

Abnormal Pain Response After a Compensable Shoulder Injury

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Background: The role of psychosocial factors has been established in patients with shoulder abnormalities. However, the prevalence of exaggerated pain behaviors and their association with the characteristics of injured workers have not been well studied.

Purpose: To examine the prevalence of abnormal pain responses (APRs) in workers with active workers' compensation claims for a shoulder injury and to examine the differences between workers with APRs versus workers without APRs.

Study Design: Cross-sectional study; Level of evidence, 3.

Methods: An analysis of electronic data files of injured workers was completed. An APR was defined as an exaggerated pain response during a clinical examination, including facial grimacing, shaking, withdrawal, nonanatomic dermatome or myotome disturbances, increased tenderness, regional symptoms, and verbal utterances such as groaning, moaning, or gasping. To control for potential confounders, patients with positive APRs (APR group) were matched with injured workers without APRs (control group) seen in the same clinic and matched for sex, age, and surgical candidacy.

Results: Data from 1000 workers who had sustained a shoulder injury at work and who were referred for an early assessment by an orthopaedic surgeon and a physical therapist were reviewed. A total of 86 (9%) injured workers (mean age, 47 ± 11 years; 55 [64%] female) demonstrated APRs and were matched with 86 injured workers without APRs. There were no statistically significant between-group differences in the wait time, mechanism of injury, coexisting comorbidity, type of abnormality, or medication consumption. The APR group reported higher levels of disability ($P < .0001$) and psychological problems ($P < .0001$), presented with more inconsistency in range of motion ($P = .04$), and had more limitations at work ($P = .02$).

Conclusion: The presence of an APR after a compensable shoulder injury was associated with higher reports of disability and psychological problems. Patients with positive APRs were more likely to be off work and less likely to perform full duties.

Keywords: work related; compensation; shoulder injury; pain behaviors

An abnormal pain response (APR) or exaggerated illness behavior was first defined over 50 years ago by Mechanic and Volkart³³ as a differential perception, evaluation, and exaggerated reaction or a lack of reaction to illness. About a decade later, Pilowsky⁴⁰ defined abnormal illness behavior as any behavior that deviated from normal. He categorized this abnormal behavior into illness-affirming and illness-denying categories that were excessive or minimizing relative to the prevailing norms, respectively.⁴¹ In the 1980s, Waddell and colleagues^{51,53} associated abnormal illness behavior with certain physical signs (tenderness, simulation, distraction, regional symptoms, and overreaction) as "maladaptive overt illness related behavior which is out of proportion to the underlying physical disease and more readily attributable to associated cognitive and affective

disturbance." These signs, which were observed in patients with chronic back pain, suggested a nonstraightforward physical problem and a potential for the presence of psychological factors.⁴⁹

Despite a wealth of knowledge related to the negative impact of compensation on outcomes of workers with shoulder injuries³³ and the role of psychosocial factors related to shoulder abnormalities,^{8,19,20} there is no specific information on the prevalence or relationship between exaggerated pain behaviors and other characteristics of injured workers with shoulder injuries. Further research is warranted to examine the prevalence of APRs and the association between these signs with patient characteristics. This information may help clinicians to identify patients who might require further management of psychological factors that may contribute to prolonged disability.

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The purpose of this study was 2-fold: (1) to determine the prevalence of APRs in workers within 16 weeks of a shoulder injury or recurrence and (2) to compare the characteristics of patients with APRs with injured workers without APRs. Based on the available literature, we hypothesized that patients with APRs would have a longer wait time to an examination, report higher levels of disability and psychological problems, consume more medication, and be less successful in performing full duties at work than injured workers without APRs. Differences in the mechanism of injury, type of abnormality, coexisting comorbidity, and other barriers to recovery were also explored.

METHODS

Design

We used a case-control design. Patients with positive APRs were matched with those without APRs seen at the same clinic based on sex, age, and surgical candidacy.

Patient Population

The patients were workers with shoulder injuries who had not returned to work or progressed in their return-to-work plan within 16 weeks of the injury or recurrence and were referred to the Early Shoulder Physician Assessment (ESPA) program. The ESPA program is funded by the Workplace Safety and Insurance Board of Ontario, and its aim is to provide a clear diagnosis and recommendations for evidence-based management of workers with shoulder injuries by specialized orthopaedic surgeons and physical therapists within a specific time frame. Approval for using the existing data was obtained from the Research Ethics Board of Sunnybrook Health Sciences Centre.

Definition of APR

The presence of an APR was documented by the assessing clinicians when the patient demonstrated multiple exaggerated pain behaviors during an interview or clinical examination, including facial grimacing, shaking, withdrawal, nonanatomic dermatome or myotome findings, increased tenderness, regional symptoms, and verbal utterances such as groaning, moaning, or gasping.

Clinical History and Examination

The patients were initially interviewed by a physical therapist and then seen by an orthopaedic surgeon with fellowship training in shoulder surgery. Standardized fillable PDF forms were used to document clinical findings and management. The mechanism of injury was classified into 4 categories as falls, traumatic impacts by an external object, repetitive activities, and push/pull activities. Previous shoulder injuries and medical comorbidities (5 areas: arthritis, cardiovascular disease, diabetes, osteoporosis, and hypertension) were documented. Medication consumption was noted for nonnarcotic analgesics, anti-inflammatory drugs, and muscle relaxants. Inconsistency in range of motion (ROM) was documented as positive when the patient demonstrated inconsistency between formal versus informal observation and had a significant limitation of active movement in the absence of a rotator cuff tear (eg, weakness was not the cause of limitation based on normal imaging findings) or adhesive capsulitis (eg, capsular tightness was not the cause of limitation based on normal passive ROM). The diagnosis was based on clinical and imaging findings. Brachial plexus injuries, abnormal neurological findings, cervical spine referred pain, or radicular symptoms, which are associated with heightened pain and increased sensitivity, were documented if present. Work status was classified into 3 categories: performing full duties, performing modified duties, and unable to work. Management involved recommending conservative treatment or surgery. Surgical candidacy was based on the need for an intervention to address rotator cuff, labral, or arthritic abnormalities.

Patient-Reported Outcome Measure

The patient-reported outcome measure used was the Quick Disabilities of the Arm, Shoulder and Hand (QuickDASH).³ The QuickDASH is an upper extremity outcome measure with 11 questions and uses a Likert scale. Higher scores of the QuickDASH indicate more disability. The QuickDASH has established validity and reliability in patients with shoulder complaints.^{3,29}

Barriers to return to work were classified into 4 categories as previous shoulder injuries, psychological factors (depression, anxiety), workplace factors, and worker's factors. The last 2 categories encompassed excessive stress at work, job dissatisfaction, difficulty performing the tasks,

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and poor relationship with supervisors or fellow employees as reported by the workers.

Statistical Analysis

Descriptive statistics were used for both groups. The chi-square and Fisher exact tests were used for categorical data as appropriate, and the *t* test was used for continuous data. The effect sizes were calculated for significantly different variables to estimate the magnitude of the differences, with the odds ratio calculated for categorical data and the Cohen *d* for continuous data. The Cohen *d* was interpreted as small (0.20-0.49), moderate (0.50-0.79), and large (≥ 0.80).⁷

RESULTS

Prospectively collected electronic data from 1000 consecutive injured workers who were seen within 16 weeks of the injury or recurrence were reviewed. Eighty-six patients (9%), with a mean age of 47 ± 11 years and 55 (64%) of them female, demonstrated APRs during the assessment (APR group).

These patients were matched with 86 patients from the same pool of data (control group) based on sex, age, and surgical candidacy. Table 1 shows the characteristics of patients with and without APRs. There were no statistically significant differences between the groups with respect to the wait time to the examination, mechanism of injury, previous shoulder surgery, coexisting comorbidity, medication consumption, type of abnormality, brachial plexus injuries, or referred/radicular symptoms related to the cervical spine.

Patients in the APR group reported a higher level of disability as measured by the QuickDASH, with a moderate effect size, than the control group (71 vs 56, respectively; $P < .0001$). The injured workers in the APR group demonstrated a higher number of inconsistencies in the clinical presentation of ROM than the control group (85% vs 72%, respectively; $P = .04$). Among barriers to return to work, the presence of psychological problems (anxiety or depression) was statistically significantly different between the groups (27% vs 2%, respectively; $P < .0001$). The odds of reporting psychological problems were 15.33 times greater in the APR group than the control group. The APR group was less likely to work full duties and more likely to be off work ($P = .02$). The odds of the APR group not working full duties or being off work were 5.90 times greater than the odds of the control group being in the same situation.

DISCUSSION

The present study demonstrated a low prevalence (86/1000 = 9%) of APRs in workers seen in the early stage after a shoulder injury or recurrence of a shoulder problem. The presence of an APR was associated with negative factors such as higher disability, psychological problems, and inability to work or perform full duties. Considering the cross-sectional nature of the study, we cannot establish a cause-and-effect relationship between the development of

these behaviors and reports of higher disability and psychological factors. However, it appears that the observation of such behaviors can help warn clinicians of greater challenges for the worker to return to normal function.

To our knowledge, this is the first study with relatively large clinical data that has examined the presence of an APR in the early stages of recovery after a compensable shoulder injury. We used a control group from the same pool of data (workers with shoulder injuries seen within the same time frame from the injury) to reduce selection bias and to improve comparability of the groups. The groups were matched by important factors such as age, sex, and surgical candidacy, which are known to influence pain and disability levels. Patient age can affect the ability to perform strenuous tasks,^{2,4,34,36} while sex has a complex interaction with physical ability, perception of pain and disability, and social factors.^{42,43,48} Surgical candidacy may also affect the injured worker's physical and psychological well-being.^{1,6} By matching the groups on these confounding variables, we were able to provide an accurate analysis of other differences between the patients with and without APRs.

In the present study, an exaggerated pain response was defined as multiple pain behaviors during an interview or clinical examination. The only exaggerated pain behaviors that have been extensively studied are the Waddell signs, which include similar signs of overreaction, widespread symptoms, and reactions to an examination.^{51,53} Consistent with our results, the literature on patients with a spinal condition indicates increased pain as the most consistent factor associated with abnormal reactions to an examination.⁸⁸ The present study showed a strong association between the presence of an APR and psychological factors. Similarly, Waddell and colleagues^{49,50,53} suggested a potential for the presence of psychological factors in patients who demonstrated an array of abnormal pain behaviors. In addition, abnormal pain behaviors (ie, the Waddell signs) in spine conditions are reported to be associated with not returning to work in patients with acute or chronic low back pain,^{5,10,11,25,32,51} which is consistent with our study.

The significance of our results is that only a small percentage of patients developed abnormal pain behaviors within 16 weeks of a shoulder injury or recurrence. Such patients are more likely to be suffering from higher levels of disability and psychological problems, which may negatively affect their return to work. The prevalence of APRs is expected to be higher in workers who have a longer symptom duration. The Waddell signs are the most widely used clinical signs to determine the sincerity of effort²⁷ and have been interpreted as an indication for secondary gains in patients involved in litigation related to their injury.^{18,22} However, Main and Waddell³⁰ have themselves cautioned clinicians against misinterpreting them as clinical signs of malingering and for medicolegal reasons. In an evidence-based review of all available studies addressing the concept of nonorganic findings, Fishbain et al¹² reported that the Waddell signs could not consistently differentiate between organic and nonorganic signs or subset of patients with

⁸⁸References 9, 13, 14, 23, 31, 39, 44, 52, 54.

TABLE 1
Characteristics of Patients With and Without an APR^a

Variable	APR Group (n = 86)	Control Group (n = 86)	Statistics	Effect Size ^b (95% CI)
Matched variables				
Age, mean ± SD, y	47 ± 11	47 ± 11	—	
Sex, n (%)			—	
Female	55 (64)	55 (64)		
Male	31 (36)	31 (36)		
Surgical candidacy, n (%)	12 (14)	12 (14)	—	
Variables compared between groups				
Wait time, mean ± SD, mo	2.53 ± 0.80	2.43 ± 0.80	$t = 0.90, P = .37$	
Medical comorbidity, n (%)				
Cardiovascular disease	1 (1)	0 (0)	FET = 0.50, $P > .99$	
Diabetes	10 (12)	6 (7)	$\chi^2 = 1.10, P = .29$	
Arthritis	2 (2)	3 (3)	FET = 0.32, $P > .99$	
Osteoporosis	2 (2)	0 (0)	FET = 0.25, $P = .50$	
Hypertension	10 (12)	13 (15)	$\chi^2 = 0.45, P = .50$	
Smoking, n (%)	25 (29)	27 (31)	$\chi^2 = 0.11, P = .74$	
Mechanism of injury, n (%)				
Repetitive activity	10 (12)	12 (14)	$\chi^2 = 0.21, P = .64$	
Fall	12 (14)	9 (10)	$\chi^2 = 0.49, P = .48$	
Traumatic impact	11 (13)	13 (15)	$\chi^2 = 0.19, P = .66$	
Push/pull activity	37 (43)	34 (40)	$\chi^2 = 0.21, P = .64$	
Other	8 (10)	10 (13)	$\chi^2 = 0.25, P = .62$	
Medication use, n (%)				
Nonnarcotic analgesics	52 (60)	40 (47)	$\chi^2 = 3.36, P = .07$	
Anti-inflammatory drugs	43 (50)	39 (45)	$\chi^2 = 0.38, P = .54$	
Muscle relaxants	7 (8)	6 (7)	$\chi^2 = 0.08, P = .77$	
ROM inconsistency, ^c n (%)	73 (85)	62 (72)	$\chi^2 = 0.04, P = .04$	OR = 0.46 (0.22-0.98)
Neurological condition, n (%)				
Cervical spine symptoms	39 (45)	36 (42)	$\chi^2 = 0.21, P = .64$	
Brachial plexus injury	1 (1)	0 (0)	FET = 0.50, $P > .99$	
Barriers to return to work				OR = 15.33 (3.49-67.45)
Psychosocial factors	23 (27)	2 (2)	FET < 0.0001, $P < .0001$	
Previous shoulder injury	6 (7)	4 (5)	$\chi^2 = 0.21, P = .64$	
Workplace factors	18 (21)	16 (19)	$\chi^2 = 0.15, P = .70$	
Worker's factors	10 (12)	6 (7)	$\chi^2 = 1.10, P = .29$	
QuickDASH score, mean ± SD	71 ± 22	56 ± 20	$t = 4.53, P < .0001$	$d = 0.69 (0.38-0.99)$
Work status, n (%)			FET = 0.0008, $P = .02$	OR = 5.90 (1.48-23.49)
Not working	31 (36)	21 (24)		
Working modified duties	52 (60)	53 (62)		
Working regular job	3 (3)	12 (14)		
Type of abnormality, n (%)				
RCFTT	7 (8)	9 (10)	$\chi^2 = 0.23, P = .60$	
RCPTT	15 (17)	14 (16)	$\chi^2 = 0.44, P = .50$	
Impingement syndrome ^d	49 (43)	59 (57)	$\chi^2 = 2.49, P = .11$	
Biceps lesion	15 (17)	28 (33)	$\chi^2 = 0.44, P = .50$	
Labral lesion	1 (1)	1 (1)	FET = 0.50, $P > .99$	
Instability	1 (1)	2 (2)	FET = 0.38, $P > .99$	

^aAPR, abnormal pain response; FET, Fisher exact test; OR, odds ratio; QuickDASH, Quick Disabilities of the Arm, Shoulder and Hand; RCFTT, rotator cuff full-thickness tear; RCPTT, rotator cuff partial-thickness tear; ROM, range of motion.

^bEffect sizes are presented for statistically significant group differences as the OR for categorical data and the Cohen d for continuous data.

^cInconsistency in ROM between formal versus informal observation and limited active movement in the absence of rotator cuff or capsular abnormality.

^dBursitis, tendinitis, or subacromial impingement.

malingering. Similarly, studies that have examined nonanatomic numbness or paralysis have not been able to show a clear distinction between organic abnormalities and hysteria or psychogenic problems.^{16,28,45} In our study, we used a homogeneous sample of injured workers, which eliminates the concept of malingering, as all patients had the same

medicolegal situation (eg, an active compensable claim). Therefore, the presence of an APR after a shoulder injury may represent an opportunity to offer psychological care along with physical rehabilitation to facilitate overall recovery.

An inherent limitation of studies that examine pain behaviors is the subjective nature of the assessment, which

is influenced not only by the patient's experience of pain but also by the complex cultural factors, past experiences, beliefs, and attitudes of both the patient and the examiner. Another limitation of the present study was the inability to compare group differences in work-related physical demands, as the occupations varied significantly and the job demands were not documented in the assessment form. There is a possibility that the APR group had a higher level of job demands. Assessments of the dose and frequency of medication will improve the accuracy of differences in medication consumption in future studies.

CONCLUSION

The presence of an APR after a compensable shoulder injury was associated with higher reports of disability and psychological problems. Patients with positive APRs were more likely to be off work and less likely to perform full duties.

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