The outcome measure of proximal humerus fracture treated by open reduction and internal fixation with proximal humerus internal locking system based on oxford shoulder score

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ABSTRACT

Objective: Proximal humerus fractures became one of the most prevalent upper extremity fractures during recent decades. The use of scoring systems has been taken under consideration to estimate the surveillance, prognosis, and post-operative outcomes. During this study, we investigated the outcome measure of proximal humerus fracture treated by open reduction and internal fixation (ORIF) with plate based on oxford shoulder score (OSS). Furthermore, we tried to propose a new classification system for OSS that could be of prognostic value.

Methods: Patients with proximal humerus fracture treated by open reduction enrolled in the study. Persian version of the OSS was completed by the patients. Data were analyzed using SPSS-22.

Results: Forty-four patients including 24 women and 20 men were assessed. The mean age was 54.61 (SD ± 19.371) years. The use of a spoon and fork at the same time had the best score and hanging the clothes up in a wardrobe with the operated hand had the worst score in the questionnaire. Comparison of OSS and number of physiotherapy session showed that patients with best outcome had least number of physiotherapy's session, but it was not statistically significant.

Conclusion: OSS is useful to evaluate the function of the traumatized shoulder. We suggest classifying the OSS score into three range groups, good (total score 12–28), moderate (total score 29–44), and bad (total scores 45–60).

Keywords: Internal fixation, oxford shoulder score, proximal humerus fracture, shoulder, treatment outcome

Introduction

Proximal humerus fracture is one of the most prevalent fractures. It is the second prevalent fracture among shoulder girdle fractures and accounts for about 4% of all fractures and 50% of all humerus fractures.[1-5] The mean age for proximal humerus fracture is about 63 years; women are more amenable than men.[6-12] As most of these case occurs during the elderly and after falling, and also because the displacement of such fractures is low, non-operative treatment is acceptable.[13] However, in patients with humeral head displacement, head-splitting, greater tuberosity displacement, excessive varus and valgus, or multiple traumas and open fractures, open reduction and internal fixation (ORIF) with proximal humerus internal locking system (PHILOS plate) is preferred.[14] Most such indications are accepted for high energy traffic injuries and youth. As most the proximal humerus fractures occur at old age and even among young patients, most of the fractures fulfill non-operative criteria, the proportion of patients that need ORIF is low.

The outcome of non-operative treatment is good, and excellent results are expected in 80–90% of patients. Of course, some studies reported less successful results.[15-17]

Scoring systems are widely used for the assessment of fractures outcomes.[18] Oxford Shoulder Score (OSS) is a strong scoring system used worldwide.[19] OSS includes 12 questions. Each question has five scores (1–5) that grade one is the best; then a total score of 12 is the best possible score.[20] The Persian

version of OSS is validated and reported by Ebrahimzadeh *et al.*[21] We designed this study to evaluate the outcomes of proximal humerus fracture treated by PHILOS based on OSS. OSS has been studied on patients on the results of rotator cuff repair surgery or shoulder joint arthroplasty in patients with chronic shoulder disease. These studies compare the results of surgery compared to before surgery. In fracture patients, surgical intervention is compared to non-surgical treatment. However, no study can predict the prognosis of patients' treatment based on OSS. In this study, we suggest a classification system for OSS that could be of prognostic value.

Methods

This cross-sectional analytical study was done during September 2018–December 2019. According to the hospital archive, about 63 patients underwent ORIF with proximal humerus locking plate. Exclusion criteria were patients denied cooperation in the study, history of cerebrovascular attack, and any other physical impairment other than fracture of the proximal humerus. The fracture was fixed with a proximal humerus locking plate through a deltopectoral approach. After taking Institutional Ethical Committee approval, all patients' telephone numbers were extracted from their files. The researcher who was blind to the patients contacted them and explained the study process. After obtaining the patients' consent, age, sex, duration of immobility, and the number of physiotherapy sessions (based on patient reminders) were collected and recorded. Furthermore, patients completed the OSS questionnaire by telephone interview. OSS consists of 12 questions that each question has five scores (score one have the best function); therefore, out of 60 total points, the best score is 12. We used the Persian version of this questionnaire.[21] All data were transferred into SPSS-22 software and analyzed by one-way ANOVA and Chi-square tests. Furthermore, we used the Shapiro–Wilk test to determine the normalcy of some variables.

Results

During 2014–2019 based on the hospital electronic system, 63 patients were gone under ORIF of proximal humerus fracture using proximal humerus locking plate. Two patients died, one could not answer the questionnaire due to Alzheimer's disease, and ten did not answer the phone. Of the remaining 50 patients, six other patients excluded from the study. One has a history of myasthenia gravis, one has spinal cord injury, three had a cerebrovascular accident, and one patient was bedridden due to old age and hip fracture.

Totally 44 patients, 24 women (54.5%) and 20 men (45.5%) entered this study. No one had any history of shoulder disease or trauma before their surgery. Eight patients (18.2%) had diabetes type 2, two (4.5%) history of epilepsy, 13 (29.5%) history of fracture in other limbs, and three patients (6.8%) had surgical site infection.

None of the 44 patients included in the study underwent reoperation due to first surgery complications. One excluded patient (due to CVA) was re-operated due to shoulder stiffness about 10 months after primary surgery.

About the mechanism of injury, 61.4% (27 patients) of fractures was due to road traffic accidents, 34.1% (15 patients) was after falling, and in two patients was (4.5%) after the falling of an object on the shoulder.

Table 1 indicates the mean ± SD of age, period of immobilization, and numbers of physiotherapy sessions.

The best function based on OSS was for using a knife and fork – at the same time. About 79.5% of patients had good scores for this question. Similarly, the function of patients in getting in and out of a car or using public transport was good in 70.5% of patients. Household shopping for seven patients was impossible; this function took the worst scores in patients [Table 2].
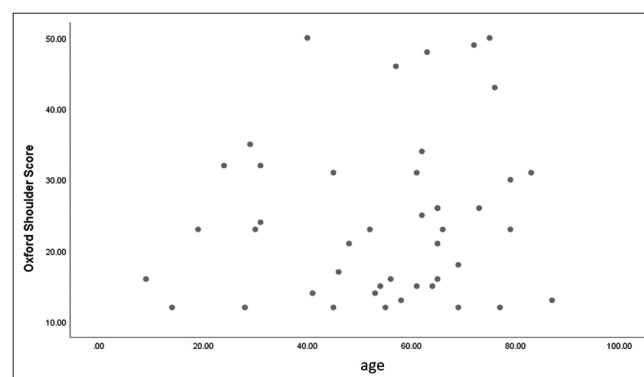
The age distribution of OSS scores [Figure 1] shows that patients older than 40 years had scores higher than 40.

In patients with fractures, we had no pre-operative OSS score, so we could not interpret the post-operative score of patients. Then, we decided to classify the score, in the hope that we could get a better picture of the patient's condition. Then for comparison, we made two classification systems for OSS. In the first classification, we divided the scores into good (scores: 12–36) and bad (scores: 37–60). In another classification system, three groups of good (scores: 2–28),

Table 1: Mean±SD of age, period of immobilization and sessions of physiotherapy

Variable	Mean	Standard deviation	Lowest	Highest
Age	54.61	19.37	19	87
Period of immobilization	2.39	1.18	1	6
Sessions of physiotherapy	18.34	16.94	0	70

SD: Standard deviation

Figure 1: Age distribution of oxford shoulder score

Table 2: Scores of each question of OSS questionnaire in patient with proximal humerus fracture treated by ORIF

Question	Score 1 N (%)	Score 2 N (%)	Score 3 N (%)	Score 4 N (%)	Score 5 N (%)
1. How would you describe the worst pain you had from your shoulder?	None 15 (34.1%)	Mild 6 (13.6%)	Moderate 17 (38.6%)	Severe 6 (13.6%)	Unbearable 0
2. Have you had any trouble dressing yourself due to your shoulder?	No trouble at all 20 (45.5%)	A little bit of trouble 14 (31.8%)	Moderate trouble 5 (11.4%)	Extreme difficulty 4 (9.1%)	Impossible to do 1 (2.3%)
3. Have you had any trouble getting in and out of a car or using public transport due to your shoulder?	31 (70.1%)	6 (13.6%)	4 (9.1%)	3 (6.8%)	0
4. Have you been able to use a knife and fork – at the same time?	Yes, easily 35 (79.5%)	With little difficulty 5 (11.4%)	With moderate difficulty 2 (4.5%)	With extreme difficulty 2 (4.5%)	No, impossible 0
5. Could you do the household shopping on your own?	18 (40.9%)	10 (22.7%)	7 (15.9%)	2 (4.5%)	7 (15.9%)
6. Could you carry a tray containing a plate of food across a room?	27 (61.4%)	9 (20.5%)	1 (2.3%)	3 (6.8%)	4 (9.1%)
7. Could you brush/comb your hair with the affected arm?	20 (45.5%)	11 (25%)	6 (13.6%)	3 (6.8%)	4 (9.1%)
8. How would you describe the pain you usually had from your shoulder?	None 20 (45.5%)	Mild 10 (22.7%)	Moderate 7 (15.9%)	Severe 6 (13.6%)	Unbearable 1 (2.3%)
9. Could you hang your clothes up in a wardrobe, using the affected arm?	Yes, easily 16 (36.4%)	With little difficulty 8 (18.2%)	With moderate difficulty 8 (18.2%)	With extreme difficulty 6 (13.6%)	No, impossible 6 (13.6%)
10. Have you been able to wash and dry yourself under both arms?	16 (36.4%)	10 (22.7%)	6 (13.6%)	6 (13.6%)	6 (13.6%)
11. How much has pain from your shoulder interfered with your usual work (Including housework)?	Not at all 15 (34.1%)	A little bit 12 (27.3%)	Moderately 10 (22.7%)	Greatly 7 (15.9%)	Totally 0
12. Have you been troubled by pain from your shoulder in bed at night?	No nights 22 (50%)	Only 1 or 2 nights 6 (13.6%)	Some night 9 (20.5%)	Most nights 3 (6.8%)	Every nights 3 (6.8%)

OSS: Oxford shoulder score, ORIF: Open reduction and internal fixation

moderate (scores: 29–44), and bad (scores: 45–60) were selected. Again, OSS scores were assessed based on these two classification systems. Furthermore, the relation between each scoring system and independent variables (sex, diabetes, duration of immobilization, and physiotherapy sessions) were analyzed [Tables 3-5]. There was no statistical relation between OSS scores and age, diabetes, duration of immobilization, and physiotherapy sessions in any classification systems ($P > 0.05$).

Discussion

The prevalence of proximal humerus fractures is increased during past decades.[22] Although most of the studies report favorable outcomes of non-operative treatment in non-displaced fractures, some prospective studies indicate considerable dysfunction after such treatment and about two-thirds of patients reported chronic pain.[15] About surgery, many studies reported equal outcomes to non-operative treatment but with higher cost and possible surgery complications.[23] Of course in some situations, the surgery is inevitable and should

be done. In this manuscript, we studied the outcome of surgical fixation of proximal humerus fracture based on the OSS.

Most present studies used OSS to assess the improvement of patients' function after a specific surgery. Patients filled the OSS questionnaire before and after the operation and improvement in score is analyzed. Olley *et al.*[24] used OSS to assess the results of rotator cuff repair. OSS was completed before and after surgery in certain intervals and the improvement in score is considered a good result. For patients with fractures, this type of follow-up is not possible and the first functional assessment could be possible after union and primary mobilization.

Nowak *et al.,* in a meta-analysis, suggested that three scoring systems of OSS, disabilities of the arm, shoulder, and hand (DASH), and American Shoulder and Elbow Surgeons (ASES) are the most helpful tools for assessing pain and disability of patients with proximal humerus fracture.[25]

Table 3: Relation between scores of OSS and diabetes, duration of immobilization and physiotherapy sessions based on two (good [scores: 12–36] and bad [scores: 37–60]) and three groups (good [scores: 2–28], moderate [scores: 29–44] and, bad [scores: 45–60]) of severity classification

Group (score)	OSS scores in three groups model			*P*-value
	Good (12–28)	Moderate (29–44)	Bad (45–60)	
Total	30 (68.2%)	9 (20.5%)	5 (11.4%)	
Sex				
Female	17 (56.7%)	5 (55.6%)	2 (40%)	0.78
Male	13 (43.3%)	4 (44.4%)	3 (60%)	
Diabetes				
Yes	4 (13.3%)	2 (22.2%)	2 (40%)	0.33
No	26 (86.7%)	7 (77.8%)	3 (60)	
Immobilization				
Mean±SD	2.13 (±1.04)	3.11 (±1.61)	2.6 (±0.54)	0.084
Physiotherapy sessions				
Mean±SD	16.73 (±16.19)	21.67 (±20)	22 (±18)	0.66
	OSS scores in two groups model			
	Good (12–36)	Bad (37–60)		
Total	38 (86.4%)	6 (13.6%)		
Sex				
Female	21 (55.3%)	3 (50%)		1
Male	17 (44.7%)	3 (50%)		
Diabetes				
Yes	6 (15.8%)	2 (33.3%)		0.29
No	32 (84.2%)	4 (66.7%)		
Immobilization				
Mean±SD	2.37 (±1.26)	2.5 (±0.54)		0.32
Physiotherapy sessions				
Mean ± SD	17.55 (±17.1)	23.33 (±16.42)		0.3

SD: Standard deviation, OSS: Oxford shoulder score

In a randomized multicenter clinical trial study in 2015, the surgery is compared to non-surgical treatment. Patients followed for 2 years. The OSS and SF20 scores did not show a significant difference between the two groups.[26] These results were confirmed again at 5 years follow-up.[27] In another study in 2019, during a historical cohort study, patients who underwent humerus proximal fracture surgery were evaluated. In this study, general results support surgery in proximal humerus fracture in younger and fit patients. This surgery has good long-term outcomes, although the rate of complications and the need for reoperation is relatively high; of course, some of these complications should be attributed to the nature of the fracture rather than surgery.[28]

In our study, the mean OSS scores in all patients were 22.45 that 26 patients (59.1%) had scored lower than mean scores, but 18 (40.9%) patients had higher scores.

Because in most of the studies improvement of OSS score was considered as an improvement in patients` function, there was no suggested range to help for the interpretation of the obtained score. The questions in OSS are not homogenous. Three questions

are related to pain, some questions evaluate the shoulder function and its movement in several directions during daily life. Then, it is possible that the patient has no problem or pain in slight movements, but by increasing the range of motion disability becomes obvious. As OSS calculates by the sum of each question score, better scores in questions that need no extreme motions can impact total scores and the interpretation of shoulder function too. In this study, we introduce a range for OSS aiming to predict the function, prognosis, and possible need for additional interventions.

In only one study,[18] the score 24 (based on a modified scoring system, in which scores patients from 1 (the worst) to 5 (the best), unlike traditional scoring of OSS that scores patients from 1 (the best) to 5 (the worst)) considered as an alarming cut point for arthroplasty and suggested that patients with scores under 24 should recall for more evaluation and assessing the need for surgical intervention.

We, in our study at first, divided the scores into two ranges of good (total scores 12–36) and bad (total scores 37–60) and assessed each question based on this classification. Then,

Table 4: Scores of each question of OSS in patient with proximal humerus fracture treated by ORIF based on three groups of severity classification (good [scores: 12-28], moderate [scores: 29-44] and, bad [scores: 45-60])

1. How would you describe the worst pain you had from your shoulder?					
Group \ Results	None	Mild	Moderate	Sever	Unbearable
Good	15 (50%)	5 (16.7%)	10 (33.3)	0	0
Moderate	0	1 (11.1%)	5 (55.6%)	3 (50%)	0
Bad	0	0	2 (40%)	3 (60%)	0

2. Have you had any trouble dressing yourself due to your shoulder?					
Group \ Results	No trouble at all	A little bit of trouble	Moderate trouble	Extreme difficulty	Impossible to do
Good	18 (60%)	10 (33.3%)	2 (6.7%)	0	0
Moderate	2 (22.2%)	3 (33.3%)	3 (33.3%)	1 (11.1%)	0
Bad	0	1 (20%)	0	3 (60%)	1 (20%)

3. Have you had any trouble getting in and out of a car or using public transport due to your shoulder?					
Group \ Results	No trouble at all	A little bit of trouble	Moderate trouble	Extreme difficulty	Impossible to do
Good	26 (86.7%)	3 (10%)	1 (3.3%)	0	0
Moderate	4 (44.4%)	3 (33.3%)	1 (11.1%)	1 (11.1%)	0
Bad	1 (20%)	0	2 (40%)	2 (40%)	0

4. Have you been able to use a knife and fork – at the same time?					
Group \ Results	Yes, easily	With little difficulty	With moderate difficulty	With extreme difficulty	No, impossible
Good	29 (96.7%)	1 (3.3%)	0	0	0
Moderate	5 (55.6%)	4 (44.4%)	0	0	0
Bad	1 (20%)	0	2 (40%)	2 (40%)	0

5. Could you do the household shopping on your own?					
Group \ Results	Yes, easily	With little difficulty	With moderate difficulty	With extreme difficulty	No, impossible
Good	17 (56.7%)	9 (30%)	3 (10%)	1 (3.3%)	0
Moderate	1 (11.1%)	1 (11.1%)	4 (44.4%)	0	3 (33.3%)
Bad	0	0	0	1 (20%)	4 (80%)

6. Could you carry a tray containing a plate of food across a room?					
Group \ Results	Yes, easily	With little difficulty	With moderate difficulty	With extreme difficulty	No, impossible
Good	23 (76.7%)	7 (23.3%)	0	0	0
Moderate	4 (44.4%)	2 (22.2%)	1 (11.1%)	1 (11.1%)	1 (11.1%)
Bad	0	0	0	2 (40%)	3 (60%)

7. Could you brush/comb your hair with the affected arm?					
Group \ Results	Yes, easily	With little difficulty	With moderate difficulty	With extreme difficulty	No, impossible
Good	19 (63.3%)	8 (26.7%)	2 (6.7%) 0	0	1 (3.3%)
Moderate	0	3 (33.3%)	4 (44.4%)	2 (22.2%)	0
Bad	1 (20%)	0	0	1 (20%)	3 (60%)

8. How would you describe the pain you usually had from your shoulder?					
Group \ Results	None	Mild	Moderate	Sever	Unbearable
Good	20 (66.7%)	9 (30%)	1 (3.3%)	0	0
Moderate	0	1 (11.1%)	5 (55.6%)	3 (33.3%)	0
Bad	0	0	1 (20%)	3 (60%)	1 (20%)

9. Could you hang your clothes up in a wardrobe, using the affected arm?					
Group \ Results	Yes, easily	With little difficulty	With moderate difficulty	With extreme difficulty	No, impossible
Good	16 (53.3%)	8 (26.7%)	5 (16.7%)	0	1 (3.3%)
Moderate	0	0	3 (33.3%)	5 (55.6%)	1 (11.1%)
Bad	0	0	0	1 (20%)	4 (80%)

(Contd...)

Table 4: (*Continued*)

| 10. Have you been able to wash and dry yourself under both arms?					
Group Results	Yes, easily	With little difficulty	With moderate difficulty	With extreme difficulty	No, impossible
Good	15 (50%)	9 (30%)	5 (16.7%)	1 (3.3%)	0
Moderate	1 (11.1%)	1 (11.1%)	1 (11.1%)	3 (33.3%)	3 (33.3%)
Bad	0	0	0	2 (40%)	3 (60%)
11. How much has pain from your shoulder interfered with your usual work (Including housework)?					
Group Results	Not at all	A little bit	Moderately	Greatly	Totally
Good	20 (66.7%)	4 (13.3%)	4 (13.3%)	2 (6.7%)	0
Moderate	3 (33.3%)	2 (22.2%)	4 (44.4%)	0	0
Bad	0	0	1 (20%)	1 (20%)	3 (60%)
12. Have you been troubled by pain from your shoulder in bed at night?					
Group Results	No nights	Only 1 or 2 nights	Some nights	Most nights	Every nights
Good	20 (66.7%)	4 (13.3%)	4 (13.3%)	2 (6.7%)	0
Moderate	3 (33.3%)	2 (22.2%)	4 (44.4%)	0	0
Bad	0	0	1 (20%)	1 (20%)	3 (60%)

OSS: Oxford shoulder score, ORIF: Open reduction and internal fixation

scores were divided into three ranges, good (total score 12–28), moderate (total score 29–44), and bad (total scores 45–60).

Our study population was 44 patients. This sample size makes the interpretation of our results difficult. Based on a statistical analysis, we found no relation between scores and sex, diabetes, duration of immobilization, and physiotherapy sessions. However, when comparing the categorized results for each question in the proposed range classification some interesting points could be seen. Results show that some patients in the moderate group have better scores in questions evaluate functions at a slight range of motions and this caused better total scores and hide the high scores in questions evaluate an extreme range of motions (for example, question no 9 on hanging clothes up in a wardrobe). Such patients were not satisfied with the surgery but had favorable scores.

When evaluating question-by-question, the best performance was related to the simultaneous use of knives and forks. Many patients with poor overall scores performed well on this question. Likely because the use of forks and knives is done with wrist and elbow movements and is possible in mild shoulder abductions. We can extend this interpretation to the question of getting in and out of the car (which most patients performed well).

Another interesting result is related to the efficacy of physiotherapy to improve shoulder function after proximal humerus fracture and surgical fixation. In the three-range classification, patients with better scores reported fewer physiotherapy sessions. Of course, no statistically significant relationship was found, but the clinical results were significant, which could be the subject of future studies with larger populations.
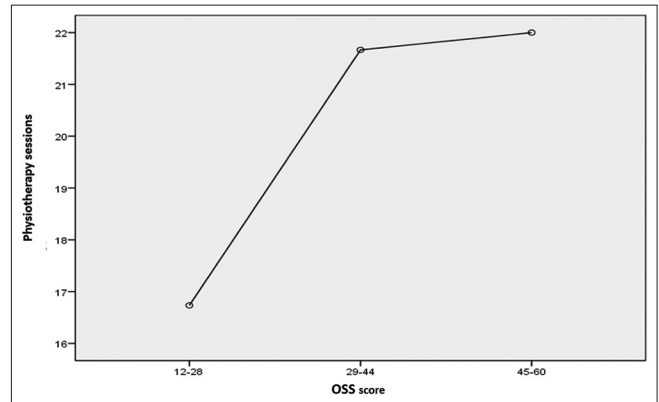
Figure 2: Relation between oxford shoulder score and physiotherapy sessions in three group classification system

In our view, these results suggest that post-fracture function is more closely related to fracture morphology and trauma mechanism. Figure 2 shows that patients in the "moderate" group had more physiotherapy sessions than the "good" group, and patients in the "bad" group had the highest number of physiotherapy sessions.

About demographic variables, previous studies indicated that only 15–30% of all proximal humerus fractures occur in men.[10] Our study also confirms the higher prevalence of such fractures in women (54.5%) and also shows that possibly men need surgical fixation more.

In our study population, the most prevalent cause of fracture was traffic accidents, while, in other studies, falling at home is more prevalent.[3] This difference could be related to our study design. Our population is patients that need surgical fixation. In this population group, high-energy traumas are predictable.

Table 5: Scores of each question of OSS in patient with proximal humerus fracture treated by ORIF based on two groups of severity classification (good [scores: 12–36] and bad [scores: 37–60])

1. How would you describe the worst pain you had from your shoulder?					
Group / Results	None	Mild	Moderate	Sever	Unbearable
Good	15 (39.5%)	6 (15.8%)	15 (39.5%)	2 (5.3%)	0
Bad	0	0	2 (33.3%)	4 (66.7%)	0

2. Have you had any trouble dressing yourself due to your shoulder?					
Group / Results	No trouble at all	A little bit of trouble	Moderate trouble	Extreme difficulty	Impossible to do
Good	20 (52.6%)	13 (34.2%)	5 (13.2%)	0	0
Bad	0	1 (16.7%)	0	4 (66.7%)	1 (16.7%)

3. Have you had any trouble getting in and out of a car or using public transport due to your shoulder?					
Group / Results	No trouble at all	A little bit of trouble	Moderate trouble	Extreme difficulty	Impossible to do
Good	30 (78.9%)	6 (15.8%)	2 (5.3%)	0	0
Bad	1 (16.7%)	0	2 (33.3%)	3 (50%)	0

4. Have you been able to use a knife and fork – at the same time?					
Group / Results	Yes, easily	With little difficulty	With moderate difficulty	With extreme difficulty	No, impossible
Good	33 (86.8%)	5 (13.2%)	0	0	0
Bad	2 (33.3%)	0	2 (33.3%)	2 (33.3%)	0

5. Could you do the household shopping on your own?					
Group / Results	Yes, easily	With little difficulty	With moderate difficulty	With extreme difficulty	No, impossible
Good	18 (47.4%)	10 (26.3%)	7 (18.4%)	1 (2.6%)	2 (5.3%)
Bad	0	0	0	1 (16.7%)	5 (83.3%)

6. Could you carry a tray containing a plate of food across a room?					
Group / Results	Yes, easily	With little difficulty	With moderate difficulty	With extreme difficulty	No, impossible
Good	27 (71.1%)	9 (23.7%)	1 (2.6%)	1 (2.6%)	0
Bad	0	0	0	2 (33.3%)	4 (66.7%)

7. Could you brush/comb your hair with the affected arm?					
Group / Results	Yes, easily	With little difficulty	With moderate difficulty	With extreme difficulty	No, impossible
Good	19 (50%)	11 (28.9%)	5 (13.2%)	2 (5.3%)	1 (2.6%)
Bad	1 (16.7%)	0	1 (16.7%)	1 (16.7%)	3 (50%)

8. How would you describe the pain you usually had from your shoulder?					
Group / Results	None	Mild	Moderate	Sever	Unbearable
Good	20 (52.6%)	10 (26.3%)	5 (13.2%)	3 (7.9%)	0
Bad	0	0	2 (33.3%)	3 (50%)	1 (16.7%)

9. Could you hang your clothes up in a wardrobe, using the affected arm?					
Group / Results	Yes, easily	With little difficulty	With moderate difficulty	With extreme difficulty	No, impossible
Good	16 (42.1%)	8 (21.1%)	8 (21.1%)	4 (10.5%)	2 (5.3%)
Bad	0	0	0	2 (33.3%)	4 (66.7%)

10. Have you been able to wash and dry yourself under both arms?					
Group / Results	Yes, easily	With little difficulty	With moderate difficulty	With extreme difficulty	No, impossible
Good	16 (42.1%)	10 (26.3%)	6 (15.8%)	4 (10.5%)	2 (5.3%)
Bad	0	0	0	2 (33.3%)	4 (66.7%)

11. How much has pain from your shoulder interfered with your usual work (Including housework)?					
Group / Results	Not at all	A little bit	Moderately	Greatly	Totally
Good	15 (39.5%)	12 (31.6%)	10 (26.3%)	1 (2.6%)	0
Bad	0	0	0	6 (100%)	0

12. Have you been troubled by pain from your shoulder in bed at night?					
Group / Results	No nights	Only 1 or 2 nights	Some nights	Most nights	Every nights
Good	22 (57.9%)	6 (15.8%)	8 (21.1%)	2 (5.3%)	0
Bad	1 (16.7%)	0	1 (16.7%)	1 (16.7%)	3 (50%)

OSS: Oxford shoulder score, ORIF: Open reduction and internal fixation

Conclusion

Based on this study, OSS is useful to evaluate the function of the traumatized shoulder. We suggest classifying the OSS score into three groups, good (total score 12–28), moderate (total score 29–44), and bad (total scores 45–60). We think this segmentation will help us better interpret the results, and it can also help us decide on the possible need for other interventions or predict the patient's prognosis. Assessing such a hypothesis requires further studies with a large study population. Prospective studies can help reduce some biases, such as reminder bias (e.g., recall of physiotherapy sessions), that may affect outcomes.

Authors' Declaration Statements

Ethical clearance

Ethical clearance was obtained from "Research Ethics Committees of Health Research Institute-Babol University of Medical Sciences" Babol, Iran. Reference Number is IR.MUBABOL.HRI.REC.1398.210

Consent to participant

Consent was taken from participants and the objective and details of the study were explained.

Consent for publication

All the authors of the study provide their consent for publication.

Availability data and materials

The data of this study are available and will be provided by the corresponding author on a reasonable request.

Competing interest

None to declare.

Funding statement

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Authors' Contributions

Mani Falsafi and Behnam Baghianimoghadam designed this study, Sara Altini collected the sample. Mahmood Hajiahmadi verified and analyzed the methodology, Masoud Bahrami-Freiduni and Yousef Fallah supervised the finding of this work. Seyed Mohammad Reza Esmaeilnejad-Ganji and Behnam Baghianimoghadam took the lead in writing manuscript. All authors discussed results and contribute to final manuscript.

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