

การตอบสนองของอาการปวด พิสัยการเคลื่อนไหวในท่าหมุนข้อไหล่ ออก และการจำกัดการทำงานของข้อไหล่ในผู้ที่มีเยื่อหุ้มข้อไหล่อักเสบยึดติด

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ภาวะเยื่อหุ้มข้อไหล่อักเสบยึดติดมีอาการและอาการแสดงได้แก่ อาการปวด พิสัยการเคลื่อนไหวที่ลดลง และการจำกัดการทำงาน การศึกษาเกี่ยวกับการตอบสนองของตัวแปรเหล่านี้มีความสำคัญต่อการจัดการภาวะเยื่อหุ้มข้อไหล่อักเสบยึดติด การศึกษานี้จึงมีวัตถุประสงค์เพื่อประเมินการตอบสนองของอาการปวด พิสัยการเคลื่อนไหว และการจำกัดการทำงานในผู้ที่มีเยื่อหุ้มข้อไหล่อักเสบยึดติด โดยผู้เข้าร่วมการศึกษา 24 คนได้รับการประเมินอาการปวด การเคลื่อนไหวในท่าหมุนข้อไหล่ ออก และการจำกัดการทำงาน เมื่อแรกเริ่ม และที่ 2 สัปดาห์ภายหลังการรักษา โดยการตอบสนองภายในประเมินจากค่าความแตกต่าง ขนาดอิทธิพล และค่าเฉลี่ยการตอบสนองมาตรฐาน และการตอบสนองภายนอกใช้ค่าสหสัมพันธ์ของความพึงพอใจกับตัวแปรต่างๆ ผลการศึกษาพบความแตกต่างอย่างมีนัยสำคัญระหว่างค่าแรกเริ่มและค่าภายหลังการรักษาในทุกตัวแปรทางคลินิก โดยพบว่า อาการปวด การเคลื่อนไหวในท่าหมุนข้อไหล่ ออก และการจำกัดการทำงานมีค่าการตอบสนองสูง โดยพิจารณาจากค่าเฉลี่ยการตอบสนองมาตรฐาน (อยู่ในช่วง 0.87 ถึง 2.61) แต่มีค่าสหสัมพันธ์กับความพึงพอใจต่ำ การศึกษานี้พบว่า อาการปวด การเคลื่อนไหวในท่าหมุนข้อไหล่ ออก และการจำกัดการทำงาน มีค่าการตอบสนองสูง สามารถสืบหาความแตกต่างระหว่างช่วงเวลาที่เกิดขึ้นในผู้ที่มีเยื่อหุ้มข้อไหล่อักเสบยึดติดได้

คำสำคัญ: การตอบสนอง, ข้อไหล่ยึดติด, ปวด, พิสัยการเคลื่อนไหว, การทำงานของข้อไหล่



Responsiveness of pain, shoulder external rotation range of motion, and disability in individuals with shoulder adhesive capsulitis

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Abstract:

Shoulder adhesive capsulitis is evident with pain, decreased active range of motion (AROM), and disability. Knowing the responsiveness of these clinical outcomes is beneficial in management of shoulder adhesive capsulitis. This study therefore aimed to investigate the responsiveness of pain, AROM, and disability in individuals with shoulder adhesive capsulitis. Twenty-four subjects were measured for pain, active external rotation (AER), and disability at baseline and 2 weeks after interventions. Change scores, effect size (ES), and standardized response mean (SRM) for internal responsiveness, and the correlation with satisfaction for external responsiveness were calculated in each parameter. There were significant differences between baseline and after-intervention data in all clinical outcomes. It was found that pain, AER, and disability were responsive according to high SRM (ranged from 0.87 to 2.61) but low correlation with the satisfaction. This study found that pain, AER, and disability were responsive in detecting the changes in individuals with shoulder adhesive capsulitis from time to time.

Keywords: Responsiveness, Frozen shoulder, Pain, Range of motion, Shoulder function

Introduction

After the back and the neck, the shoulder is the third most-frequently painful region⁽¹⁾. By which, shoulder adhesive capsulitis is a frequently found problem seeking for physical therapy interventions among other shoulder disorders. Two to five percent of general population had shoulder adhesive capsulitis, and the incidence increased from 10 - 38% in individuals with diabetes and thyroid disease⁽²⁾. Shoulder adhesive capsulitis is common among individuals aged between 40 and 65 years⁽³⁾, mostly females⁽²⁾. The cause of shoulder adhesive capsulitis is classified to primary and secondary. Primary adhesive capsulitis is defined as unknown cause, while, the secondary adhesive capsulitis includes 3 categories: 1) systemic causes such as diabetes mellitus, hyperthyroidism, and hypoadrenalism, 2) extrinsic causes such as cardio pulmonary disease, cervical disc, and humerus fractures, and 3) intrinsic causes such as biceps tendinitis, rotator cuff tendinitis, and rotator cuff tears⁽⁴⁾.

Signs and symptoms of shoulder adhesive capsulitis depends on the stage of this condition but the most common are pain, range of motion (ROM) limitation, especially external rotation direction⁽⁵⁾, and functional disability such as washing hair, putting on t-shirts, carrying a heavy object, and the others^(6, 7, 5). Also, those aforementioned signs and symptoms affect to the occupation which arm elevation is needed.

The interventions for managing those signs and symptoms are therefore exactly needed to minimize pain, disability, and to increase ROM in order to promote individuals' resumption to their jobs and social participation. The effective interventions can be considered by their responsiveness^(8, 9). In addition, the responsiveness can also determine which signs, symptoms, or other clinical parameters are responsive or sensitive to the change from time to time^(8, 10).

The responsiveness consists of internal responsiveness and external responsiveness⁽¹¹⁾. The internal

responsiveness consists of change score, effect size (ES), standardized response mean (SRM), while the external responsiveness is the correlation between the selected parameter and the external reference^(8, 12, 13). From literature review regarding the responsiveness in individuals with shoulder adhesive capsulitis, it was found that pain and disability scores (the Shoulder Pain and Disability Index, SPADI) were more responsive than ROM^(13, 14). Tveitå et al⁽¹³⁾ reported the responsiveness of SPADI pain subscale, SPADI disability subscale, and SPADI total score with SRM of 1.62, 1.76, and 1.81 respectively, while the responsiveness of ROM ranged from 0.85 to 1.52 in SRM. Another study conducted by van Meeteren⁽¹⁴⁾ reported the responsiveness of pain, activity (Shoulder Disability Questionnaire, SDQ), active external rotation ROM, and active abduction ROM with SRM of 2.1, 1.6, 1.2, and 0.5 respectively. However, the responsiveness of the clinical outcomes of those previous studies was from the invasive techniques; intra-articular injections. The objective of this study therefore aimed to investigate the responsiveness of pain, AROM, and shoulder disability in individuals with shoulder adhesive capsulitis who got recovered from physical therapy interventions.

Materials and Methods

This research is a responsiveness study. The individuals with shoulder adhesive capsulitis were from Physical Therapy Center, both Pinklao main center and Salaya campus, Faculty of Physical Therapy, Mahidol University. This study has been approved by Mahidol University Institutional Review Board (MU-IRB).

Subjects

Twenty-four individuals (17 women and 7 men) with shoulder adhesive capsulitis were recruited from Physical Therapy Center, both Pinklao main center and Salaya campus, Faculty of Physical

Therapy, Mahidol University. The inclusion criteria consisted of the age ranged between 40 and 65 years, had a unilateral shoulder adhesive capsulitis with the duration of more than 3 months (stage 2 or 3 of adhesive capsulitis), had pain intensity ranged between 3 and 7 cm by Visual Analogue Scale (VAS), decrease of active range of motion (AROM) in external rotation of affected shoulder at least 10 degrees, could perform shoulder abduction at least 90 degrees. While, the exclusion criteria were detectable inflammation in shoulder girdle region, trauma of shoulder complex within 6 months before participation, having previous shoulder surgery or manipulations under anesthesia, diabetes mellitus, neurological disorders, other shoulder conditions, for example, Rheumatoid arthritis, osteoarthritis, rotator cuff rupture, malignancies in the shoulder region, taking analgesic drugs before treatment within 6 hours. All eligible subjects signed consent forms before participation.

Clinical parameters

This study consists of four clinical parameters: pain, active range of motion (AROM), shoulder functions, and satisfaction.

Pain

Ten-centimeter horizontal line visual analogue scale (VAS) anchoring “no pain” on the left end and “worst pain imaginable” on the right was marked by the subjects to express their pain intensity at the end range of active external rotation (AER).

Active range of motion (AROM)

A universal full-circle goniometer with the length of lever arms of 17 centimeters was used to measure the subjects’ active external rotation (AER). The circle comprises 360 degrees with 1 degree interval. All subjects were measured by the same examiner (WK). The demonstration was provided for

every subject before the measurement. The position of measurement, the subject was positioned in supine lying on the measurement plinth; the subject’s measurement shoulder was in 90-degree abduction and 90-degree elbow flexion. The elbow rested on the plinth while the forearm was perpendicular to the plinth, and the wrist was neutral. Then, the subject was asked to actively perform shoulder external rotation keeping 90-degree shoulder abduction and 90-degree elbow flexion allowing only the movement of shoulder external rotation. The physical therapists (RA and SM) were blinded to the measurement record and the data analysis. Before the research, the examiner was trained several times to ascertain the reliability and her intratester reliability presenting with ICC_(3,1) value was 0.968 (lower bound = 0.881, upper bound = 0.992)

Shoulder disability

In this study, the shoulder disability pertaining to shoulder external rotation was investigated comprising 3 activities: washing hair, putting on t-shirt, and carrying a heavy object (4.5 kilograms approximately). The method for shoulder disability measurement was the use of 10-centimeter horizontal VAS with the left end “no difficulty” and the right end “so difficult it requires help”. The subjects were asked to exactly perform those activities and then marked the level of disability in each activity to express their difficulty. Score range in each item is between 0-10, the less score the less disability.

Satisfaction

The satisfaction comprises 4 levels: 1 (very unsatisfied), 2 (unsatisfied), 3 (satisfied), and 4 (very satisfied)⁽¹⁵⁾. The subjects chose only 1 of 4 satisfaction levels representing their satisfaction at the end of the treatment program. The satisfaction was used to correlate with pain, AROM, and shoulder disability.

Interventions

The subjects underwent 2-visit physical therapy program in 2 consecutive weeks. Each treatment visit offered muscle energy technique (MET) for 5 minutes and shoulder mobilization 10 minutes. The subjects were in supine lying during MET and shoulder mobilization treatments.

The MET was actively done by the subjects with isometric contraction at approximately 25% of maximum voluntary contraction in the internal rotation direction against the physical therapist's hand and hold for 30 seconds. After that, the subjects relaxed. The MET was done 3 times totally.

For shoulder mobilization, grade III and grade IV⁽¹⁶⁾, end-range mobilization was given at the affected glenohumeral joint^(17, 18). Four directions of mobilization technique: 1) physiological movement of external rotation direction, 2) accessory movement of anteroposterior direction, 3) accessory movement of posteroanterior with cephalocaudal direction in supine, and 4) accessory movement of posteroanterior with cephalocaudal direction in prone, were done to increase shoulder external rotation. Total duration of mobilization session lasted 10 minutes.

Procedures

Baseline assessments were recorded including pain (VAS), AROM (AER), and shoulder disability (washing hair, putting on t-shirt, and carrying a heavy object). Then, all subjects underwent intervention session lasting 2 weeks. At the end of the treatment program (after-intervention), the subjects were assessed again including all aforementioned assessments plus satisfaction.

Statistical analysis

This study used both internal and external responsiveness methods. The internal responsiveness

included change scores, effect size (ES), and standardized response mean (SRM). The external responsiveness was the correlation between the change score of each parameter and the satisfaction. To investigate the significant differences between baseline and after-intervention data, Wilcoxon signed rank test was used since the distribution of the data was not normal according to Shapiro-Wilk test.

Change scores

Change score is the absolute values of the difference between after-intervention and baseline scores; the greater the difference, the greater the responsiveness.

Effect size (ES)

ES is another method for considering the responsiveness, defined as the absolute value of mean change (after-intervention minus baseline scores) divided by standard deviation of the baseline score. According to Cohen's suggestion, ES value less than 0.4 is considered small responsiveness, 0.5 moderate, and 0.8 large^(19, 20).

Standardized response mean (SRM)

SRM is similar to ES, defined as the absolute value of mean change (after-intervention minus baseline scores) divided by standard deviation of this change⁽¹¹⁾. Interpretation of the magnitude of SRM was considered with Cohen's suggestion as well, which are less than 0.4 small, 0.5 moderate, and 0.8 large^(19, 20).

Correlation with the satisfaction

This study investigated the correlation by matching between the change score of each parameter (pain, AROM, shoulder disability) and the satisfaction. Spearman's correlation was then used with p-value set at less than 0.05 for statistical significance.

Results

There were 24 subjects participated in this study. Demographic data of the subjects are reported in **Table 1**. The baseline and after-intervention data of the subjects: pain, AROM, shoulder disability, and the satisfaction are provided in Table 2. By which, the significant differences between baseline and after-intervention data were found in all outcomes. Nineteen subjects of 24 (79.17 %) rated the satisfaction at

level 4, and the rest (5 subjects, 20.83 %) rated level 3. The results of change score, ES, SRM, and correlation are shown in Table 3. The change score of the parameters ranged from 1.69 – 12.75, the ES ranged from 0.61 -2.11, and the SRM ranged from 0.87 – 2.61. The correlation of the change score of each parameter and the satisfaction ranged from 0.030 – 0.349, without statistical significance.

Table 1 Demographic data of the subjects.

Characteristics ^a	
Female/Male, n	17/7
Age (yr)	54.37 ± 7.02
Weight (kg)	60.59 ± 8.99
Height (cm)	160.17 ± 7.39
Body mass index (kg/m ²)	23.71 ± 3.86
Duration of symptom (months)	8.35 ± 6.86
Dominant side of arm: Right/Left, n	20/4
Affected side of shoulder: Right/Left, n	14/10

^a Data are shown as number or mean ± standard deviation

Discussion

The objective of this study was to investigate the responsiveness of pain, AROM, and shoulder disability in individuals with shoulder adhesive capsulitis who came for physical therapy interventions. There were 24 subjects who met all inclusion criteria included in this study. All of the subjects reported that they got recovered and satisfied after the physical therapy session, **Table 2**. The data of all subjects were therefore gathered for the responsiveness study.

The demographic data of the subjects in this study, the subjects were categorized as primary adhesive capsulitis since the known pathologic causes such as diabetes mellitus, inflammation, neurological disorders, and other shoulder conditions were excluded⁽⁴⁾, females were the majority and the average age was

54.37, which corresponded to the previous statements regarding the majority of gender and age of adhesive capsulitis^(2, 3). Most subjects (83.33 %) were right-handed. Fourteen of 24 affected shoulders were on the right side. The average duration of symptoms was 8.35 months, which fell on the freezing and the frozen stages defining the duration lasts between 10 and 36 weeks, and between 4 and 12 months respectively. These stages are evident in pain and stiffness of the affected shoulder⁽²¹⁾. According to the physical examination before the participation, all subjects had the limitation of active external rotation (AER) in common. They therefore had the difficulty in the activities involving active external rotation such as washing hair, putting on T-shirt, and carrying a heavy object^(6, 7, 5).

Table 2 Baseline and after-intervention data of the subjects.

Parameters	Baseline	After-intervention	P - value [#]
Pain			
Pain scale (VAS) (cm)	5.27 ± 1.51	2.08 ± 1.77	< 0.001 *
AROM			
AER (degrees)	46.91 ± 20.69	59.66 ± 20.36	< 0.001 *
Shoulder disability			
Washing hair (cm)	2.82 ± 2.19	1.13 ± 1.53	< 0.001 *
Putting on T-shirt (cm)	3.43 ± 2.41	1.38 ± 1.75	< 0.001 *
Carrying a heavy object (cm)	3.58 ± 2.70	1.53 ± 2.01	< 0.001 *
Satisfaction			
Satisfaction level 4 (number)	N/A	19 ^a	N/A
Satisfaction level 3 (number)	N/A	5 ^a	N/A
Satisfaction level 2 (number)	N/A	0 ^a	N/A
Satisfaction level 1 (number)	N/A	0 ^a	N/A
Median (25, 75 percentiles)	N/A	level 4 (4, 4) ^b	N/A

VAS = Visual analogue scale, AROM = Active range of motion, AER = Active external rotation, N/A = not applicable

Data are shown as mean ± standard deviation, except ^a is number, and ^b is median (25, 75 percentiles)

[#] P-value investigated using the Wilcoxon signed rank test, * significant difference

Table 3 Absolute values of change score, effect size, standardized response mean, and Spearman's correlation of each parameter.

Parameters	Internal responsiveness			External responsiveness	
	Change scores	ES	SRM	r	P - value
	Mean (SD)	(95% CI)	(95% CI)		
Pain	3.19 (1.22)	2.11 (1.77-2.45)	2.61 (2.12-2.95)	-0.037	0.863
AER	12.75 (7.21)	0.61 (0.46-0.76)	1.77 (1.33-2.22)	0.030	0.891
Washing hair	1.69 (1.94)	0.77 (0.40-1.14)	0.87 (0.39-1.26)	0.260	0.221
Putting on T-shirt	2.05 (1.83)	0.85 (0.53-1.17)	1.12 (0.65-1.53)	0.349	0.095
Carrying a heavy object	2.05 (1.89)	0.76 (0.46-1.05)	1.08 (0.62-1.50)	0.341	0.103

CI = confidence interval, r = Spearman's correlation

Besides the change scores and ES, in order to compare with the previous studies^(13, 14), the SRM was also calculated. The difference between ES and SRM is that the absolute value of mean change divided by standard deviation (SD) of the baseline score (ES) or the SD of the change score (SRM). The criteria for determination of ES or SRM were the same, from Cohen's suggestion, which are less than 0.4 small, 0.5 moderate, and 0.8 large^(19, 20).

For internal responsiveness, it was found that pain showed large responsiveness, 3.19 cm change score, 2.11 ES, 2.61 SRM. The change score of pain of 3.19 cm in this study was greater than the suggestion of Bird and Dickson⁽²²⁾ stating that 1.9 cm of change on 10-cm VAS is the minimum value for significant change in pain for patients. ES value of 2.11 and SRM of 2.61 considered large responsiveness as well. SRM of pain of this study was similar to those of the previous studies, which reported SRM of 2.1⁽¹⁴⁾ and 1.62⁽¹³⁾, despite the pain measurements in the previous studies were different, numeric rating scale (NRS-101) and pain score from SPADI. AER in this study was also high (1.77 SRM) as well as the previous studies, 1.2 SRM⁽¹⁴⁾, and 1.13 SRM⁽¹³⁾. The result of SRM proved that AER is very responsive to detect the change from time to time in individuals with shoulder adhesive capsulitis. For shoulder disability, it was found that putting on T-shirt was the most responsive activity (1.12 SRM) compared with washing hair (0.87 SRM) and carrying a heavy object (1.08 SRM). Anyhow, these activities were greater than the Cohen's suggestion of 0.8, these three activities all considered large responsiveness. These three activities, SRM values were higher than ES values (ranged from 0.76 – 0.85) reflecting the greater variability of the baseline scores compared to those of the change scores. The shoulder disability representing three activities in this study could not be compared with the previous studies since they used different outcomes, SDQ (1.6 SRM)⁽¹⁴⁾ and

SPADI (1.76 SRM)⁽¹³⁾. Anyhow, their disability's SRMs were highly responsive as well. The internal responsiveness in this study was very high, corresponding to the previous studies^(13, 14), even though the techniques of treatments were different, physical therapy interventions in this study versus the invasive techniques in the previous studies.

For external responsiveness, the correlations between the change scores of each parameter and the satisfaction ranged from 0.030 to 0.349 representing low association. The correlations in the previous studies ranged from 0.02 to 0.40⁽¹³⁾ and 0.02 to 0.76⁽¹⁴⁾. The magnitude of the correlation in the present study was similar to the study of Tveitå et al⁽¹³⁾. However, the comparison with the previous studies could not be made because the correlations were done in different contexts. The low correlation in this study might be due to the ceiling effect of the satisfaction scores, most subjects (79.17 %) rated level 4 of satisfaction which perhaps reflecting the Hawthorne effect. The future study should therefore select more relevant external reference. The correlation data in this study was very similar to the previous study using the similar methods⁽¹²⁾.

The result of this study proved that physical therapy is also effective in managing individuals with shoulder adhesive capsulitis representing with decreased pain, improved AER, and decreased shoulder disability. This study focused on pain, AER, and three activities representing disability. The further study can extensively study the responsiveness of other clinical outcomes such as other shoulder ROM and other shoulder disability outcomes. Other references for external responsiveness should be used to get more relevant external responsiveness. Also, other subgroups of shoulder adhesive capsulitis or other shoulder disorders are interesting.

Conclusion

This study proved that pain, AER, and shoulder disability: washing hair, putting on T-shirt, and carrying a heavy object, were responsive to physical therapy interventions according to their high internal responsiveness. It was therefore suggested that those aforementioned clinical outcomes can be used as indicators for detecting the change from time to time.

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