Evaluating the effectiveness of frozen shoulder treatment on the right and left sides

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Abstract. [Purpose] To evaluate treatments with interferential current, hot pack, ultrasound therapy, stretching, strengthening and range-of-motion exercises, comparing between the right and left shoulders in terms of pain and functional capacity in patients with frozen shoulder. This was a retrospective study. [Subjects and Methods] Sixty-four patients (34 right side, 30 left side) were treated with interferential current and hot pack application for 20 min each, ultrasound therapy for 3 min, regular range-of-motion exercises, stretching exercises, strengthening with a Theraband in all directions and post-exercise proprioceptive neuromuscular facilitation techniques. All cases were evaluated with visual analogue scales for pain, passive and active range of motion, Constant score, and the shoulder disability questionnaire, at baseline and 7 and 12 weeks after baseline. [Results] Marked improvement was noted in all patients in both right and left sides after treatment, and at 7 and 12 weeks of follow-up compared with baseline. There was no significant difference between the right and left shoulder groups, in all outcome measures. [Conclusion] The combination of physical therapy, exercise, and manual techniques is effective in treating frozen shoulder. The location of the lesion in the right or left shoulder does not, in itself, affect the prognosis or treatment outcome.

Key words: Frozen shoulder, Interferential current, Exercise

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INTRODUCTION

Shoulder pain is a commonly encountered problem, with prevalence studies indicating a frequency of 7–20% among the adult general population1, 2). Frozen shoulder, also called adhesive capsulitis, is one of the diseases that cause shoulder pain. The incidence of this condition in the general population is between 2% and 5%3). It is more common among women aged 40–60 years4). The disease is characterized by pain, loss of function, and loss of joint range of motion (ROM)5). Its etiology is incompletely elucidated6). The pathologic anatomy of frozen shoulder includes synovial inflammation, joint capsule hypertrophy, and a resulting development of fibrous structures7). The condition occurs bilaterally in 20–30% of cases8). Awareness of the disease generally starts with a sensation of strain while performing critical movements and joint pain when moving in any direction9).

The frozen shoulder syndrome affects the glenohumeral joint; the physiologic movement most restricted by the syndrome is external rotation3, 9, 10). The main patient complaint is joint stiffness3). As this problem gradually worsens, the patient avoids mobilizing the shoulder, creating a vicious circle in which movement restriction increases pain and causes atrophy, resulting in further increased stiffness. Thus, it is of critical importance for both the patient’s quality of life and the reversibility of the condition to recognize the disease and promptly provide treatment before it reaches an advanced stage.

Frozen shoulder can be of primary or secondary type. The term “primary” indicates an idiopathic condition. Secondary disease may be linked to trauma, cardiovascular disease, hemiparesis, surgical procedures or diabetes11, 12). The probability

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of frozen shoulder syndrome occurring in a diabetic patient is 10–36%
(13). A recurrence in the same shoulder very rarely occurs (13).

Although numerous published studies on the most effective treatment for frozen shoulder are available, the topic remains somewhat controversial (14). Many treatment methods have been applied; the most widespread and effective treatments are heat application, ultrasound, neuromuscular electrostimulation, continuous passive movement exercises, joint mobilization, proprioceptive neuromuscular facilitation (PNF) techniques, and ROM exercises (15). PNF exercises include diagonal and spiral movements that indirectly affect muscles by increasing their contraction (16).

**SUBJECTS AND METHODS**

Sixty four patients (64 shoulders) in whom frozen shoulder syndrome was diagnosed between 2011 and 2014 by an orthopedics and traumatology specialist were retrospectively assessed. Of the 64 affected shoulders, 34 were on the right side and 30 on the left side. Patient data and detailed histories were collected by physical medicine and rehabilitation specialists. The patients were seen for treatment every other day according to the physician’s choice. The Constant-Murley shoulder outcome score (CMS) was evaluated at baseline at the first session and then at visits on the 7th and 12th weeks after baseline (17). The patients’ self-evaluation of pain level was also assessed on a visual analogue scale (VAS) at the same visits (18). The CMS consists of four subscales evaluating pain, the ability to carry out normal daily activities, ROM and strength.

In all patients without a contraindication to deep or superficial heat application, the treatment protocol included interferential current and hot pack application for 20 min each, ultrasound therapy for 3 min, regular ROM exercises, stretching exercises, strengthening with a Theraband in all directions and applying post-exercise PNF techniques. In our study approximation, contract-relax and repetitive stretching in PNF techniques were preferred. Itoh et al. suggested that the approximation technique especially provides suitable contractions and suitable balanced function of articular capsules, and muscles through affecting deep sensory receptors (19). Twenty manual stretching exercises were performed, five in each direction. The directions of manual stretching were internal rotation, abduction, flexion, external rotation and extension respectively. Each stretching exercise took 30 s followed by 15 s of rest between each stretch (20). After the stretching exercises, transcutaneous electrical nerve stimulation (TENS) and cold pack applications were performed simultaneously.

As this study involved human subjects, the ethical standards of the Declaration of Helsinki were followed. The ethical committee of Bahcesehir University has approved the study protocol and written consent was obtained from each patient.

The data are expressed by using descriptive statistics: mean, standard deviation (SD), median, minimum and maximum (range), and frequency and percentage. The data were tested for normal distribution by using the Kolmogorov-Smirnov test. The Mann-Whitney U test was used for continuous variables, and the \( \chi^2 \) test or Wilcoxon’s signed rank test was used, as applicable, for categorical data. SPSS 22.0 software was used for analysis.

**RESULTS**

No significant difference was found in age and gender distribution when comparing patients affected in the right shoulder versus those affected in the left shoulder (\( p>0.05 \); Table 1). The baseline, and the first and second VAS assessments at 7 and 12 weeks showed no significant difference between the left and right shoulder groups (Table 2), whereas the values at the first and second assessments were significantly lower than those at baseline (\( p<0.05 \)) within both the right and left shoulder groups. The degree of improvement in the VAS was not significantly different between these two groups (Table 2).

The passive shoulder flexion range did not differ significantly between the left and right shoulder groups at baseline or at the first or second assessments (Table 3). The first and second assessment values were significantly lower than those at baseline (\( p<0.05 \)) within both the right and left shoulder groups. The increase in the passive flexion range from baseline to the first and second assessments were not significantly different between the left and right shoulder groups (Table 3). The same results were found for the increase from baseline and the difference between the two patient groups for the active shoulder flexion values (Table 3).

No significant difference was found in the passive abduction range between the left and right shoulder groups at baseline, or at the follow-up assessments (Table 4). These values differed significantly from baseline to their first and second assessments (\( p<0.05 \)) within both patient groups. The rate of increase from baseline to the follow-up assessments in the passive abduction range was not statistically significant (Table 4). For the active abduction range (Table 4) and the passive internal 24.2\(^\circ\)rotation or the active internal rotation range (Table 5), the results were similar.

The passive external rotation value was not significantly different between the two groups at baseline and at the first and second follow-up assessments (Table 6). There was, however, a significant increase in the passive external rotation range from baseline to the two follow-up assessments, both in the left and the right shoulder groups (\( p<0.05 \)), although there was no difference when comparing the degree of improvement between the left and right shoulder groups (Table 6).

The passive external rotation value was not significantly different between the two groups at baseline and at the first and second follow-up assessments (Table 6). The active external rotation values were similar at all time points in degree of improvement and by group (Table 6).
### Table 1. Demographic data

|                      | Left shoulder | Right shoulder |
|----------------------|---------------|----------------|
|                      | Mean ± 1 SD   | Med (min–max)  | Mean ± 1 SD   | Med (min–max)  |
| Age (years)          | 54.5±9.5      | 54 38–78       | 55.5±10.5     | 54 38–80       |
| Gender               |               |                |               |                |
| Female               | 10 33%        | 12 35%         |               |                |
| Male                 | 20 67%        | 22 65%         |               |                |

Mann-Whitney U test / χ² test

### Table 2. Passive and active shoulder flexion before and after treatment

|                      | Left shoulder | Right shoulder |
|----------------------|---------------|----------------|
|                      | Mean ± 1 SD   | Med (min–max)  | Mean ± 1 SD   | Med (min–max)  |
| Passive shoulder flexion |               |                |               |                |
| Baseline             | 142.8°±21.6°  | 148° −95°–175° | 147.6°±20.7°  | 150° 100°–180° |
| 1st assessment       | 161.1°±15.2°  | 167° 130°–180° | 165.6°±13.4°  | 170° 130°–180° |
| 2nd assessment       | 169.8°±10.9°  | 175° 145°–180° | 174.1°±9.6°   | 180° 135°–180° |
| Change from baseline |               |                |               |                |
| 1st assessment       | 18.2°±12.8° * | 16° −10°–47°   | 18.1°±13.7° * | 18° 0°–45°     |
| 2nd assessment       | 27.0°±16.2° * | 25° 5°–77°     | 26.6°±18.4° * | 23° 0°–65°     |
| Active shoulder flexion |               |                |               |                |
| Baseline             | 130.8°±22.5°  | 135° 85°–160°  | 134.9°±22.5°  | 140° 90°–170°  |
| 1st assessment       | 150.0°±19.5°  | 153° 110°–180° | 154.7°±17.0°  | 160° 110°–175° |
| 2nd assessment       | 159.4°±15.6°  | 160° 125°–180° | 166.8°±12.3°  | 170° 125°–180° |
| Change from baseline |               |                |               |                |
| 1st assessment       | 19.2°±11.4° * | 20° −20°–40°   | 19.9°±13.2° * | 18° 0°–45°     |
| 2nd assessment       | 28.6°±12.8° * | 30° 0°–67°     | 31.9°±18.3° * | 30° 3°–70°     |

Mann-Whitney U test / Wilcoxon’s signed rank test
*Significant within-group change from baseline, p<0.05
°Shoulder range of motion measured in degrees

### Table 3. Passive and active shoulder abduction before and after treatment

|                      | Left shoulder | Right shoulder |
|----------------------|---------------|----------------|
|                      | Mean ± 1 SD   | Med (min–max)  | Mean ± 1 SD   | Med (min–max)  |
| Passive shoulder abduction |               |                |               |                |
| Baseline             | 123.6°±29.8°  | 120° 80°–180°  | 130.0°±25.7°  | 130° 90°–80    |
| 1st assessment       | 142.8°±26.0°  | 138° 90°–180°  | 147.3°±24.2°  | 143° 105°–80   |
| 2nd assessment       | 155.6°±22.3°  | 158° 110°–180° | 164.3°±17.8°  | 170° 120°–180° |
| Change from baseline |               |                |               |                |
| 1st assessment       | 19.2°±17.0° * | 15° −10°–55°   | 17.3°±15.6° * | 15° 0°–60°     |
| 2nd assessment       | 32.0°±22.5° * | 30° −5°–75°    | 34.3°±24.5° * | 35° 0°–90°     |
| Active shoulder abduction |               |                |               |                |
| Baseline             | 111.0°±32.0°  | 105° 60°–180°  | 115.9°±24.2°  | 118° 70°–175°  |
| 1st assessment       | 126.8°±28.6°  | 123° 70°–180°  | 135.6°±24.8°  | 135° 95°–175°  |
| 2nd assessment       | 141.4°±28.2°  | 140° 90°–180°  | 153.4°±21.8°  | 160° 100°–180° |
| Change from baseline |               |                |               |                |
| 1st assessment       | 15.8°±12.9° * | 15° −20°–50°   | 19.8°±15.1° * | 18° 0°–55°     |
| 2nd assessment       | 30.4°±20.7° * | 25° −10°–75°   | 37.5°±23.8° * | 40° 0°–100°    |

Mann-Whitney U test / Wilcoxon’s signed rank test
*Significant within-group change from baseline, p<0.05
°Shoulder range of motion measured in degrees
### Table 4. Passive and active shoulder internal rotation before and after treatment

|                        | Left shoulder |                                                                 | Right shoulder |                                                                 |
|------------------------|---------------|-----------------------------------------------------------------|----------------|-----------------------------------------------------------------|
|                        | **Mean ± 1 SD** | **Med (min–max)** | **Mean ± 1 SD** | **Med (min–max)** |
| Passive shoulder       |               |                                                                |                |                                                                |
| internal rot.          |               |                                                                |                |                                                                |
| Baseline               | 72.5°±14.5°   | 75° 30°–90°           | 77.4°±14.9°    | 88° 50°–90°          |
| 1st assessment         | 83.7°±9.0°    | 90° 65°–90°           | 84.8°±9.0°     | 90° 60°–90°          |
| 2nd assessment         | 85.8°±8.9°    | 90° 60°–90°           | 86.9°±6.3°     | 90° 70°–90°          |
| Change from baseline   |               |                                                                |                |                                                                |
| 1st assessment         | 11.2°±15.1°   | 5° –15°–55°           | 7.4°±11.2°     | 3° –20°–35°          |
| 2nd assessment         | 13.3°±15.4°   | 10° –15°–60°          | 9.5°±13.3°     | 3° –20°–35°          |
| Passive shoulder       |               |                                                                |                |                                                                |
| internal rot.          |               |                                                                |                |                                                                |
| Baseline               | 59.8°±20.1°   | 60° 15°–90°           | 67.9°±18.0°    | 70° 30°–90°          |
| 1st assessment         | 75.9°±11.4°   | 80° 50°–90°           | 79.6°±12.8°    | 90° 55°–90°          |
| 2nd assessment         | 80.0°±12.5°   | 85° 40°–90°           | 84.3°±9.7°     | 90° 60°–90°          |
| Change from baseline   |               |                                                                |                |                                                                |
| 1st assessment         | 16.0°±18.4°   | 10° –10°–65°          | 11.6°±13.5°    | 10° –20°–45°         |
| 2nd assessment         | 20.1°±20.0°   | 18° –15°–75°          | 16.3°±15.7°    | 20° –20°–45°         |

*Mann-Whitney U test / Wilcoxon’s signed rank test*

*Significant within-group change from baseline, p<0.05

°Shoulder range of motion measured in degrees

### Table 5. Passive and active shoulder external rotation before and after treatment

|                        | Left shoulder |                                                                 | Right shoulder |                                                                 |
|------------------------|---------------|-----------------------------------------------------------------|----------------|-----------------------------------------------------------------|
|                        | **Mean ± 1 SD** | **Med (Min–Max)** | **Mean ± 1 SD** | **Med (Min–Max)** |
| Passive shoulder       |               |                                                                |                |                                                                |
| external rot.          |               |                                                                |                |                                                                |
| Baseline               | 52.3°±20.9°   | 50° 10°–90°           | 57.9°±23.1°    | 60° 15°–90°          |
| 1st assessment         | 60.8°±20.2°   | 60° 30°–90°           | 69.3°±19.5°    | 70° 25°–90°          |
| 2nd assessment         | 72.4°±16.4°   | 78° 25°–90°           | 79.1°±14.1°    | 85° 40°–90°          |
| Change from baseline   |               |                                                                |                |                                                                |
| 1st assessment         | 8.5°±14.7°    | 10° –50°–35°          | 11.4°±12.5°    | 10° –10°–55°         |
| 2nd assessment         | 20.1°±20.3°   | 23° –55°–60°          | 21.2°±20.5°    | 18° 0°–75°           |
| Passive shoulder       |               |                                                                |                |                                                                |
| external rot.          |               |                                                                |                |                                                                |
| Baseline               | 41.3°±22.5°   | 43° 0°–85°            | 47.8°±23.8°    | 50° 0°–90°           |
| 1st assessment         | 52.0°±21.0°   | 50° 20°–90°           | 59.5°±21.4°    | 63° 10°–90°          |
| 2nd assessment         | 62.2°±19.8°   | 65° 20°–90°           | 72.0°±18.3°    | 80° 15°–90°          |
| Change from baseline   |               |                                                                |                |                                                                |
| 1st assessment         | 10.7°±15.4°   | 8° –40°–45°           | 11.7°±13.3°    | 10° –10°–45°         |
| 2nd assessment         | 21.0°±18.4°   | 18° –40°–50°          | 24.2°±20.4°    | 20° 0°–80°          |

*Mann-Whitney U test / Wilcoxon’s signed rank test*

*Significant within-group change from baseline, p<0.05

°Shoulder range of motion measured in degrees

### Table 6. VAS before and after treatment

|                        | Left Shoulder |                                                                 | Right Shoulder |                                                                 |
|------------------------|---------------|-----------------------------------------------------------------|----------------|-----------------------------------------------------------------|
|                        | **Mean ± 1 SD** | **Med (Min–Max)** | **Mean ± 1 SD** | **Med (Min–Max)** |
| VAS                    |               |                                                                |                |                                                                |
| Baseline               | 6.1°±2.6°     | 7° 0°–10°             | 6.7°±2.7°     | 8° 2°–10°             |
| 1st assessment         | 4.5°±2.4°     | 5° 0°–9°              | 4.7°±2.3°     | 4° 1°–10°             |
| 2nd assessment         | 3.1°±2.2°     | 3° 0°–9°              | 3.3°±2.3°     | 3° 0°–9°              |
| Change from baseline   |               |                                                                |                |                                                                |
| 1st assessment         | –1.6°±1.5°    | –2° –7°–0°           | –2.0°±1.6°    | –2° –6°–2°           |
| 2nd assessment         | –3.1°±2.0°    | –3° –9°–0°           | –3.4°±2.7°    | –3° –10°–2°          |

*Mann-Whitney U test / Wilcoxon’s signed rank test*

*Significant within-group change from baseline, p<0.05

°Shoulder range of motion measured in degrees
DISCUSSION

The frozen shoulder syndrome is characterized by progressive pain, as well as active and passive ROM restriction, that degrade the patient’s quality of life. Its development is linked to numerous factors; however its main cause remains un-elucidated. While a homolateral recurrence of frozen shoulder is rare, contralateral recurrences occur because of patients’ tendency to protect their affected side. While the main conclusion of our study is the absence of observed differences between left and right laterality, it has been shown repeatedly that frozen shoulder more often affects the dominant extremity21).

Although studies indicate that the condition is more frequent in women aged 40–60 years, retrospective evaluations do not reveal a significant difference in gender incidence. The patient population of this study was too small to form general conclusions. More studies are needed to verify our results.

As a prompt evaluation of the perception of disease severity by the patient, VAS is a significant index that aids direct rehabilitation in the clinic. Concerning CMS, besides being a widely used, popular evaluation method, it can also be useful for evaluating the entire process of shoulder therapy and completing the clinical examination22).

Various physical therapy methods have been described for treating frozen shoulder; however none has been established as a formal treatment program. While some studies focused on capsular tension and functional results, others have compared results in terms of pain and stiffness. Studies validating the therapeutic efficacy of manual therapy and shoulder exercises have been published23). For example, Do Moon et al. compared the Maitland and Kaltenborn mobilization techniques and found significant differences in pain and the ROM of both internal and external shoulder rotation pre- and post-intervention in the Maitland and Kaltenborn groups; however, there were no significant differences when the groups were compared for outcome measures24). On the other hand, Park et al. demonstrated in their study that a combination of intensive mobilization and steroid injection with capsular distension was the best treatment modality for frozen shoulder25).

Our evaluation of function at visits on the 7th and 12th weeks showed the presence of significant improvement. In all patients not presenting a contraindication to deep or superficial heat application, the treatment protocol included interfemoral current and hot pack application for 20 min each, ultrasound therapy during 3 min, regular ROM exercises, stretching exercises, strengthening with Theraband in all directions, and the application of post-exercise PNF techniques. Twenty manual stretching exercises were performed, five in each direction. This was followed by 10 min of TENS and cold pack application. It is difficult to explain which of all these applications played a role in the results, or the possible superiority of one method over another. Published reports suggest that the efficacy of either stretching or active exercises by themselves is less than that of their combination. Whereas studies with such a combination have not attempted separate evaluations for the right and the left shoulder, our study indicates that this combination treatment is beneficial regardless of the laterality of the shoulder lesion. However there are studies about shoulder impingement for which PNF techniques (especially contract-relax and repetitive stretching) improve the external rotation ROM and decrease pain in teh shoulder joint26). Nonetheless, testing on a larger patient population is needed.

No significant difference was detected in ROM limitations between patients in the left and right shoulder groups; however, a significant ROM improvement was noted in both active and passive mobilization measures. Considering this finding, it can be concluded that the location of the lesion in the right or the left shoulder does not in itself affect the prognosis or the treatment result.

The patients were not differentiated according to the primary or secondary origin of their frozen shoulder and were pooled for evaluation. The treatment protocol resulted in significant improvement in both groups of patients. From a more general perspective, the lesion localization on the left or right side did not differ in terms of disease progression or treatment results; however a study on a larger patient population is necessary to confirm this result.

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