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Atraumatic shoulder instability: patient characteristics, comorbidities, and disability

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Background: Atraumatic shoulder instability of the shoulder is well described, and numerous extrinsic factors have been identified as having a negative influence on long-term shoulder function, including age, sex, smoking, and workers' compensation status. Furthermore, physical factors such as acute or chronic pain, as well as psychological comorbidities such as depression and suicidal thoughts, are common in shoulder-related conditions.

Methods: Patients with atraumatic shoulder instability were recruited from a review of outpatient logbook and inpatient rehabilitation center admission records. Average and worst pain visual analogue scale rates were recorded for acute and chronic shoulder pain. Disability was measured using the "Disability of the Arm and Hand" score, as well as the Stanmore Percentage of Normal Shoulder Assessment (SPONSA). Depression was assessed using Becks Depression Inventory II, and further single psychological items were selected from other psychological assessment questionnaires.

Results: We included 64 patients, of which 51 (79.7%) were female. Mean visual analogue scale pain scores were in average 5.11 (standard deviation 2.24) and 5.58 (standard deviation 2.34) for acute and chronic shoulder pain, respectively. A stepwise, multiple linear regression revealed that only chronic shoulder pain remained significantly related to disability ($F(1,61) = 46.13, P < .001$). A second linear regression analysis was performed and showed a significant association between the overall Disability of the Arm, Shoulder and Hand score and overall Becks Depression Inventory score ($F(1,62) = 12.78, P < .001$). A further stepwise, multiple linear regression analysis indicated that chronic pain and depression remain independent variables in the prediction of disability.

Conclusion: In addition to sociodemographic factors, pain and psychological comorbidities were found to have a negative impact on patient's functional outcome. This study further supports the need for an multidisciplinary team, holistic approach in the management of atraumatic shoulder instability patients with particular emphasis on chronic pain management and psychological support.

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Atraumatic instability of the shoulder as a separate entity of shoulder instability was first described by Neer and Foster²² and further specified by others.^{2,3,20} It is commonly described as shoulder instability in two or more directions; however, nomenclature remains conflicting. It is understood that atraumatic shoulder instability accounts for 2%–10% of patients with shoulder

instability and is frequently caused by deficient static and dynamic stabilizers.¹² Physiotherapy is established as the first-line treatment^{7,21}; however open and arthroscopic stabilization operations are also reported with overall high recurrence, disability, and pain rates.^{8,19}

Recently numerous extrinsic factors, including age, sex, smoking, and workers' compensation status, have been identified having a negative influence on postoperative shoulder function and pain.²⁶ Furthermore, Hoffman et al¹⁵ and others^{6,27} have conceptualized that biopsychological factors such as depression are an important determinant for musculoskeletal pain intensity and disability. Cho et al⁹ have demonstrated the association among preoperative depression, increased postoperative disability, and high pain scores

The Institutional Review Board of the Royal National Orthopaedic Hospital has reviewed and approved this project (reference # 2016/17-35).

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in patients with rotator cuff injuries. Furthermore, physical factors such as acute or chronic pain, as well as psychological comorbidities such as depression and suicidal thoughts, are common in shoulder-related conditions,¹⁷ and genetic single-nucleotide polymorphisms in key genes such as *ADRB2*, *GCH1*, and *IL6* were associated with higher depression, anxiety, and pain rates in patients after shoulder surgery.¹³

This article is, to our knowledge, the first to describe detailed socioeconomic characteristics and disability levels in relation to acute and chronic pain levels, clinical and subclinical depression, and suicidal thoughts in atraumatic shoulder instability patients. Our hypothesis is that depression is negatively correlated with shoulder function. Our secondary aim was to evaluate the impact of contributing factors such as acute and chronic pain, self-harm and suicide attempts, and socio-economic characteristics on functional outcome in atraumatic shoulder instability patients.

Materials and methods

We recruited 64 symptomatic patients with atraumatic shoulder instability from our inpatient rehabilitation center admission records. Inclusion criteria were (1) age over 16 years and (2) symptomatic, atraumatic shoulder instability (including ongoing subluxation or dislocations, continuous shoulder pain or the need for continuous physiotherapy or orthopedic interventions). The diagnosis of atraumatic shoulder instability was established after clinical examination and magnetic resonance imaging, and diagnostic shoulder arthroscopy was commonly performed to rule out structural damage including labral injury. In addition, every patient was subsequently discussed during a multidisciplinary team (MDT) in the presence of senior surgeons of our shoulder and elbow unit as well as specialist physiotherapists to confirm the diagnosis and their suitability for our in-patient rehabilitation program, and the admission book of this rehabilitation unit was used for recruitment. Patients with bilateral instability, as well as postoperative patients, were included. A total of 237 patients were identified after screening of our records, of which $n = 95$ patients were uncontactable, $n = 13$ patients did not meet the inclusion criteria (ie, post-total shoulder replacement, glenohumeral joint fusion, asymptomatic), and $n = 129$ patients agreed to be contacted via post with the study protocol, a written consent form, and self-report questionnaires, alongside a prestamped return envelope. Of those, $n = 64$ patients have returned all relevant documents, including a complete questionnaire, and were subsequently included in our analysis. The Royal National Orthopaedic Hospital Clinical Effectiveness Lead (institutional review board) has reviewed and approved the study protocol (Ref. 2016/17–35). No financial compensation was offered to the patients to avoid bias.

Assessments and instruments

Sociodemographics

All patients completed a comprehensive, self-report questionnaire with sociodemographic items, including age, sex, hand dominance, highest qualification, and current employment status, as well as pre-existing medical conditions, including mental health and medical treatment, if applicable.

Pain score

Pain scores were assessed using visual analogue scale (VAS) ranging from 0 (no pain) to 10 (unbearable pain) for both average and worst shoulder pain with the last week and last 3 months.

Disability

Primary outcome was assessed using the Disability of the Arm, Shoulder and Hand (DASH) score, a well-established 30-item,

self-report questionnaire, ranging from 0 (no disability/symptoms) to 100 (severe symptoms, unable to perform task).¹⁶ It is widely used in shoulder and upper limb conditions and has proven to be a validated and reliable assessment tool.^{4,25} Beside the originally described DASH score, Franchignoni et al have recently described three sub-scores (“manual functioning”, “shoulder range of motion”, and “symptoms and consequences”), which can be calculated from the DASH raw data and are believed to further characterize upper limb disability.¹¹ In addition, disability was also assessed using the “Stanmore Percentage of Normal Shoulder Assessment” (SPONSA) for each shoulder. The SPONSA score is a percentage of perceived shoulder function ranging from 0% (highly compromised shoulder function) to 100% (normal shoulder function) and has been validated as an accurate and reliable questionnaire to assess and monitor shoulder disability.²³

Depression

The Becks Depression Inventory II (BDI-II)⁵ is a well-established and validated, 21-item self-reported screening tool for clinical and subclinical depression and is widely used in patients with chronic pain and musculoskeletal conditions.^{1,10,14,24} Its score ranges from 0 to 63, and different cutoffs for subgroups have been established.

Statistics

Baseline descriptive and frequencies were analyzed to characterize all participants. We used Chi-square test to examine the dependency between categorical variables for sex, age, level of education, marital status, and current occupation. Furthermore, we used two-tailed Pearson's correlation and linear regression models to assess the relationship between socioeconomic variables, BDI, pain VAS, and DASH scores. Stepwise multiple linear regression was performed to correlate disability with BDI and pain VAS variables. All statistical analyses were performed using SPSS (IBM SPSS Statistics for Macintosh, Version 27.0; IBM, Armonk, NY, USA), and $P < .05$ was considered statistically significant.

Results

We included 64 patients, of which 51 (79.7%) were female, with a mean age of 28.23 years (SD 10.02) and 33.3 years (SD 13.23) for female and male participants, respectively. The mean age of symptoms onset was 17.44 years (SD 9.38), and in our cohort, patients reported an average duration of 11.35 years of symptoms (SD 7.89). Out of 60 included patients, 40 (66.7%) had at least one shoulder operation (mean 2.8, SD 2.25). **Table I** summarizes the main sociodemographic characteristics of our cohort. Marital status, level of education, and occupation, as well as depression and pain VAS scores, were significantly correlated with disability and were subsequently included in the regression analysis (**Table II**).

The mean VAS pain score for acute shoulder pain was, in average, 5.11 (SD 2.24), with a mean peak acute shoulder pain of, in average, 7.47 (SD 2.34). Chronic VAS shoulder pain was in average 5.58 (SD 2.34) and had a mean chronic peak rate of 8.06 (SD 2.08).

BDI-II was used to define depression, and the overall mean score was 17.4 (SD 11.7). We used the originally described cutoffs to subdivide depressive groups, with $n = 26$ (40.6%), $n = 12$ (18.8%), $n = 14$ (21.9%), and $n = 12$ (18.8%) for the sub-groups minimal, mild, moderate, and severe depression, respectively.

The overall mean for the DASH score was 52.7 (SD 21.2), and 49.2 (SD 22.2), 58.0 (SD 25.7), and 54.9 (SD 22.5) for the subscales “manual functioning”, “shoulder range of motion”, and “symptoms and consequences”, respectively. Furthermore, the mean SPONSA score for the dominant hand was 58.0 (SD 27.3), and the lower score (out of both shoulders) was 45.0 (SD 25.2).

Table I
Sociodemographic characteristics of patients with atraumatic shoulder instability.

Patient demographics	Mean	
Age (yr)	29.31 (SD 10.876)	Range: 16–62
Gender		
Female		N = 51 (79.7%)
Male		N = 13 (20.3%)
Marital status		
Single		N = 39 (60.9%)
Married, living with partner		N = 23 (35.9%)
Divorced		N = 2 (3.1%)
Level of education		
GCSE		N = 15 (23.4%)
A-Levels		N = 23 (35.9%)
University degree		N = 22 (34.4%)
Missing data		N = 4 (6.3%)
Occupation		
Unemployed		N = 18 (28.1%)
Employed		N = 29 (45.3%)
Housework		N = 5 (7.8%)
Self-employed		N = 2 (3.1%)
Student		N = 7 (10.9%)
Retired		N = 2 (3.1%)
Missing data		N = 1 (1.6%)
Hand dominance		
Right hand dominant		N = 58 (90.6%)
Left hand dominant		N = 6 (9.4%)

GCSE, General Certificate of Secondary Education.

Disability and depression

Pearson's correlations showed a significant association between overall BDI score and overall DASH score ($r = 0.41, P < .05$), as well as all three DASH subgroups. A significant correlation was further noted between BDI and SPONSA for the dominate hand ($r = -0.39, P < .05$) and for the most symptomatic limb ($r = -0.32, P < .05$) (Table III).

A linear regression analysis was performed and also showed a significant association between the overall DASH score and the overall BDI score ($F(1,62) = 12.78, P < .001$), with R^2 of 0.170 (Fig. 1, A). These findings were reproduced with a second, stepwise, multiple linear regression model with overall BDI as a dependent variable and two different SPONSA items (SPONSA worst score and SPONSA dominant side), which found that only SPONSA of the dominant hand was associated with depressive symptoms ($F(1,62) = 27.014, P < .001$), with R^2 of 0.150, whereas SPONSA worst side was no longer significant ($P = .462$). Eleven patients (17.2%) have reported at least one attempted suicide in the past, and 19 patients (29.7%) had a history of self-harm; however, neither was significantly correlated with shoulder disability.

Disability and pain

Pearson's correlations showed a significant association between DASH (and all three DASH sub-scores) and all our acute and chronic

Table II
Pearson's correlations between sociodemographics and outcome measures.

Variable	DASH overall	SPONSA dominant hand	SPONSA lowest function	Depression overall	Peak pain VAS past 7 d	Average pain VAS past 7 d	Peak pain VAS past 3 mo	Average pain VAS past 3 mo
Age	.255*	-.096	-.192	-.100	.016	-.026	.020	-.006
Sex	-.036	-.071	.055	-.063	.032	.028	.041	.025
Marital status	.353 [†]	-.293*	-.303*	.041	.382 [†]	.432 [†]	.325 [†]	.345 [†]
Level of education	-.501 [†]	.382 [†]	.337 [†]	-.379 [†]	-.452 [†]	-.514 [†]	-.404 [†]	-.552 [†]
Occupation	-.419 [†]	.122	.245	-.208	-.155	-.240	-.089	-.151

DASH, Disability of the Arm and Hand; SPONSA, Stanmore Percentage of Normal Shoulder Assessment; VAS, visual analogue scale.

*Statistically significant at the 0.05 level (2-tailed).

[†]Statistically significant at the 0.01 level (2-tailed).

pain VAS variables. After this, a stepwise, multiple linear regression revealed that only average chronic shoulder pain (within the last 3 months) remained highly related to low functional outcome ($F(1,61) = 46.13, P < .001$), with an R^2 of 0.431 (Fig. 1, B).

Pain, depression, and disability

A multiple, stepwise, linear regression model with DASH score as a dependent variable and all pain scores, as well as overall BDI score, as predictors was performed which showed that average chronic pain and depression remained significant, independent variables associated with disability, accounting for 46.8% of variance ($F(1,60) = 4.163, P < .05$, with R^2 of 0.468) (Table II).

Discussion

To the best of our knowledge, this is the first study to assess the prevalence and severity of acute and chronic pain and clinical and subclinical depression and its association with disability in atraumatic shoulder instability patients. We found that clinically relevant depression was present in over 40% of patients studied, and self-harm, as well as attempted suicide, was a common reported symptom. High, chronic pain scores, as well as depression, were the main predictors for disability, and it is a low functional performance of the dominant arm that seems to be the driver of depressive symptoms, rather the lowest performing limb. Interestingly, demographic factors such as sex and age, which frequently are associated with depressive episodes, were not significantly associated in this cohort.

It is well established that psychological comorbidities such as depression are major contributors to quality of life, and an association among pain, depression, and disability in patients with upper limb conditions has previously been reported. Cho et al⁹ demonstrated an association between severity of pain and severity of depression, anxiety, and sleep disturbance in patients who underwent rotator cuff repair. However, they further noted that pain as an independent variable was not a necessity for the onset of depression. Our patients had overall moderate, average pain scores (within the last week and last three months); however, higher chronic pain scores remained an independent predictor for disability, alongside depression.

Cognitive behavioral studies have shown that patients' thoughts, beliefs, expectations, and coping resources can either intensify or diminish pain and disability. It is further conceptualized that those thoughts, behaviors, and sensations are interrelated and mutually interfering. Lawson et al¹⁸ and others have argued that self-efficacy, which is understood to be the perceived ability to achieve a desired outcome, can predict success in coping with pain and disability. Hoffman et al¹⁵ have further explored the interaction of depression and disability in their recent level I meta-analysis in low back pain patients and concluded that psychological interventions such as cognitive behavioral therapy, relaxations, and

Table III
Descriptive statistics and correlations of outcome measures of shoulder instability patients with disability, depression, and pain scores.

	Mean:	Range/N	Multiple linear regression results					
Disability scores								
DASH overall:	52.72 (SD 21.21)	Range: 2.50-91.67	DASH × BDI & VAS pain scores					
DASH sub-scale 1: manual functioning	49.23 (SD 22.20)	Range: 3.30-96.67	-	R ²	F change	df	Sig	
DASH sub-scale 2: shoulder ROM	57.99 (SD 25.73)	Range: 0-100	Model 1 (a)	431	46.133	1(61)	P = .000	
DASH sub-scale 3: symptoms and consequences	54.90 (SD 22.52)	Range: 2.78-97.22	Model 2 (b)	468	4.163	1(60)	P = .046	
SPONSA dominant hand	58.02 (SD 27.29)							
SPONSA worst side	44.97 (SD 25.24)							
Depression (BDI) score								
Overall BDI	17.38 (SD 11.72)	Range 0-48	Coefficients	B	SE	β	t	Sig.
Subgroup: BDI minimal		N = 26 (40.6%)	Model 1 (a)					
Subgroup: BDI mild		N = 12 (18.8%)	VAS pain:	5.931	.873	.656	6.792	.000
Subgroup: BDI moderate		N = 14 (21.9%)	Model 2 (b)					
Subgroup: BDI severe		N = 12 (18.8%)	VAS pain	5.257	.913	.582	5.755	.000
			BDI	.369	.181	.206	2.040	.046
Pain scores								
Peak past 7 d	7.47 (SD 2.34)	Range 0-10	(a) Depended: DASH; independent: average pain last 3 months					
Average past 7 d	5.11 (SD 2.24)	Range 0-10	(b) Depended: DASH; independent: average pain last 3 months, BDI					
Peak past 3 mo	8.06 (SD 2.08)	Range 2-10						
Average past 3 mo	5.58 (SD 2.34)	Range 0-10						

DASH, Disability of the Arm and Hand; BDI, Becks Depression Inventory; VAS, visual analogue scale; SD, standard deviation; ROM, range of motion; SPONSA, Stanmore Percentage of Normal Shoulder Assessment; SE, standard error.

biofeedback were at least as effective as standard biomedical therapies. Low anticipated self-efficiency on the management of disease can lead to pronounced “passive coping strategies” such as “depending on others”, which further leads to disability and depression. To break through this cycle, it is important to appreciate that those cognitive recourses can be learned and practiced and, therefore, form a well-established part of a holistic treatment approach of musculoskeletal pain.

Furthermore, chronic pain is established to play a major role in the development of disability, as well as depression; however, we could show that both pain and depression remain separate predictors for disability, which emphasizes the need of treatment for both.

Strength and weaknesses

This study has several limitations: The sample size is relatively small; however, true atraumatic shoulder instability is a rare subgroup within a shoulder instability cohort. All patients included were recruited from a single center and diagnosed by sub-specialized shoulder consultants and physiotherapists during an

MDT meeting, leading to a homogenous cohort. This is of particular importance because variance in terminology is common. Second, depression was measured using a self-report questionnaire rather than by diagnostic interview; however, the BDI is known for its high reliability as well as the ability to capture subclinical depression. Third, we have not assessed the subjects for use of antidepressant or pain medication, which means that the reported prevalence of depression or the interference of pain can be underrated. This is partially mitigated by the choice of pain variables included, assessing average pain scores in the last 7 days and 3 months. Finally, our study lacks a control group, and prevalence of shoulder pain and depression in patients without instability remains unclear. Cho et al have published depression scores in pre-operative and post-operative patients with rotator cuff tear and have reported depression present in 26.2%.⁹ Prevalence of moderate or severe depression in our cohort was observed in over 40% of patients included; however, we appreciate that cohort demographics are fundamentally different.

Our data support the need to treat shoulder instability patients with a holistic, multidisciplinary team with specialized surgeons, physiotherapists, pain specialists, psychologists, and psychiatrists.

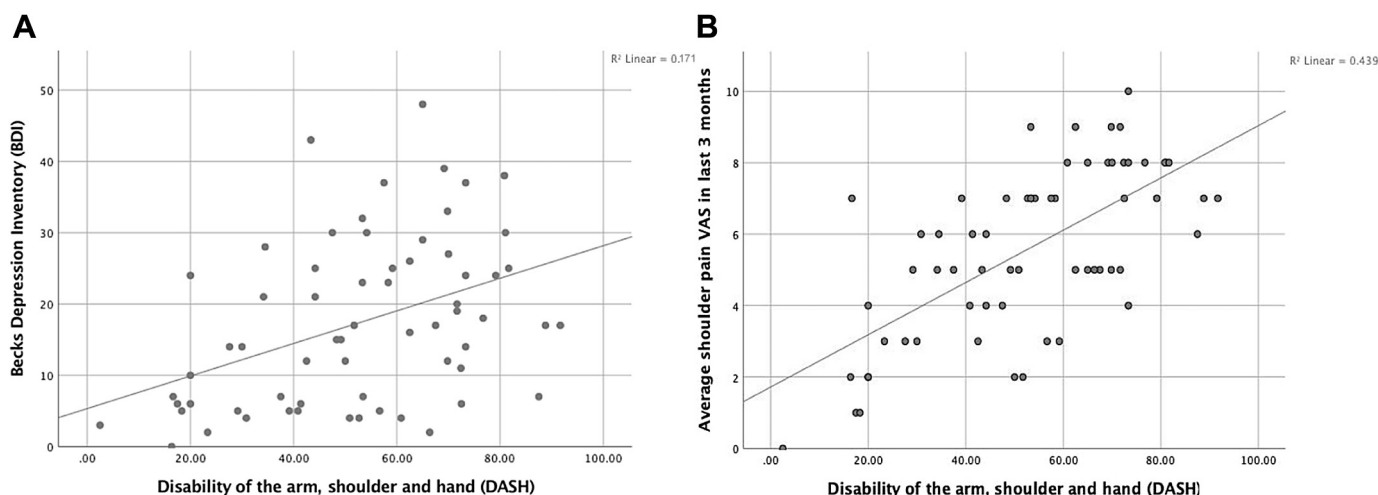


Figure 1 Scatter plot showing the association of disability (DASH) with (A) Beck Depression Inventory (BDI) and (B) average pain (VAS) score within the last 3 months. Both, high depression and average, chronic pain scores were significantly correlated with disability as individual variables after multiple stepwise regression modeling.

The aim is not only to treat instability and control pain but also to teach and evaluate cognitive factors, as well as patients' recourses, beliefs, and expectations.

Conclusions

This study demonstrates important psychosocial factors in our cohort of patients suffering with recurrent, atraumatic shoulder instability. In addition to sociodemographic factors, pain and psychological comorbidities were found to have a negative impact on patients' functional outcome. This study supports the need for an MDT approach to the management of this group of instability patients and advocates the need for dedicated psychology support if needed.

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