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ORIGINAL ARTICLE

Effects of Elastic Band Resistance Training and Dumbbell Resistance Training on Shoulder Pain and Range of Motion in Korean Traditional Dancers with Adhesive Capsulitis: A Randomized Controlled Trial

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KEYWORDS
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Shoulder Pain,
Rehabilitation,
Adhesive Capsulitis.

ABSTRACT

Background. Shoulder pain is prevalent not only in the general population but also in dancers, who engage their shoulders intensely. **Objectives.** This study aimed to identify practical rehabilitation exercises for Korean traditional dancers suffering from adhesive capsulitis (AC), focusing on the comparative effects of elastic bands and dumbbells. **Methods.** Sixteen female participants diagnosed with shoulder pain were divided into two groups and underwent a 6-week training program involving either elastic bands or dumbbells. Measurements of shoulder joint range of motion (ROM) and pain intensity using the Numerical Rating Scale (NRS) were collected pre- and post-intervention. **Results.** Both groups showed improvements in ROM and NRS, with large effect sizes, though differences between groups were not statistically significant. **Conclusion.** Strength training using both elastic bands and dumbbells positively influenced shoulder rehabilitation. This suggests that resistance training, regardless of the tool, is beneficial in recovery. Further research with larger samples and longer durations is recommended.

INTRODUCTION

In Korea, the condition has been referred to as adhesive capsulitis (AC), which occurs when inflammation develops in the shoulder joint capsule, causing thickening or contraction of the capsule and adhesion to surrounding tissues. This condition has been commonly associated with individuals in their 50s, with a natural recovery process, leading to the colloquial term "frozen shoulder" (1). AC affects approximately 2-5% of the population, and according to national health big data on diseases of public interest, about 62% of patients are women as of 2021. Furthermore, it has been found that approximately 20% of patients experience similar symptoms in the opposite shoulder (2). AC generally occurs within five years following shoulder recovery (3). Although it was initially common in individuals over 50, recent trends show that it increasingly affects younger age groups, including individuals in their 30s and 40s, particularly dancers who use their shoulders intensively (4).

Appropriate treatment for AC patients is essential to prevent permanent shoulder dysfunction (5). Among various treatment

options, non-surgical treatments are preferred, including medication, manual therapy, and exercise-based interventions. Medication, such as nonsteroidal anti-inflammatory drugs and corticosteroids, is typically used early to reduce inflammation and pain (6). Additionally, interventional procedures such as hydraulic distension, which involves injecting saline and local anesthetics to expand the joint capsule and break adhesions, are commonly used. Hydraulic distension, introduced by Andren and Lundberg in 1965, remains a widely utilized treatment for AC patients (7).

Various tools are used in exercise programs to improve physical strength and balance (8). Resistance bands are one of the most popular among commonly used exercise tools due to their portability, ease of use without space constraints, and widespread use across age groups (9). Resistance bands are effective in rehabilitation and fitness improvement due to their low-impact nature (10), and their ability to adjust resistance in accordance with changes in the direction of joint movement during exercise allows for activation of multiple muscles in a single movement (11).

Despite differences in the direction and magnitude of resistance, resistance bands and other resistance tools, such as dumbbells, are often used interchangeably in various exercise programs (12). Ribeiro et al. (13) reported that resistance band exercises can effectively replace heavy weights for strength training, and Andersen et al. (14) found that resistance bands and dumbbells elicit similar levels of muscle activation, suggesting that both resistance tools can be used equivalently during exercise. However, other studies have reported that resistance band training produces higher muscle activation compared to dumbbells (15). These differing findings in the literature highlight the challenges in comparing the effectiveness of resistance bands and dumbbells (14), potentially causing confusion among users.

In addition, research on appropriate resistance exercise tools for patients with AC is limited. Although flexibility exercises are important for patients with adhesive capsulitis, they may lead to greater damage if they are only aimed at improving the range of motion (16, 17). Isometric exercises using resistance bands can safely increase the reduced range of motion in patients with adhesive capsulitis. Isometric exercises that increase muscle strength to maintain muscle length can reduce additional damage and safely increase the range of motion (18). However, research on appropriate resistance exercise tools is limited. Due to this lack of research, patients with adhesive capsulitis may not benefit significantly from exercise even if they start treatment at the right time and with the proper method. Therefore, this study aimed to compare the effects of resistance bands and dumbbell-based strength training on shoulder range of motion, pain, and functional disability indices in patients with adhesive capsulitis.

MATERIALS AND METHODS

Study Design. This randomized controlled trial involved 16 women who visited a medical institution and were diagnosed with adhesive capsulitis within the past year. All of these women were dancers majoring in Korean dance and complained of shoulder pain. The participants were randomly assigned to two groups: resistance band group (n=8) and dumbbell group (n=8). The intervention was performed 3 times a week for 6 weeks, 25 minutes per set,12repetitions per set (Figure 1).

Participants. Inclusion criteria were female participants experiencing shoulder pain rated 7 or higher on the NRS. Those with cardiac conditions, visual or cognitive impairments, or who had undergone shoulder surgery within 6 months were excluded.

Tools and Reagents. Inclusion criteria included female participants with AC who experienced shoulder pain with a pain score of 7 or greater on the Nearly Rated Shoulder Pain Rating Scale (NRS). Those with cardiac disease, visual or cognitive impairment, or who had undergone shoulder surgery within the previous 6 months were excluded.

Training Protocol. Both groups performed the same exercises using resistance bands or dumbbells, and additional supervised home exercise was performed weekly. Each session included joint mobility exercises (25 minutes) using the lowest level of resistance bands and muscle strengthening exercises (25 minutes) using 2 kg dumbbells (Tables 1, 2).

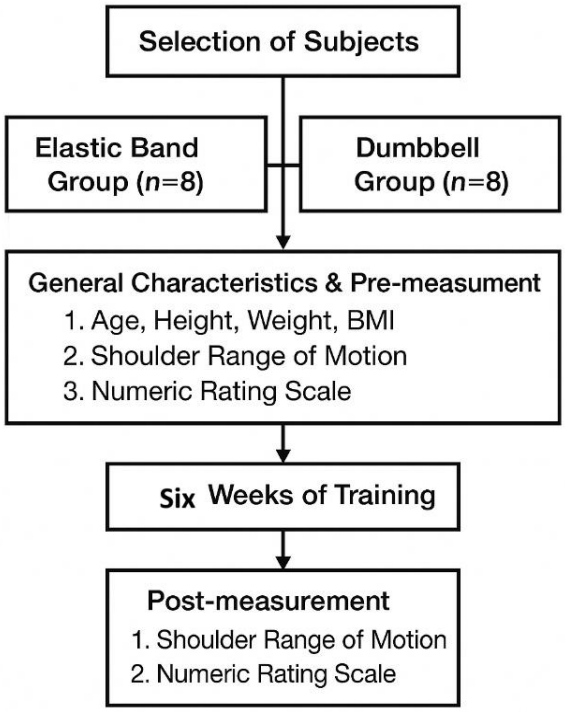

Figure 1. Indicates the research design.

Table 1. Shoulder articular mobilization.

Articular Mobilization	Grade	Time
Anterior gliding	I~III	25 min / once a week
Inferior gliding		
Posterior gliding		
Superior gliding		

Table 2. Exercise program.

	Workout	Rep/Set
Warming up	Wall slide – Flexion	10 reps / 1 set
	Wall slide – Horizontal Abduction	
	Wall slide – Horizontal Adduction	
	Quadruped Shoulder Tap	
Main Workout	Scaption	10 reps / 3 sets
	Lateral Rotation	
	Medial Rotation	
	Horizontal Abduction	
	Horizontal Adduction	
Cool down	Thoracic Rotation	10 reps / 1 set

Rep: Repetition.

Data Collection. To check the mobility of the shoulder joint, the subject stands with his back to the wall, performs shoulder flexion and horizontal abduction movements, and measures the angle between the arm and the wall. The anatomical posture for horizontal abduction is 0 degrees, and the angle is measured by how much the arm is raised. NRS scores were recorded pre- and post-intervention. SPSS 26.0 was used for statistical analysis, and an independent sample t-test was performed to compare each group's pre- and post-test data. A two-way repeated measures analysis of variance was used to confirm the difference between groups in NRS, and the significance level was set at $p<0.05$.

RESULTS

The average age of the participants was 54.7 ± 6.3 years for the elastic band group and 53.3 ± 5.8 years for the dumbbell group. The average height was 161.7 ± 5.7 cm for the elastic band group and 161.2 ± 5.7 cm for the dumbbell group.

The results of ROM measurements showed an increase in numerical values; however, no statistically significant interaction effects between time and group were found for each movement. Specifically, for flexion (F=1.00, p=0.300), abduction (F=0.977, p=0.788), lateral rotation (F=0.001, p=0.955), and medial rotation (F=0.187, p=0.598), there were no significant interaction effects between time and group (Table 3, Figure 2).

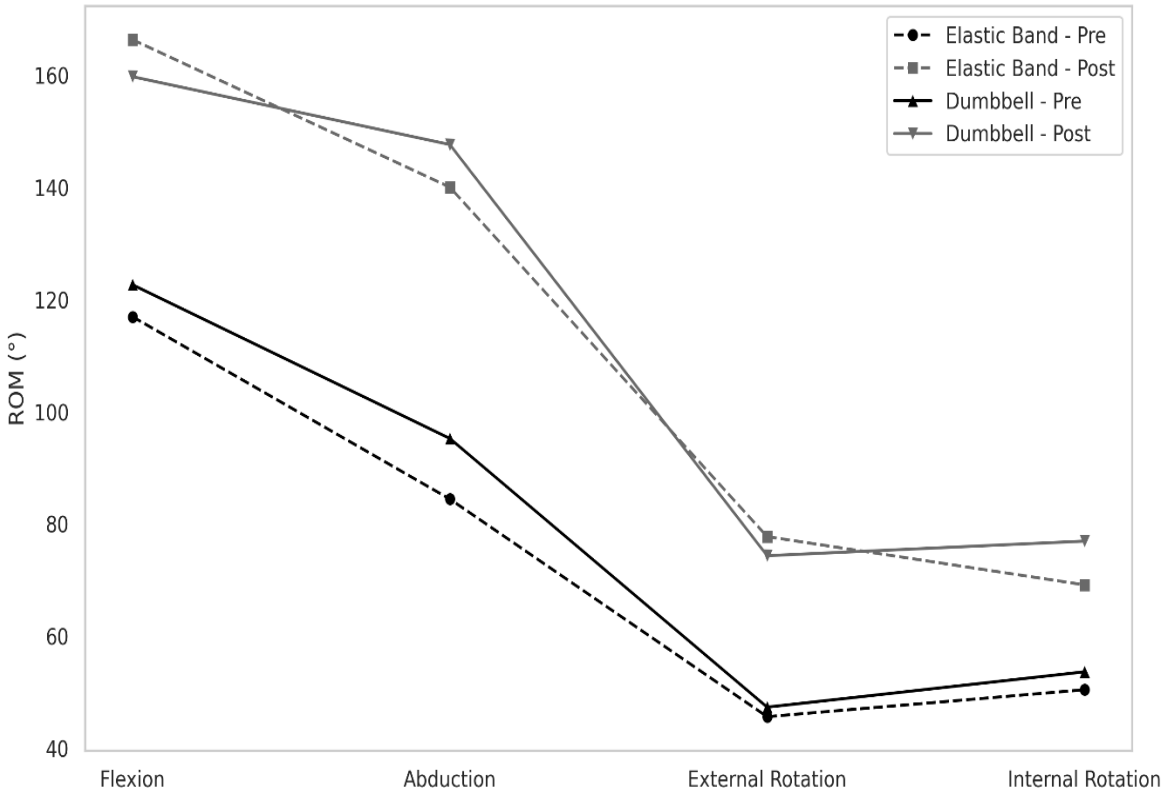

Figure 2. Changes in shoulder ROM pre- and post-intervention. ROM: Range of motion.

Table 3. Analysis results of ROM [°].

Variable	Group	Pre (Mean±SD)	Post (Mean±SD)	Source	F	p
Flexion	Elastic band group	117 ± 15.4	166.4 ± 7.5	Time	180.1	<0.001***
				Group	0.587	0.346
	Dumbbell group	122.7 ± 21.4	159.8 ± 11.2	Time × Group	1.00	0.312
Abduction	Elastic band group	84.5 ± 15.2	140.1 ± 17.1	Time	202.01	<0.001***
				Group	0.850	0.344
	Dumbbell group	95.3 ± 18.9	147.7 ± 24.1	Time × Group	0.977	0.788
Lateral Rotation	Elastic band group	45.7 ± 11.2	77.8 ± 4.9	Time	155.4	<0.001***
				Group	0.000	0.985
	Dumbbell group	47.4 ± 15.0	74.4 ± 10.7	Time × Group	0.001	0.955
Medial Rotation	Elastic band group	50.5 ± 9.2	69.2 ± 9.9	Time	87.51	<0.001***
				Group	1.52	0.215
	Dumbbell group	53.7 ± 14.9	77 ± 11.9	Time × Group	0.187	0.598

ROM: Range of motion; Values are expressed as Mean ± SD; *: p<0.05; **: p<0.01; ***: p<0.001.

For the NRS in the two-way repeated measures ANOVA, although no significant differences between groups or significant interaction effects between time and group were found, there was a significant effect between time points (F=357.11, p<0.001) (Table 4, Figure 3). The average effect size for the elastic band group was d=4.57, g=4.57, while the average effect size for the dumbbell group was d=4.00, g=4.00. Both groups demonstrated a large effect between time points (Table 5), with the elastic band group showing a relatively larger effect size.

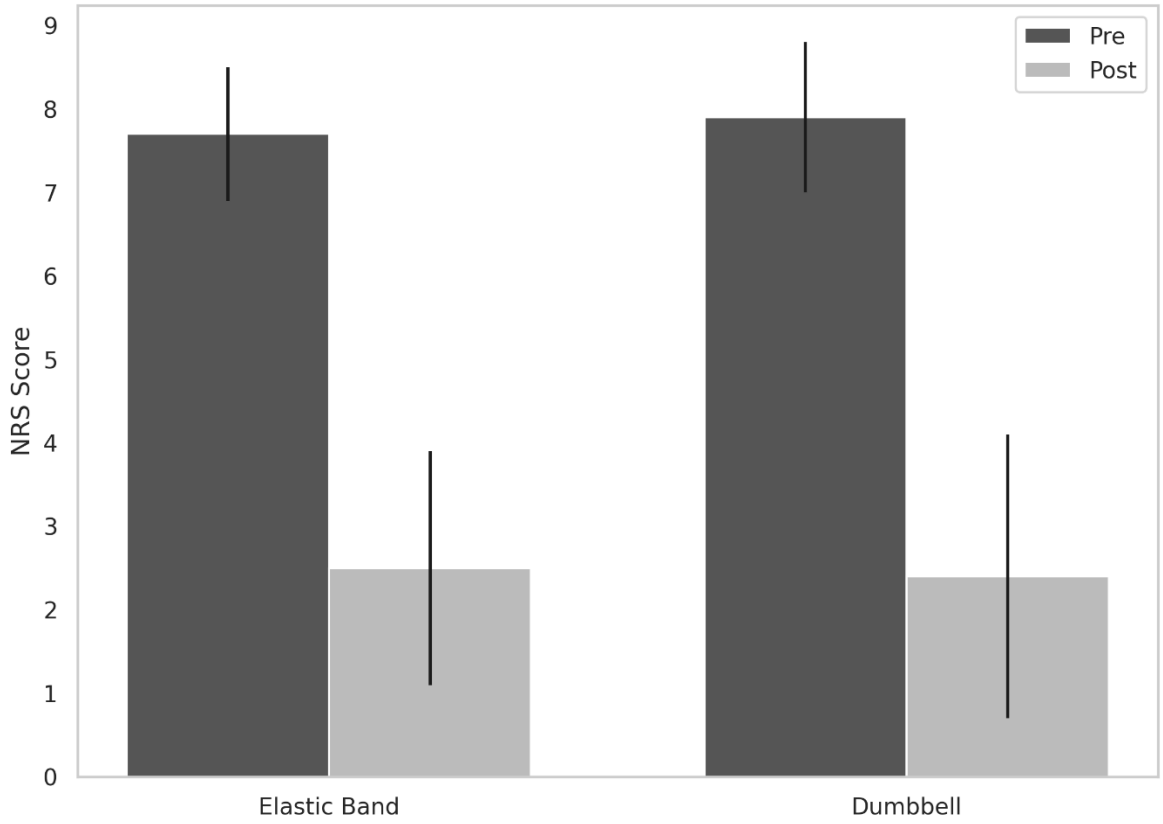

Figure 3. Pain level reduction after 6 weeks. NRS: Numerical rating scale.

Table 4. Analysis results of NRS.

Variable	Group	Pre (Mean±SD)	Post (Mean±SD)	Source	F	p
NRS	Elastic band group	7.7 ± 0.8	2.5 ± 1.4	Time	357.11	<0.001***
				Group	0.036	0.851
	Dumbbell group	7.9 ± 0.9	2.4 ± 1.7	Time × Group	0.257	0.617

NRS: Numerical rating scale; Values are expressed as Mean ± SD; *: p<0.05; **: p<0.01; ***: p<0.001.

Table 5. Effect size of elastic band and dumbbell on NRS.

Variable	Group	Cohen's d	Hedges' g
NRS	Elastic band group	4.57	4.57
	Dumbbell group	4.00	4.00

NRS: Numerical rating scale.

DISCUSSION

Research on the effects of exercise in AC joint patients has been steadily reported, but studies on appropriate exercise methods or identifying resistance tools to enhance exercise efficiency are still lacking. While some studies are comparing

elastic bands and dumbbells, the most commonly used resistance tools for strength training in the general population, there is a notable lack of research specifically targeting AC patients. As strengthening exercises are emphasized for AC patients, this study aims to compare the effects of elastic bands and dumbbells to identify suitable resistance tools that can aid in shoulder recovery for AC patients.

The key result of this study is that there was no significant difference in shoulder ROM and NRS between the elastic band group and the dumbbell group, even when the same exercise program was applied to both groups. These results align with studies by Andersen et al. (14) and Lopes et al. (19), which suggested that there was no significant difference in shoulder recovery between elastic bands and dumbbells in AC patients. Although the interaction effect between time and groups was not confirmed, both groups showed improvements in shoulder pain and ROM post-exercise compared to pre-exercise, supporting the positive effects of elastic band exercises on shoulder joints (20) and the positive influence of dumbbell exercises on shoulder recovery (21, 22), as mentioned in previous studies.

Based on the positive results observed in both groups, it can be concluded that strength training itself may significantly impact shoulder recovery, more so than the difference in resistance tools used. This supports the argument made by Escamilla et al. (23) regarding the necessity of strength exercises. Additionally, as suggested by Kim Yeon-soon (24) and Cho Han-su, Kim Won-moon (1), the combined application of exercises and joint mobilization likely contributed positively to pain recovery.

While previous studies have reported no significant difference between the effects of elastic bands and dumbbells on muscle activation, shoulder pain, and ROM recovery, this study further analyzed the extent of changes in ROM and NRS between pre- and post-assessment by calculating effect sizes. The results showed that the elastic band group had a greater effect on the recovery of shoulder ROM for flexion, external rotation, and internal rotation, while the dumbbell group had a more significant effect on abduction. This difference can be attributed to the nature of the resistance tools. While dumbbells rely on the moment arm and gravity, elastic bands provide variable resistance depending on their elasticity, and the direction of resistance can be adjusted based on the individual's chosen angle (25). The ease with which resistance and direction can be set using elastic bands may enhance the efficiency of exercise, allowing for more effective training without being restricted by the moment arm, which could explain why the elastic band group showed greater ROM recovery.

Furthermore, based on previous studies that observed greater improvements in pain, ROM, and strength in groups performing eccentric contractions with elastic bands (26) and both concentric and eccentric contractions (27), this study incorporated both types of muscle contractions during exercise, and the elastic band group showed greater improvement in ROM recovery.

Regarding NRS effect size, the elastic band group showed more significant results than the dumbbell group (Table 5), which can be attributed to the nature of the NRS scale. NRS measures overall pain experienced by the participants, and since it is a comprehensive measure, the differences in resistance tools' effects could vary depending on when the pain is felt. Additionally, the significant changes observed in the dumbbell group regarding the pain index are likely due to improved ROM recovery, shoulder strength, and stabilization, leading to reduced discomfort during daily activities.

Although all 16 participants showed reduced pain over the 6-week study period, functional disabilities, such as discomfort during daily movements, persisted longer than the pain. This suggests that the recovery of ROM was slower, emphasizing the effectiveness of joint mobilization and exercises in pain reduction. Notably, the recovery of external and internal rotation was slower than other movements, with internal rotation showing the most limited improvement. The average recovery angle for internal rotation was 24.4°, significantly less than the 65° improvement observed in abduction, highlighting that recovery of movements in the transverse plane may require more time than the 6 weeks used in this study. Future research should focus on developing appropriate exercise methods for recovering internal rotation and other horizontal-plane movements in AC patients.

Due to the short duration of this study, it may not be sufficient to fully determine the differences in the effects of these two resistance tools or propose complete recovery methods for AC

patients. Additionally, the study was limited to middle-aged women, and the different stages of AC were not considered, which may have influenced the results. Elastic bands also present challenges in determining resistance as their resistance increases gradually and changes with angle, making it difficult to compare to dumbbells with fixed resistance. Future studies should focus on determining the appropriate weight settings for both elastic bands and dumbbells to ensure their effectiveness in shoulder recovery. Overall, a well-designed strength training program will likely have a more positive impact for optimal recovery in AC patients than focusing solely on the difference between resistance tools.

CONCLUSION

This study demonstrated that both elastic bands and dumbbells effectively reduce shoulder pain and improve functional recovery in AC patients. While no significant differences were found between groups, strength training overall showed meaningful improvements in ROM and pain. These results support incorporating resistance exercises as part of non-surgical interventions for shoulder rehabilitation.

APPLICABLE REMARKS

- Muscles move and feel sensations under the control of nerves. Therefore, when musculoskeletal pain occurs, applying interventions that allow the muscles to move smoothly helps relieve pain. This study confirmed the effect of reducing pain by using the shoulder joint muscles of subjects experiencing adhesive capsulitis.

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AUTHORS' CONTRIBUTIONS

Study concept and design: Hee-Jin Kim, Hea Kyung Choi. Acquisition of data: Hee-Jin Kim, Hea Kyung Choi. Analysis and interpretation of data: Hee-Jin Kim, Hea Kyung Choi. Drafting the manuscript: Hee-Jin Kim, Hea Kyung Choi. Critical revision of the manuscript for important intellectual content: Hea Kyung Choi. Statistical analysis: Hea Kyung Choi. Administrative, technical, and material support: Hea Kyung Choi. Study supervision: Hea Kyung Choi.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

FINANCIAL DISCLOSURE

This study has no financial interests related to the material in the manuscript.

FUNDING/SUPPORT

This study has no funding or support for the manuscript.

ETHICAL CONSIDERATION

This study protocol conforms to the ethical guidelines of the 1975 Declaration of Helsinki.

ROLE OF THE SPONSOR

The funding organizations are public institutions and had no role in the design and conduct of the study.

ARTIFICIAL INTELLIGENCE (AI) USE

It did not use AI or AI-assisted tools in the study.

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