosity osteotomy is then performed. The osteotomy is performed with an osteotome starting in the biceps sulcus and removing a piece of bone $\geq$ 5 mm in thickness. Care should be taken to avoid inadvertent damage to the glenoid during the osteotomy because the humeral head is in a posteriorly dislocated position. Before one attempts a reduction, we recommend that all adhesions between the posterior glenoid and humeral head be released. Reduction of the dislocation is achieved with lateral distraction and external rotation, and if needed, an assistant can also manually apply a gentle force pushing the humeral head anteriorly. A blunt elevator can be used to assist reduction, paying attention not to further damage the humeral head and glenoid. After reduction, the humeral head cartilage is evaluated. If digital pressure on the humeral head causes an indentation similar to a thumb pressing on a ping-pong ball is identified, then a shoulder arthroplasty is considered. If considered viable, the modified McLaughlin procedure is performed. Before the reconstruction, the glenohumeral joint is assessed for stability throughout a functional range of motion. This will be important as a guideline for later rehabilitation. As most of our patients had dislocations for $>$2 months (8 cases), it was not possible to repair the posterior capsule and labral structures. Fixation of the lesser tuberosity is performed in a double-row fashion. Medial-row fixation is performed with 1 or 2 anchors near the articular margin of the humeral head with sutures

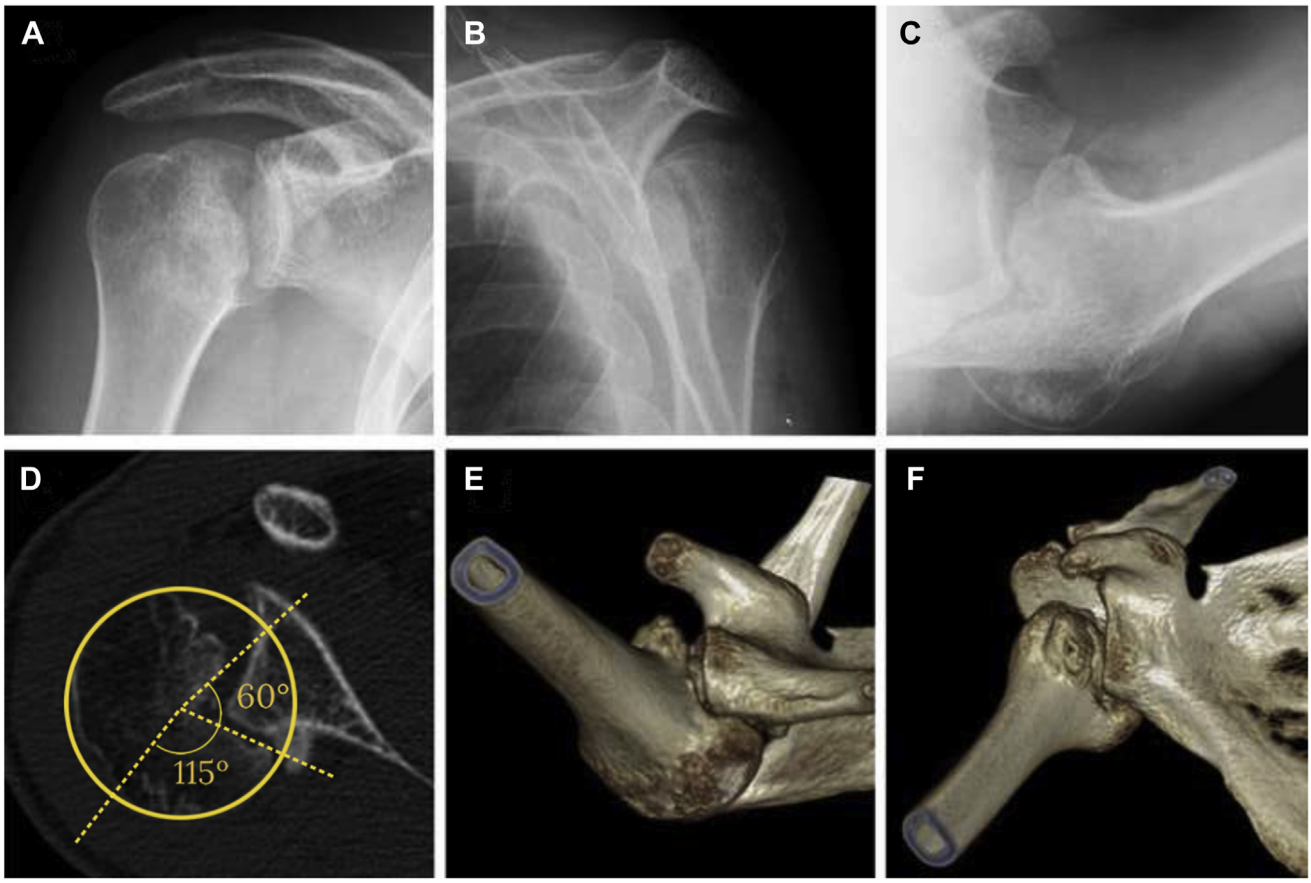

Figure 1 **(A-C)** Preoperative radiographs of the right shoulder of a patient with a 6-week delay from injury to diagnosis showing a chronic locked posterior dislocation of the shoulder with a large reverse Hill-Sachs lesion. **(D)** The defect size is calculated on an axial 2-dimensional computed tomography image, according to Gerber et al.[19] The percentage of the cartilage angle (175° in this case) that the defect angle (60° in this case) represents is the estimated size of the defect (34% in this case). **(E, F)** Three-dimensional computed tomography reconstruction images of the same patient.

through the subscapularis tendon in a mattress fashion, and the lateral row, with No. 5 nonabsorbable transosseous sutures through the lesser tuberosity. The sutures are tightened with the arm in 30° of external rotation.

The shoulder was immobilized in an abduction arm sling postoperatively for 6 weeks. Passive range of motion including external rotation and forward flexion was started only after 6 weeks. Medial rotation exercises were allowed only at 8 weeks after surgery.

Statistical analysis

All data are expressed as means and standard deviations. Preoperative and postoperative range of motion and functional scores were analyzed by the *t* test for dependent samples. Nonparametric data were analyzed by the χ^2 test. $P < .05$ was considered significant.

Results

The mechanism of injury for dislocation was trauma in 5 cases and seizure disorder in 5. The 10 patients included 9 men and 1 woman, and the mean age at the time of surgery was 36.3 years (range, 23-54 years). The right shoulder was affected in 7 patients, and the left was affected in 3. The time between dislocation and surgery ranged from 6 weeks to 14 months, with a mean of 23 weeks (Table I). The mean size of the reverse Hill-Sachs defect was 32% (range, 22%-35%). The mean follow-up period for clinical data was 59.4 months (range, 24-110 months). Range of motion improved significantly after surgery (Fig. 2): Mean forward flexion improved from 71° ± 5° to 126° ± 36° ($P < .001$), mean external rotation improved from 7° ± 7° to 51° ± 18° ($P = .012$), and mean internal rotation improved from gluteal region ± 1 vertebral level to L1 ± 4 vertebral levels ($P = .001$). Functional outcome measures demonstrated significant improvements: The mean CMS improved from 22 ± 2.4 (range, 20-26) to 65 ± 21.5 ($P < .001$), the mean UCLA score improved from 9.8 ± 1.3 (range, 8-12) to 27 ± 9.7 ($P < .001$), and the mean visual analog scale score improved from 4.6 ± 0.8 (range, 3-6) to 2.4 ± 2.3 ($P < .001$) (Table II). According to the Samilson-Prieto classification, 6 patients had grade 1 OA, 2 patients had grade 2 OA, and 2 patients had grade 3 OA. On the basis of the UCLA score, 8

Table I Patient data

Patient no.	Age, yr	Cause	Time to diagnosis, weeks	Defect size, %	Follow-up, mo	Preoperative ROM and functional scores						Postoperative ROM and functional scores				
						FF, °	ER, °	IR	CMS	UCLA score	VAS score	FF, °	ER, °	IR	CMS	UCLA score	VAS score
1	42	Seizure	8	35	110	70	0	L5	18	12	5	150	65	T10	72	32	1
2	42	Trauma	8	25	84	70	10	Lateral thigh	24	10	5	150	70	T9	70	33	0
3	40	Seizure	7	22	110	80	0	Buttock	24	11	4	160	70	T10	74	32	1
4	29	Seizure	6	35	60	60	10	Buttock	20	10	6	140	50	T12	80	32	1
5	38	Trauma	56	30	28	70	15	L5	26	9	6	60	20	Buttock	28	8	5
6	23	Trauma	24	35	30	80	10	L5	22	8	5	140	50	L3	82	31	2
7	29	Seizure	8	35	28	70	0	Lateral thigh	20	10	4	150	60	T10	78	31	1
8	30	Trauma	52	35	24	70	20	Buttock	22	9	5	60	20	Buttock	22	9	7
9	32	Seizure	19	30	60	70	10	Buttock	20	8	4	120	50	L3	70	30	3
10	36	Trauma	21	35	60	70	0	Buttock	24	11	5	130	60	T10	74	32	2

ROM, range of motion; *FF*, forward flexion; *ER*, external rotation; *IR*, internal rotation; *CMS*, Constant-Murley score; *UCLA*, University of California, Los Angeles; *VAS*, visual analog scale.

patients (80%) were satisfied with the procedure. The 2 remaining cases had LPDS for 52 and 56 weeks, and both evolved with poor functional outcomes and severe glenohumeral degenerative joint disease. Although shoulder arthroplasty was indicated in both cases, neither patient consented to the operation. There were no cases of recurrent dislocation, infection, or neurologic injury.

Discussion

Isolated posterior dislocation of the shoulder occurs rarely and is challenging to manage. Delayed diagnosis and treatment can have serious deleterious effects on shoulder function.[26] The management of posterior shoulder dislocation depends on the size of the bone lesion, duration of the dislocation, and age of the patient.[3,4,10,22,31] A delay in diagnosis of an LPDS of up to 3 weeks is regarded as acute by some authors. In our series, we defined chronic cases as those with a delay in diagnosis $>$ 6 weeks.[5,10,15,19,22,23] Chronic cases are usually associated with larger bone lesions and not amenable to closed reduction.[5,27,35] Once the decision has been made to perform an open reduction, usually in the presence of a significant reverse Hill-Sachs lesion (20%-40%), the modified McLaughlin procedure is our treatment of choice.

In 1952, McLaughlin[25] described an open tenodesis procedure by transposing the subscapularis into the anterior bony defect of the humeral head for patients with posterior dislocation. This procedure and various modifications are still the standard treatment for patients with LPDS and impression fractures of 20%-40% of the humeral head.[4,11,12,21,28] In 1987, Hawkins et al[21] described a modification of the McLaughlin technique by transferring a subscapularis tendon bone graft after osteotomy of the lesser tuberosity into the defect. The rationale of this procedure was to provide more secure fixation for the subscapularis tendon. Castagna et al[10] reported on a nonhomogeneous group of patients with LPDS treated with the modified McLaughlin procedure and concluded that it was a reproducible technique with good results at medium- and long-term follow-up, being possible to adopt this technique in cases older than 6 months or with humeral head defects up to 50%. In all cases, they performed temporary glenohumeral fixation with 2 K-wires for a 4-week period. In contrast to their study, temporary fixation was not performed in any of our patients.

Our study findings demonstrated that the modified McLaughlin procedure showed good results with a follow-up period $\geq$ 2 years. The results of this procedure were worse when there was a delay from injury to treatment $>$ 6 months. During surgery, it is not easy to evaluate the viability of the humeral head just by palpating the humeral cartilage. In doubtful cases, we believe that when the time between the dislocation and treatment is $>$6 months, another procedure should be considered. A systematic

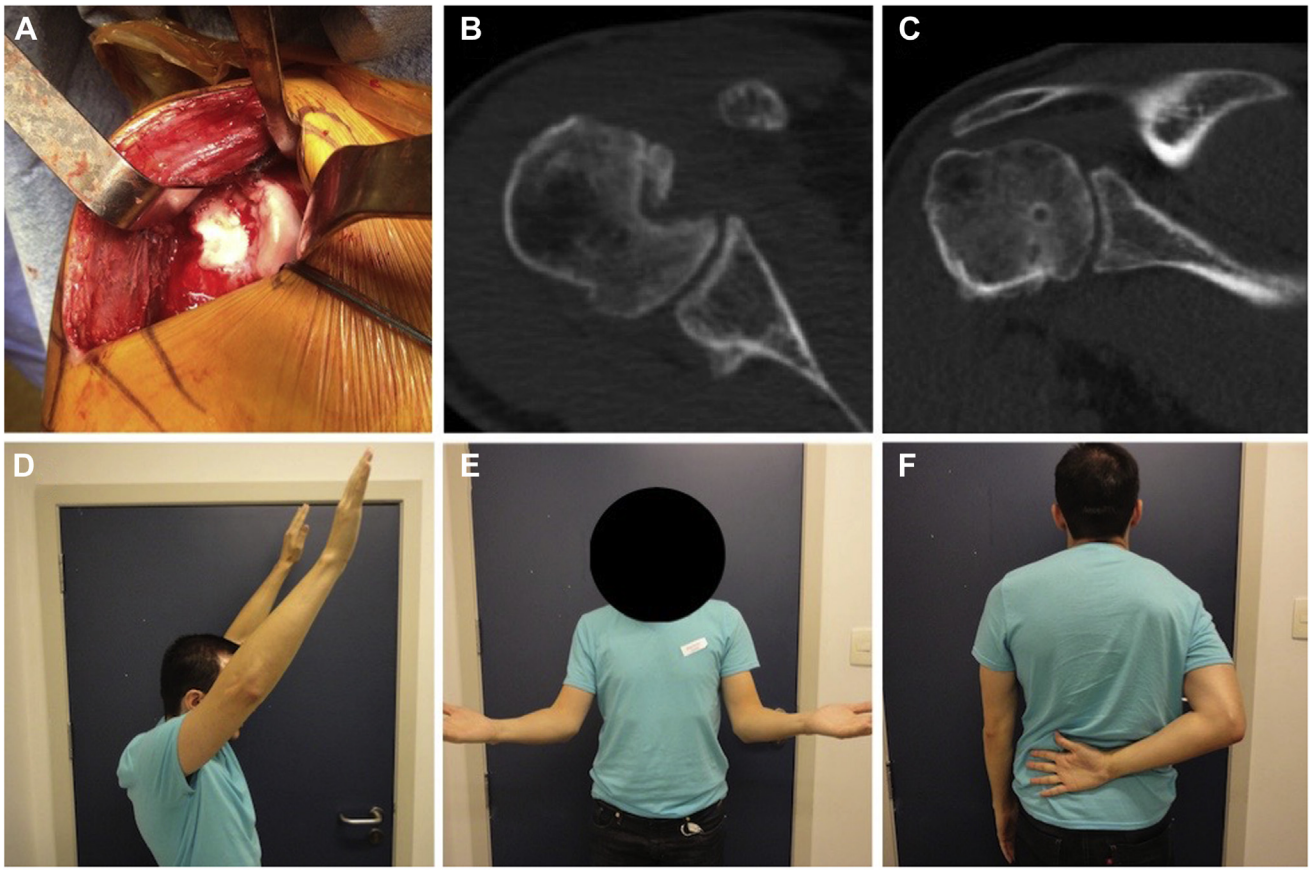

Figure 2 **(A)** Intraoperative photograph after humeral reduction showing a large reverse Hill-Sachs lesion of the right shoulder. **(B, C)** Immediate postoperative computed tomography scans showing the results of the modified McLaughlin procedure. **(D-F)** Good functional results of the right shoulder were observed 2 years after surgery.

Table II Preoperative and postoperative range of motion and functional results

	Preoperative	Postoperative	*P* value
FF, °	71 ± 5	126 ± 36	<.001
ER, °	7 ± 7	51 ± 18	.012
IR	Buttock ± 1 vertebral level	L1 ± 4 vertebral levels	.001
VAS score	4.6 ± 0.8	2.4 ± 1.3	<.001
CMS	22.0 ± 2.5	65.0 ± 21.5	<.001
UCLA score	9.8 ± 1.3	27.0 ± 9.8	<.001

FF, forward flexion; *ER*, external rotation; *IR*, internal rotation; *VAS*, visual analog scale; *CMS*, Constant-Murley score; *UCLA*, University of California, Los Angeles.
Data are presented as mean ± standard deviation.

review of the treatment of locked posterior dislocation has shown that when acute and chronic cases treated with the McLaughlin procedure were compared, the CMS values of acute LPDS cases were better.[5] According to the authors, the success of the McLaughlin procedure decreases as the time from injury to surgery increases.[5]

Checchia et al[13] reported their results of patients with defects from 20% to 50% and a time from dislocation < 6 months treated with either the McLaughlin technique or Neer modification. In their series, 9 cases, treated after 4 weeks, were re-evaluated after a mean period of 40.2 months. The mean UCLA score was 28.8, with 3 cases considered excellent; 4, good; 1, fair; and 1, poor. The case considered fair had a delay in diagnosis of 10 months. In the case classified as having a poor result, a postoperative infection and humeral head osteonecrosis developed.

Other strategies, such as arthroscopic stabilization, bone grafting, humeral rotational osteotomy, and arthroplasty, have been described.[4,5,14,17,27,34] Arthroscopic treatment of LPDS has evolved with different techniques to address reverse Hill-Sachs lesions. It is minimally invasive and allows treatment of concomitant intra-articular lesions but is likely to be more successful in the acute and subacute clinical scenarios.[33,34] Anatomic procedures with the goal to restore the original shape of the impressed humeral head using bone grafting techniques have been described, although there is no consensus on which patients this technique would be suitable for because of the lack of evidence in the literature.[7,16,20] Diklic et al[18] described the functional outcomes of 13 patients who had a chronic posterior dislocation of the shoulder with an associated impression fracture involving between 25% and 50% of the articular surface and underwent reconstruction of the humeral head with an osteochondral allograft. At follow-up, 9 patients had no pain or restriction of activities of daily living and their mean CMS was 86.8 (range, 43-98), with no cases of symptoms of instability of the shoulder. In 1 patient, with LPDS for 9 months before treatment, osteonecrosis of the humeral head developed; this patient had an unsatisfactory result. We attribute our lower mean CMS, when compared with the study by Diklic et al, to our 2 lowest scores (22 and 28).

Shoulder arthroplasty is usually reserved for cases with humeral defects $>$ 40% of the articular surface and the presence of severe arthritis or collapse of the humeral head during reduction. Wooten et al[35] reported the results of anatomic shoulder arthroplasty for the treatment of LPDS in patients with an impression fracture involving $>$45% of the humeral head. They documented that this procedure can provide pain relief and improve external rotation but with complications leading to a reoperation in more than one-quarter of the patients for a variety of reasons.

Only a few studies in the literature have described the treatment of chronic LPDS, mostly with a small number of cases. Nevertheless, the results reported from small patient series provide some guidance as to the appropriate treatment. One of the advantages of the described technique is its reproducibility, without the need for—and risks of—an allograft. Despite the fact that this technique was described $>$50 years ago, in our experience the McLaughlin technique is a good option for those chronic cases of LPDS and defects of $<$40% of the humeral head.

Conclusion

Our study findings demonstrated that the modified McLaughlin procedure showed good results over a 2-year minimum follow-up period in patients with LPDS. This technique has poor outcomes when used to treat cases with a delay from injury to treatment $>$ 6 months.

Disclaimers

The authors, their immediate families, and any research foundations with which they are affiliated have not received any financial payments or other benefits from any commercial entity related to the subject of this article.

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