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The Effectiveness of Intensive Mobilization Techniques Combined with Capsular Distension for Adhesive Capsulitis of the Shoulder

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Abstract. [Purpose] The aim of this study was to determine the synergistic effect of intensive mobilization techniques combined with capsular distension for patients with adhesive capsulitis (AC). [Subjects] The subjects were 53 patients with AC (mean age, 56.0 ± 7.6 years). [Methods] Patients were randomized to one of four treatment groups: intensive mobilization after one steroid injection with capsular distension (IMSID); intensive mobilization (IM); one steroid injection with capsular distension (SID); and general physical therapy only (GPT). The IMSID, IM, and SID groups also received general physical therapy for 20 minutes. All treatments were performed twice per week for 4 weeks. Patients were assessed using the Shoulder Pain and Disability Index (SPADI), Constant-Murley Shoulder Function Assessment Score (CS), Active Range of Motion (AROM), and Verbal Numeric Score (VNS). [Results] There were significant post-intervention differences in all the measured values in each of the groups, except for external rotation ROM in the SID group. The IMSID group showed the greatest differences among the groups. There were significant differences among the means of all the groups. [Conclusion] The most effective treatment for AC was the combination of the intensive mobilization and steroid injection with capsular distension, which helped to control inflammation, extend joint space, and recover ROM.

Key words: Adhesive capsulitis, Intensive mobilization, Capsular distension

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INTRODUCTION

Adhesive capsulitis (AC) is a shoulder condition characterized by gradual and painful loss of both active and passive range of motion (ROM) in all planes of the glenohumeral joint[1)]. Shoulder pain and stiffness are accompanied by severe disability. Often, this results in absenteeism from work, inability to perform leisure activities, and utilization of health care resources. Although it is generally believed to be a self-limiting condition lasting 2–3 years, some studies have reported that up to 40% of patients have persistent symptoms and stiffness beyond 3 years. Therefore, effective treatment that shortens the duration of symptoms and disability has the potential to be of significant value in terms of reduced morbidity and costs[2)]. Many treatments have been advocated for AC: rest, analgesia, active and passive mobilization, physical therapy, oral and injected corticosteroids, capsular distension, manipulation under anesthetic, and arthroscopic capsular release. Currently, there is no consensus as to which is the most effective treatment[3)].

Physical therapy following joint distension provides no additional benefits in terms of pain, function, or quality of life, but results in sustained greater active range of shoulder movement and participant-perceived improvement up to 6 months. Capsular distension and subsequent intensive rehabilitation has a beneficial effect, and this combination enables rapid, significant improvement from the first week onwards[4)]. It has been reported that general physical therapy plus distension with intra-articular (IA) steroid injection is superior to physical therapy alone for the functional improvement of frozen shoulder; however, the pain score difference was not significant between the two groups[5)].

The efficacy of AC treatment is still being debated. Steroid injection with distension is currently recommended for the treatment of AC. It also has been demonstrated that a variety of mobilization therapies show the same clinical outcome with less risk[6)]. Nevertheless, the synergistic effect of an intensive mobilization technique combined with capsular distension and steroid injection for AC in improving pain, shoulder ROM, and shoulder function is unclear. Therefore, we conducted a randomized controlled trial for 4 weeks, focusing on the effectiveness of an intensive mobilization technique combined with distension for AC of the shoulder.

SUBJECTS AND METHODS

Using patient medical records, this study retrospectively analyzed treatment effects. Patients with shoulder pain and

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limitation in motion visiting the outpatient rehabilitation department were initially selected. The inclusion criteria of this study were as follows: stage 1 or 2 AC, with a symptom duration of 3–9 months, and difficulties in two or more of the following: flexion, abduction, external rotation, and/or hands behind the body presenting limitation of more than 30 degrees in active ranges of motion, compared to the normal side with regard to range of motion[2, 7].

Prior to participation, all participants were informed about the study's aims and procedures, and signed in formed consent forms. This study conformed to the ethical principles of the Declaration of Helsinki.

Patients in the intensive mobilization after steroid injection with distension (IMSID) group received an injection once before treatment was started. Under fluoroscopic guidance, all patients received 40 mg of triamcinolone, 3 ml of 1% lidocaine, and 10 ml of normal saline given by the anterior route. All injections were performed by the same doctor of rehabilitation medicine, who is well-trained. After injection, the IMSID group received intensive mobilization therapy for 20 minutes which was performed by one physical therapist. Specific intensive mobilization techniques included: 1) glenohumeral joint passive accessory glides, including the Maitland mobilization technique (MMT)[8], End-Range Mobilization (ERM)[9] and Kaltenborn's convex-concave gliding[10]; and 2) glenohumeral joint physiologic mobilization, including Mobilization with Movement (MWM)[11]. The Intensive Mobilization (IM) was treated only with the intensive mobilization technique. The Steroid Injection with Distension (SID) group received only a single capsular distension at the times of steroid injection. The General Physical Therapy (GPT) group received physical therapy for 20 minutes, which included moisture hot pack, transcutaneous electrical nerve stimulation, and ultrasound diathermy. The IMSID, IM, and SID groups also received general physical therapy for 20 minutes. At the beginning of the intervention, participants were instructed to maintain their program of 10 minutes of daily home exercise. All treatments were performed twice per week for 4 weeks.

Patients were assessed using the Shoulder Pain and Disability Index (SPADI), Constant-Murley Shoulder Function Assessment Score (CS), Range of Motion (ROM), and Verbal Numeric Score (VNS) before treatment and at 4 weeks, after the final treatment. The primary outcome measure, the SPADI, is a self-administered assessment tool that assesses pain and disability related to shoulder disease[12]. Functional disability of the shoulder was also assessed using the CS, which includes an analysis of pain, shoulder motion, strength, and function[13]. The degree of shoulder pain was graded using the Verbal Numeric Scale (VNS). When using the VNS, the patients were asked to rate their pain on a scale from 0 to 10, with 0 representing no pain and 10 the worst pain possible[14]. The shoulder active ROM was measured with a goniometer that demonstrated good reliability (ICC $\geq$0.80)[15]. In the sitting position, shoulder flexion, abduction, and external rotation were measured (in degrees) with the goniometer, and internal rotation was measured as the distance (in cm) from the base of the occiput to the highest point the hand could reach up behind the back (HBB) with a tape measure.

We performed the Wilcoxon rank test to compare differences before and after intervention in each group. Comparisons of the mean values of SPADI, CS, VNS, and ROM across all groups were performed using the Kruskal Wallis test. When statistical significance was found, multiple comparisons were performed using the Mann-Whitney U test. Statistical analysis was performed using SPSS 18.0, and significance was accepted for values of $p<0.05$.

RESULTS

The demographic characteristics of the participants (n = 53) were as follows. Their mean age was 56 ± 7.6 years; the number of the female participants (n = 40) was more than the number of male participants (n = 13); and 24 patients had AC on the right side and 29 patients had AC on the left side.

There were significant post-intervention differences ($p < 0.05$) in VNS, AROM, SPADI, and CS in each of the groups, except for external rotation ROM in the SID group. The IMSID group showed the greatest differences in all measured values among the groups. There were significant differences ($p < 0.05$) among the means of the groups (Table 1).

The post hoc Mann-Whitney U test revealed that there were no significant differences between the IMSID and IM groups or between the SID and GPT groups ($p > 0.01$). There were significant differences in all values between the IMSID and SID groups. There were significant differences in VNS, HBB, SPADI, and CS between the IMSID and GPT groups ($p < 0.01$). There were significant differences in all values between the MI and SID groups, except SPADI. There were significant differences in VNS, HBB, and CS between the MI and GPT groups ($p < 0.01$).

DISCUSSION

There have been many studies of AC, but there is still debate about the most effective treatment. In general, intra-articular steroid injections, capsular distension, and joint mobilization therapy are known to be effective in the treatment of AC. While, joint mobilization techniques improve the mobility of the joint and soft tissues[16], researchers have reported different results with regards to pain management. Steroid injection therapy is very effective for pain reduction, but results in a relatively small improvement in ROM. This study demonstrated that additional intensive mobilization techniques after distension with steroid injection are the most effective intervention for AC.

Capsular distension is a method of separating the adherent synovium using hydrostatic pressure by injecting a large amount of fluid. Rizk et al.[17] explained that capsular distension shares a mechanism similar to manipulation under anesthesia. Intra-articular steroid injection in AC also shows efficacy by reducing the inflammatory response to the pathological process. Steroid injection is frequently used together with capsular distension, in order to reduce the symptoms and to increase the treatment effect during the inflammation phase. In this study, the IMSID and SID groups received capsular distension and steroid injection. They both showed improvements in all the measured val-

Table 1. Comparison of VNS, AROM, SPADI and CS among the groups

		IMSID (n=16)	IM (n=14)	SID (n=12)	GPT (n=11)
VNS	pre	8.1±1.0	7.8±0.8	7.8±0.8	7.6±1.0
	post	2.9±1.4 *	3.5±1.6 *	5.5±1.5 *	5.6±1.4 *
Fl (˚)	pre	116.3±19.3	120.0±26.6	115.0±23.2	126.8±27.4
	post	161.9±12.2 *	157.5±21.2 *	127.5±26.0 *	139.0±32.0 *
Abd (˚)	pre	84.4±8.9	94.3±30.6	101.2±32.5	103.1±28.1
	post	149.4±22.9 *	145.7±30.6 *	117.5±33.7 *	121.3±40.2 *
ER (˚)	pre	28.3±15.2	34.3±21.4	37.5±14.8	40.9±20.2
	post	71.9±8.3 *	64.3±16.9 *	42.1±19.7	55.0±24.7 *
HBB (cm)	pre	51.8±8.2	51.0±9.1	50.2±6.3	50.4±9.4
	post	33.6±8.1 *	34.9±9.5 *	46.7±6.9 *	43.7±9.9 *
SPADI	pre	64.3±12.8	60.6±12.9	56.6±9.6	55.4±11.7
	post	32.2±9.4 *	37.4±11.0 *	44.3±12.2 *	44.5±10.4 *
CS	pre	39.8±6.9	45.1±10.9	42.9±11	45.4±9.8
	post	71.4±10.1 *	67.1±11.3 *	52.2±12.8 *	55.2±14.9 *

Mean ± SD, * $p<0.05$
VNS, verbal numeral scale; Fl, flexion; Abd, abduction; ER, external rotation; HBB, hand behind the back to occiput; SPADI, Shoulder Pain and Disability Index; CS, Constant-Murley Shoulder Function Assessment Score; IMSID, intensive mobilization after steroid injection with distension; IM, intensive mobilization; SID, steroid injection with distension; GPT, general physical therapy

ues, and the IMSID group had a higher variation than the SID group. In a systematic review, Buchbinder et al.[18] reported the same results, suggesting that short term benefits with regard to pain, range of movement, and function can be achieved with capsular distension using saline and steroids.

Several studies have demonstrated the effectiveness of joint mobilization for patients with AC[19, 20]. The accumulated evidence indicates that not only passive joint mobilization, but also active mobilization, such as Kaltenborn's convex-concave rule and MWM may need to be considered to improve pain, ROM, and shoulder function. In this study, the IMSID and IM groups received intensive mobilization and showed improvement in all outcome measures.

Khan et al.[5] reported greater improvement in pain and ROM in patients receiving distension with steroid injection and physical therapy, such as therapeutic exercises, than participants receiving physical therapy alone; however, they reported no difference in the VAS pain score. According to our present results, there were significant differences in pain, AROM, and shoulder function scores between the IMSID and SID groups, as well as between the IMSID and GPT groups. Although there were significant differences between the IM and SID groups, and between the IM and GPT groups, the improvements were greater in the IMSID group than in the IM group. These results support our hypothesis that intensive mobilization techniques combined with capsular distension and steroid injection would improve pain, AROM, and the shoulder function of patients with AC, more than among those receiving only one kind of therapeutic approach.

In this study, only capsular distension treatment, including steroid injection without intensive mobilization, or simple conservative treatment, such as thermoelectric therapy, was effective. However, there is not yet enough evidence to suggest that this method is optimal for the treatment of frozen shoulder.

The results of this study suggest that the most effective treatment for subacute AC is a combination of intensive mobilization and steroid injection with capsular distension, and helped to control inflammation, extend joint space, and recover ROM. Therefore, intensive mobilization should be conducted by a skilled physical therapist after steroid injection with capsular distension to optimize the treatment effect for patients with AC.

In this study, the intervention period was only 4 weeks. It will be necessary to investigate the long-term treatment effects because of the unique aspects of AC. Further studies according to the stage of AC should also be undertaken.

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