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Locked posterior dislocation of the shoulder: A systematic review

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■ Locked posterior dislocation of the shoulder is very rare. Seizures and trauma are the most common causes of this injury.

■ There is no current benchmark treatment strategy for these rare cases.

■ This study has shown that reconstruction of the shoulder joint in an anatomical way in acute and chronic cases up to 16 weeks provides good results.

■ The purpose of this study is to evaluate the results of different treatment procedures with outcomes and to compare the results of the same procedures in acute and chronic cases.

Introduction

Locked posterior dislocation of the shoulder (LPDS) is an uncommon condition that is often misdiagnosed and becomes chronic due to an inadequate physical examination. LPDS cases include actual fracture-dislocations, impression fractures and isolated posterior dislocations without any fracture pattern.[1-3] Posterior fracture-dislocation of the shoulder (PFDS) is rare in orthopaedic practice, constituting only 2% to 4% of all shoulder dislocations, and its annual incidence is 0.6 in 100 000.[4,5] Impression fracture of the anteromedial humeral head (also called 'reverse Hill-Sachs lesion' [RHL]) is reported to occur in 40% to 90% of patients with an initial dislocation.[6,7] In addition to their rarity, what makes LPDS cases important is that they are easily missed. These cases are frequently missed in the initial examination as the occurrence of the dislocation is overlooked because urgent treatment of the seizure is the priority.[5,8] Cases that are diagnosed after three weeks are called 'neglected' PFDSs, while cases neglected for more than three weeks are called 'chronic' PFDSs.[9] When the literature is reviewed, almost all chronic PFDS cases were reported to be LPDSs.[10] However, the group of LPDS may include the cases of PFDS as well because it can only occur with a RHL. Thus, it is necessary to evaluate the surgical and conservative treatment results of two different patient groups separately. PFDS cases are classified by the number of fragments, as described by Neer.[11] According to this classification, the treatment results of fractures with three and four parts are not satisfactory. The number of fragments, the time elapsed from injury to surgery, age, treatment options and the experience of the surgeon all affect the results. There is no generally accepted approach for the treatment of neglected PFDS cases. However, the treatment is decided according to the amount of impaction (%) in isolated cases accompanied by the RHL. In these isolated cases, techniques such as the disimpaction of the fracture, lesser tubercle transfer, reconstruction with allograft and the filling of the defect are described.[12-15] Arthroplasty is preferred in cases in which 50% or more of the articular surface is affected.[16]

There is no gold standard treatment for LPDS and no specific study on the treatment algorithm has been published. This article provides a systematic review of the current literature, describes the diagnosis and discusses the different treatment options for LPDS.

Materials and methods

Posterior dislocation cases reported between 1987 and 2016 and accompanied by PFDS, as well as isolated RHLs, were included in this study. The PubMed, Web of Science and ScienceDirect databases were scanned for this purpose. Databases were searched using the term 'posterior dislocation and shoulder' in the title/abstract/keyword parts according to the Boolean operator scanning

Table 1. Inclusion/exclusion criteria

Inclusion criteria	Exclusion criteria
General adult population	Case reports/series with no details about patients (age, treatment, follow-up, results)
PFDS or RHL with 20% and over defect	Only observation or descriptive studies without follow-up
Cases with treatment and detailed result	Cases with shoulder instability or recurrence
Patients with a minimum of ten months follow-up	Review articles, radiological reports, technical notes
Interval between injury and treatment reported patients	Patients with glenoid bone loss or fracture
Original publications in English language	At least one of these scores not reported cases (CMS, ASES, Rowe, Neer, JOA)

LPDS, locked posterior dislocation of shoulder; PFDS, posterior fracture-dislocation of shoulder; RHL, reverse Hill-Sachs lesion; CMS, Constant-Murley score; ASES, American Shoulder and Elbow Surgeons; JOA, Japanese Orthopedic Association

Table 2. Etiological distribution of acute and chronic cases

LPDS	Seizure n (%)	Fall n (%)	RTA n (%)	Electrocution n (%)	Sports injuries n (%)
Acute cases	34 (45.9)	23 (31.1)	11 (14.9)	4 (5.4)	2 (2.7)
Chronic cases	52 (66.7)	14 (17.9)	5 (6.4)	6 (7.7)	1 (1.3)
Undetailed case series	80 (39.8)	73 (36.31)	31 (15.42)	17 (8.45)	0
Total	166 (47.02)	110 (31.16)	47 (13.31)	27 (7.64)	3 (0.84)

RTA: road traffic accidents

principles. The articles which were especially reported were those with numerical shoulder scores, such as Constant-Murley scoring (CMS). In total, 1120 articles were found in PubMed, 796 in Web of Science and 238 in ScienceDirect. Articles taken from all three databases were combined with Endnote X7 software. Duplicated publications were removed. The Endnote library was simplified according to the inclusion/exclusion criteria (Table 1). Articles in English for adult patients were included. Full-text scanning was made for 486 articles after the selection. The cases were divided into two groups according to our conformity criteria of acute or misdiagnosed/chronic. The articles were scanned with the words 'missed', 'neglected', 'chronic', 'overlooked', 'unreduced' and 'undiagnosed' in order to separate chronic or neglected cases. LPDSs that were diagnosed late were noted within the specified criteria. Finally, this study included 30 articles (111 cases) in the acutely treated LPDS group and 31 articles (91 cases) in the neglected LPDS group. In total, 104 neglected and 124 acutely treated shoulders were assessed according to the treatment and its results.

Statistical analysis

All data are expressed as means ± standard deviation (SD). Statistical analysis was performed using SPSS 20.0 (IBM, Chicago, IL, USA). Descriptive statistics are reported as the mean with the range for continuous measures and as the number and percentage of discrete measures. Independent samples t-test was used to compare acute and chronic groups. Non-parametric data were analysed by the Mann-Whitney U and Wilcoxon tests for two independent samples. K independent samples with the Kruskal-Wallis test was used to compare selected cases. The values of $p < 0.05$ were considered as significant.

Results

PFDS cases made up a major part of acutely treated LPDS cases. Of 124 acute LPDS that we included in our study, 94 (75.8%) were also PFDS. Only 20 shoulders (19.23%) in the chronic LPDS group were treated with the PFDS diagnosis. When LPDS cases are assessed aetiologically, the most frequent cause in both acute and chronic cases was a seizure. This was followed by falling and traffic accidents (Table 2). The seizure-related LPDS rate of incidence (66.7%) was higher in chronic cases than acute cases. There were 26 LPDS patients with bilateral involvement, 23 (88.46%) of which were attributed to seizures and three (11.64%) were caused by electric shock. We believe that seizure-related LPDS is frequently neglected in the first examination ($p = 0.021$). The other most frequent reasons for LPDS are falling (including indirect traumas), traffic accidents and electric shocks. Acute and chronic percentages are close (31.1% to 17.9%) in trauma-related LPDS cases, and this verifies that LPDS cases are fractures that can be easily neglected. LPDS cases can be missed in the initial examination independently of aetiology despite radiological and clinical findings.

The time from injury to surgery (TFIS) duration also affects the results of chronic LPDS treatment. However, whether the poor results are related to a time delay or the preferred method of treatment is not clear. The treatments and results of the cases included in the study are listed in Table 3. The cases in which two or more of the summarized treatment methods were applied together were named 'combined procedures' (e.g. open reduction and stabilization with modified McLaughlin procedure). In this study, the average TFIS was found to be 23.30 ± 41.68 weeks (3 to 344). Although LPDS cases with longer delay were reported in the literature, they were not included in

Table 3. Analysis of acute and chronic LPDS cases according to age, bilaterality, RHL, CMS and follow-up

	Age	Bilaterality n (%)	RHL (%)	CMS	Follow-up
Acute cases	43.87 ± 13.82	13 (23.7)	33.68 ± 11.06	83.54 ± 12.08	34.67 ± 23.33
Chronic cases	45.18 ± 12.02	13 (20.3)	38.97 ± 9.91	75.96 ± 16.95	40.19 ± 17.04

Table 4. The treatments and results of the cases included in the study

	Acute					Chronic						p-values
	n	RHL (%) Mean ± SD	Constant score Mean ± SD	Min-max. CMS	Follow-up (months)	n	TFIS (week)	RHL (%) Mean ± SD	Constant score Mean ± SD	Min-max. CMS	Follow-up (months)	
Arthroplasty (TSA/HA)	8	50 ± 8.16	59 ± 11.14	49-71	25.87 ± 24.99	17	65.59 ± 89.8	49.5 ± 5.5	60.61 ± 10.20	42-82	27.36 ± 14.49	0.885
Allograft/autograft fixation	10	37.5 ± 10.87	86.78 ± 3.60	83-95	48.2 ± 29.33	4	12.75 ± 8.62	40 ± 8.16	89.67 ± 3.51	86-93	35 ± 24.08	0.160
McLaughlin/modified McLaughlin procedure	5	29.4 ± 3.58	99.33 ± 1.15*	98-100	65.4 ± 26.84	28	15.61 ± 15.27	34.83 ± 5.42	78.40 ± 10.71	60-86	23.57 ± 10.92	0.023*
Modified McLaughlin procedure + graft fixation	0					7	8.43 ± 6	39.29 ± 6.73	83.5 ± 5.36	77-90	22.43 ± 4.96	
Balloon expansion + PMMA injection	1	NR	84.5	84.5	24	2	3	30	79 ± 1.41	78-80	22	
Glenoid augmentation + graft	0					8	21.37 ± 9.91	39.25 ± 11.27	77.5 ± 18.08	55-98	43 ± 8.7	
Rotational osteotomy	0					9	21.56 ± 17.98	30.56 ± 7.26	71.67 ± 18.87	40-90	21.67 ± 6.95	
Frozen spherical-shaped allograft	1	35	†		12	25	14.32 ± 9.08	40.8 ± 8.12	79.52 ± 18.90	40-100	81.72 ± 33.43	
Combined procedures	3	NR	90.33 ± 6.35	83-94	24	1	12	30	69	69	36	
Closed reduction (with or without pin fixation)	19	24.83 ± 4	85 ± 15.11	58-100	38.63 ± 27.67	2	6 ± 2.83	20	100	100	48	
Anatomic reconstruction with plate or K-wire fixation	67	NR	82.6 ± 11.24	16-100	28.79 ± 15.26	1	8	75%	NR		24	
Bioabsorbable screw reconstruction	2	45	92.5 ± 3.54	90-95	26	0						
Open reduction	8	NR	†		57.5 ± 33.18	0						
Total	124					104						

*there is a significant difference between groups (p < 0.05)
†improper result or outcome
TSA, total shoulder arthroplasty; HA, hemiarthroplasty; RHL, reverse Hill-Sachs lesion; SD, standard deviation; PMMA, polymethyl methacrylate; K, Kirschner; CMS, Constant-Murray score; TFIS, time from injury to surgery; NR, not reported

the study since they did not fit our inclusion criteria. Of 104 late-diagnosed shoulders, 75 (72.11%) were diagnosed within 16 weeks of the injury.

The average CMS of the missed LPDS cases operated within weeks 3 and 16 was 79.09 ± 15.72 (mean 52) and the score of those that were operated after week 16 was 67.83 ± 18.72 (mean 20). There was a significant difference between both groups and this difference resulted from the group that was operated between weeks 3 and 16 (p = 0.022). Upon investigating the preferred treatment options and results in acute and chronic LPDS cases, arthroplasty cases affected the results negatively in both groups (Table 4). When different treatment methods in chronic LPDS cases were compared, while there was no significant difference between those to which arthroplasty was applied and those to which rotational osteotomy was

applied (p = 0.134); a statistical difference was found between the arthroplasty group and other treatment methods (p < 0.05). There was a significant difference between chronic LPDS cases treated with open reduction and allograft/autograft and the group in which rotational osteotomy was applied (p = 0.023). When the treatment results in the acutely treated group were compared, the CMS of the cases treated with open reduction and allograft/autograft had significantly higher scores when compared with those to which anatomical reconstruction with a plate or K-wire was applied (p = 0.018). On the other hand, no significant difference was found between the cases in which closed reduction was applied in the acutely treated group and the cases anatomically reconstructed with a plate or K-wire (p = 0.26). PFDS cases to which only open reduction (without fixation) was applied in the acute
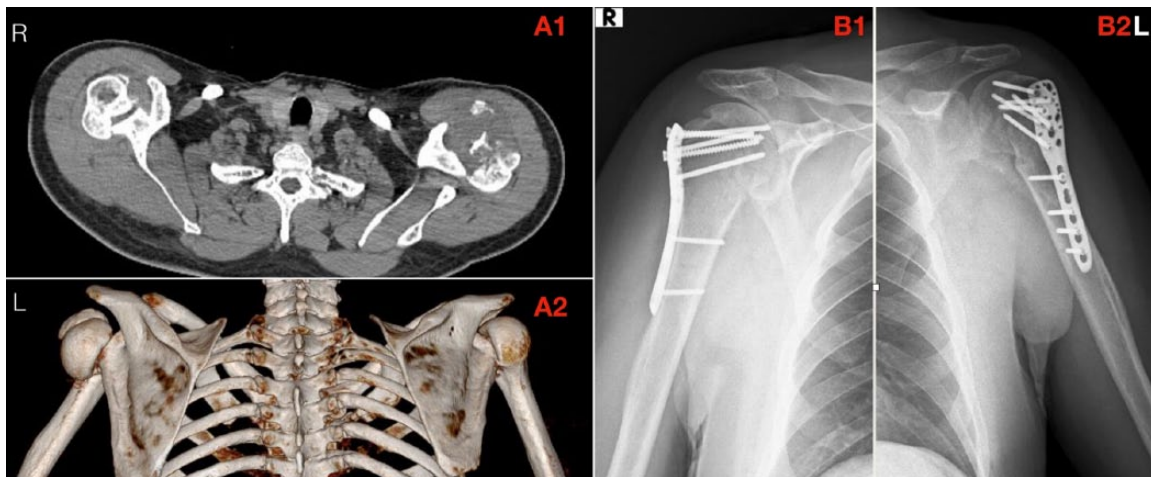
Fig. 1 Pre-operative axial and three-dimensional tomography scans (A1, A2) and post-operative radiographs of the both shoulders at 24 months (B1, B2 / R, right; L, left) of a 37-year-old male who sustained an LPDS during a seizure and was treated at the fifth week after injury.

LPDS group are summarized in Table 3. The results of this treatment, especially in dislocations with two- and three-part fractures, were reported to be excellent and satisfactory, but precise comparison could not be made since they had no CMS (Table 3).

There are common treatment methods recommended in both acute and chronic LPDS cases. These are the McLaughlin procedure, filling of the Hill-Sachs defect with allograft/autograft, balloon expansion + polymethyl methacrylate injection, closed reduction and arthroplasties. Of these treatment methods, only the McLaughlin procedure yields better results in acute cases (p = 0.023). Other treatment methods yield similar results in acute and chronic LPDS cases. Thirty-five acute LPDS cases treated with anatomical reconstruction fixed with a plate or K-wire were compared with 25 chronic LPDS cases treated with a spherical-shaped allograft obtained from the femoral head. No statistically significant difference was found between these two treatment groups (p = 0.869) (Table 5).

In chronic LPDS cases, no significant difference was observed between the results of the treatment performed using a graft and without using a graft in addition to the modified McLaughlin procedure (p = 0.460). Re-dislocation was observed in two cases of both groups. While avascular necrosis (AVN) is observed more frequently in acute cases despite being dependent on the treatment options, allograft flattening and arthritis were observed more in chronic cases.

Discussion

It is generally difficult to diagnose LPDS and it is frequently missed in the initial evaluation. Although the misdiagnosis rates were reported to be in the range of 60% to 80%, it was found to be 51% in our study.[62] Shoulder dislocations can be divided into two: locked shoulder dislocations and unstable shoulders.[64] Significant symptoms may occur such as swelling, pain and limitation of movement in the shoulder after injury. The most frequent reason for misdiagnosis is that anteroposterior (AP) radiographs are usually normal. Focusing on the seizure and not asking for the AP radiograph in PFDS cases with no direct trauma can cause misdiagnosis.

Seizures, falling/indirect trauma, traffic accidents, electric shocks and sports injuries, respectively, are the causes.[62,64,65] Although seizure cases usually develop in an epileptic background, these seizures can rarely be seen in hypoglycaemic coma, vitamin D deficiency, aortic dissection, brain tumour and idiopathically.[33,35,60,66,67] Higher rates of seizure-related chronic LPDS (66.7%) can be explained by the under-diagnosis of these cases. LPDS cases are a subset of posterior shoulder dislocations and they include cases with PFDS and isolated reverse Hill-Sachs defect. Although such a differentiation is not made in the literature, a major part (75.8%) of acute cases was made up of PFDS cases in our study. LPDS cases with PFDS and isolated RHL require different treatment procedures. No clear treatment algorithm has been suggested in PFDS cases when choosing the treatment according to the size of the defect in isolated RHL cases.

Closed reduction (with or without pin fixation), open reduction, open reduction and internal fixation (ORIF), ORIF + bone grafting and hemiarthroplasty are the preferred methods in the treatment of acute PFDS.[5,11,40,41,54] Total shoulder prosthesis, McLaughlin procedure, spherical-shaped allograft fixation, glenoid augmentation and ORIF are certainly the preferred treatment methods in chronic PFDS;[7,10,14-16] however, objective data for each

Table 5. Shoulders with acute or delayed diagnosis and authors' treatment procedures

Author	Shoulder (N)	Treatment option	Diagnosis
Kokkalis et al[14]	6	Modified McLaughlin technique + allograft	Delayed
Martinez et al[15]	6	Spherical-shaped femoral head allograft fixation	Delayed
Aksekili et al[10]	7	Glenoid augmentation with autograft	Delayed
Diklic et al[2]	13	Spherical-shaped femoral head allograft fixation	Delayed
Keppler et al[17]	9	Rotational osteotomy	Delayed
Shams et al[7]	11	Modified McLaughlin technique + grafting	Delayed
Cheng et al[16]	7	Total shoulder arthroplasty	Delayed
Abdel-Hameed et al[9]	3	Modified McLaughlin technique + grafting	Delayed
Gavriilidis et al[18]	3	Shoulder arthroplasty	Delayed
Gerber and Lambert[19]	4	Spherical-shaped femoral head allograft fixation	Delayed
Elmali et al[20]	2	Spherical-shaped femoral head allograft fixation	Delayed
Benhamida et al[21]	2	Modified McLaughlin technique + grafting	Delayed
Amir et al[22]	2	McLaughlin technique	Delayed
Jacquot et al[13]	2	Balloon expansion and PMMA injection	Delayed
Rodia et al[23]	1	Allograft fixation	Delayed
Ivkovic et al[24]	2	Autograft fixation/Hemiarthroplasty	Delayed
Bock et al[5]	1	Allograft/Autograft fixation	Delayed
Verma et al[25]	1	Closed reduction	Delayed
Bekmezci and Altan[26]	1	Modified McLaughlin technique + grafting	Delayed
Kumar et al[27]	1	Combined procedures*	Delayed
Chalidis et al[28]	1	Modified McLaughlin technique + grafting	Delayed
Takase et al[29]	1	Hemiarthroplasty	Delayed
Karachalios et al[30]	1	Open reduction and posterior capsular reconstruction	Delayed
Tellisi et al[31]	2	ORIF/CR	Delayed
Dervin et al[32]	1	Modified McLaughlin technique + grafting	Delayed
Aparicio et al[33]	2	Modified McLaughlin technique + grafting	Delayed
Poyanli et al[34]	2	Hemiarthroplasty/Modified McLaughlin technique	Delayed
Torrens et al[35]	2	Allograft/Autograft fixation/Hemiarthroplasty	Delayed
Kılıçoğlu et al[36]	2	Hemiarthroplasty	Delayed
Popelka[37]	1	Total shoulder arthroplasty	Delayed
Delcogliano et al[38]	4	Modified McLaughlin/McLaughlin technique	Delayed
Begin et al[39]	2	Allograft/Autograft fixation	Acute
Khayal et al[40]	1	Allograft/Autograft fixation	Acute
Altan et al[6]	1	Allograft/Autograft fixation (mosaicplasty)	Acute
Duralde and Fogle[41]	4	Closed reduction	Acute
Bock et al[5]	5	Allograft/Autograft fixation	Acute
Cooke and Hackney[42]	2	Hemiarthroplasty	Acute
Fukuda et al[43]	1	Anatomic reconstruction with plate or K-wire fixation	Acute
Claro et al[44]	4	Anatomic reconstruction with plate or K-wire fixation Hemiarthroplasty Closed reduction and pin fixation	Acute
Miller and Lynch[45]	3	Modified McLaughlin technique + grafting	Acute
Iosifidis et al[46]	2	Closed reduction	Acute
Assom et al[47]	2	OR and bioabsorbable screw fixation	Acute
De Wall et al[48]	3	Closed reduction and pin fixation	Acute
Ide et al[49]	1	Anatomic reconstruction with plate or K-wire fixation	Acute
Hayes et al[50]	1	Anatomic reconstruction with plate or K-wire fixation	Acute
Altay et al[51]	10	Anatomic reconstruction with plate or K-wire fixation	Acute
Soliman and Koptan[12]	21	Anatomic reconstruction with plate or K-wire fixation	Acute
Fiorentino et al[52]	5	Anatomic reconstruction with plate or K-wire fixation Combined procedures*	Acute
Robinson et al[3]	28	Anatomic reconstruction with plate or K-wire fixation	Acute
Martens and Hessels[53]	2	Anatomic reconstruction with plate or K-wire fixation Hemiarthroplasty	Acute
Finkelstein et al[54]	2	Modified McLaughlin technique	Acute
Ogawa et al[55]	10	OR/CR	Acute
Page et al[56]	2	Hemiarthroplasty	Acute
Oakes and McAllister[57]	1	Anatomic reconstruction with plate or K-wire fixation	Acute
Jacquot et al[13]	1	Balloon expansion and PMMA injection	Acute
Ketenci et al[58]	2	CR	Acute
Aparicio et al[33]	4	CR	Acute
Ito et al[59]	1	Hemiarthroplasty	Acute
Toker et al[60]	1	Allograft/Autograft fixation	Acute
Riggenbach et al[61]	1	Hemiarthroplasty	Acute
Mastrokalos et al[62]	1	Spherical-shaped femoral head allograft fixation	Acute

*combined procedures: open reduction and stabilization with modified McLaughlin procedure
OR, open reduction; CR, closed reduction; PMMA, polymethyl methacrylate; K, Kirschner

Table 6. Distribution of complications according to the groups

	Acute LPDS	Chronic LPDS
Avascular necrosis	6	2
Allograft collapse	1	3
Allograft flattening	1	10
Redislocation	2	2
Nonunion	1	-
Arthrosis/stiffness	-	7
Total	11/124 (8.87%)	24/104 (23.07%)

method are not yet ensured since there are no large case series for each treatment method.

In this review, no difference was found between acute and chronic cases in which the RHL was filled with allograft or autograft independently of the percentage of the defect. The spherical femoral head allograft (SSFHA)-treated shoulders were also compared with allograft/autograft fixed group. The difficulties in supplying and the cost of frozen femoral head allografts are also a disadvantage. This analysis showed that there was no significant difference between those treated using the femoral head allograft and standard allo/autograft (p = 0.413). When acute and chronic cases treated with the McLaughlin procedure were compared, it was observed that the CM scores of acute LPDS cases were better (p = 0.023). According to this result, the success of the McLaughlin procedure decreases as TFIS increases. No difference was observed between acute and chronic groups in the case series treated using arthroplasty and allograft/autograft (Table 4).

The SSFHA was used in two different neglected LPDS case series by Diklic et al and Gerber and Lambert.[2,18] Although the average CM scores of this method applied in cases with a defect in the range of 20% to 60% in reported studies are satisfactory, the complication rates are high. The SSFHA procedure may not be a good option considering its cost and complication rates.

There was no significant difference between chronic LPDS cases that are treated with rotational osteotomy or arthroplasty among the different treatment options (p = 0.134). Nine LPDS cases reported by Keppler et al were treated with rotational osteotomy.[17] The average Rowe score of nine cases in total was found to be 71.67 ± 18.87. Although the average HSL (Hill-Sachs Lesion) is less when compared to other chronic LPDS treatment groups, rotational osteotomy results were found to be lower. It was considered that this treatment method is not a good treatment option for chronic LPDS cases, but it can be an alternative to hemiarthroplasty cases.

The acutely treated LPDS group was made up of PFDS cases at a rate of 75.8%. Cases treated with anatomical reconstruction and internal fixation in this group were three- and four-part fracture-dislocations. Cases treated with closed reduction (with/without pin fixation) mainly consisted of two- and three-part fracture-dislocations. No

statistically significant difference was found between the treatment results of these two groups (p = 0.260). On the other hand, excellent and satisfactory results were obtained in the group including acute PFDS cases to which only open reduction was applied. The results of this group could not be compared with other groups since they were not scored over 100. Consequently, six humeral head AVNs that developed in acute LPDS cases were observed in the groups to which only open reduction was applied. The fact that AVN complication is observed more in cases to which open reduction is applied may be due to its containing three- and four-piece fractured dislocation cases and surgeon-related factors. Liu et al reported on a series of 18 patients with malunited chronic PFDS who were treated with anatomical reconstruction.[69] They reconstructed two-part (lesser tubercle) malunited fracture dislocations, and after a mean follow-up of 38.1 ± 16.5, the mean CMS was 83.9 ± 8.3. In our study, no sufficient data were found on the treatment of malunited PFDS cases with anatomical reconstruction and internal fixation in the chronic LPDS group. However, it was reported that performing osteotomy, anatomical reconstruction and fixation suitable for the fracture line in malunited PFDS cases would not constitute risk of AVN (Table 6).[68]

The biggest challenge encountered in the planning of this review is that the treatment methods and assessment methods applied differ significantly. Forty-four different outcome scores in total, 22 of which were clinician-based and 21 of which were patient-based, were defined in the literature.[69] The scoring methods in which scoring is performed over 100 were found to be CMS, ASES (American Shoulder and Elbow Surgeons), Rowe, Neer and Japanese Orthopaedic Association scores.[1,15,50,70] The most widely used study results scored over 100 were included in this study.

When the treatment results of chronic LPDS cases are examined in detail, successful results are obtained in the cases operated in the first 16 weeks, while a decrease occurs in the CM scores of the cases treated after 16 weeks. In late diagnosed cases, it was reported that the shoulder can be anatomically reconstructed up to six months.[5,8] In this study, we found the treatment results after four months to be 67.83 ± 18.72.

The modified McLaughlin technique is a frequently used technique for cases with an HSL in the range of 25% to 50%.[7,9,13,34] The defect is filled by the osteotomized lesser tubercle with this technique. A graft can be added to the modified McLaughlin procedure according to the size of the defect.[13] In the series of cases reported by Castagna et al, 16 cases with a defect in the range of 20% to 50% (41.9 years on average) were treated with the modified McLaughlin technique.[8] The average times of delay of these cases were reported to be 5.7 months and the average CMS were reported to be 75.2. The results of this case

series in which no complication is observed are lower when compared with our review data. In this technique, it is seen that joint ranges of motion theoretically decrease. The modified McLaughlin procedure may yield less successful results in PFDS cases. On the other hand, shoulder instability may develop in active individuals as a result of the changes in the tendon length in the long term, just as in the Magnuson-Stack procedure.[71]

Post-treatment complication rates were found to be 8.87% in acute LPDS cases and 23.07% in chronic LPDS cases. The most frequent complications of shoulder fracture-dislocations are AVN, secondary osteoarthritis and shoulder stiffness.[72]

Conclusions

LPDS has a complex injury pattern which includes PFDS, RHL and isolated PDSs. The number of bony fragments, time lapsed from injury to surgery, age, chosen treatment and the experience of the surgeon all affect the results. The strategy in delayed case series of reconstructing the shoulder joint in an anatomical way within a diagnostic delay period of up to 16 weeks instead of opting for a shoulder arthroplasty seems to be a promising one, knowing the outcome of shoulder arthroplasty. Reconstruction should be attempted to retain the humeral head and restore its shape primarily in delayed PFDS cases if potential signs of AVN are absent. Also, the surgeon should keep in mind that arthroplasty treatment as a salvage procedure has many pros and cons and should be selected very carefully.

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ICMJE CONFLICT OF INTEREST STATEMENT
None declared.

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