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Effects of Wearing Shoulder Taping Garments on Upper Extremity and Spinal Alignment, Range of Motion, Muscle Strength, and Activation

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ABSTRACT

Purpose: This study aimed to scientifically investigate the effects of functional shoulder taping garments on upper extremity function, postural alignment, and muscle activation.

Methods: Twenty healthy adults participated in the experiment, performing standardized assessments under two conditions: wearing taping garments and wearing conventional garments. Range of motion (ROM), spinal alignment, scapular distance, shoulder muscle strength, and the electromyographic (EMG) activity of four major muscles (pectoralis major, biceps brachii, triceps brachii, and rhomboid major) were evaluated. Motion analysis and surface electromyography systems were employed to acquire quantitative data, and a hand-held dynamometer was used to assess muscle strength.

Results: Wearing taping garments significantly increased shoulder flexion ROM ($p<0.05$). Spinal alignment improved, as indicated by an increased thoracic angle and a decreased scapular distance ($p<0.05$). EMG activity of the pectoralis major, biceps brachii, and rhomboid major significantly increased under maximal contraction when compared with conventional garments ($p<0.05$). However, no significant differences were found in shoulder flexion or abduction strength.

Conclusion: These findings suggest that taping garments may enhance shoulder joint stability, facilitate muscle activation, and positively contribute to functional shoulder performance.

Keywords: *shoulder taping garment, upper extremity alignment, spinal alignment, range of motion, muscle activation*

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1. INTRODUCTION

In modern society, musculoskeletal disorders of the shoulder joint are becoming increasingly prevalent due to sedentary lifestyles, prolonged computer use, and excessive smartphone utilization. Dysfunction of the shoulder joint not only leads to discomfort in daily life but also directly impairs athletic performance and occupational capacity (Ghozy et al., 2020). Shoulder dysfunction is often associated with reduced range of motion (ROM), altered muscle recruitment, and postural deviations such as rounded shoulders or forward head posture, which further exacerbate mechanical stress on the musculoskeletal system (Choi et al., 2018).

To address these issues, a wide range of rehabilitation and supportive interventions have been developed. Among them, functional apparel designed to provide external support and proprioceptive input has recently received growing attention (Kim & Park, 2020). Taping garments, in particular, integrate the principles of kinesiology taping into wearable clothing by incorporating specialized fabrics and biomechanically aligned patterns that mimic taping applications (Sim et al., 2017). These garments provide compression, stabilize joints, and deliver proprioceptive cues, which may facilitate muscle activation, improve circulation, and reduce injury risks (Lope & Lopez, 2017; Tanaka & Sato, 2019).

The efficacy of kinesiology taping itself has been extensively investigated in clinical and athletic populations. Studies have demonstrated that kinesio taping enhances proprioception, regulates muscle activation, and alleviates pain symptoms in patients with shoulder pathologies (Chen et al., 2016; Lee & Park, 2019). It has also been reported to improve muscle endurance and movement efficiency in overhead athletes (Al-Mohrej & Al-Shibani, 2018; Bansal & Khare, 2020). Moreover, kinesiology taping has shown favorable outcomes in improving scapular kinematics, which is critical for shoulder stability and optimal arm function (Uhl & Waldman, 2009). However, most of these studies have employed direct taping techniques, whereas evidence regarding apparel-based applications remains scarce.

Compression garments, a related intervention, have been investigated for their potential effects on venous return, oxygenation, and postural stability (Macrae & Macrae, 2011; Webster & Smith, 2017). Some studies suggest that compression-based apparel may enhance proprioceptive feedback and joint alignment during functional activities (Kim, Lee, & Kim, 2018). However, the degree to which these garments can replicate or even surpass the effects of traditional kinesio taping is still unclear.

Given this gap, the present study aimed to investigate the physiological and biomechanical effects of shoulder taping garments on healthy adults. Specifically, we examined their influence on shoulder ROM, spinal alignment, scapular distance, muscle strength, and muscle activation. By doing so, this study sought to provide empirical evidence for the potential utility of taping garments in sports performance, injury prevention, and rehabilitation contexts.

2. MATERIALS AND METHODS

2.1 Study Design

This study employed a repeated cross-sectional experimental design conducted at S University in Korea. The design was selected to allow participants to serve as their own controls, thereby minimizing inter-individual variability and enhancing statistical power (Lope & Lopez, 2017). All assessments were conducted under two distinct garment conditions—conventional clothing and shoulder taping garments (TAG GROUP, South Korea, 2025)—with a washout period between trials. The sequence of testing was counterbalanced to reduce order effects.

2.1.1 Participants

Twenty-three healthy adults (9 males and 14 females; mean age 22.3 ± 1.59 years) were initially recruited through university postings and voluntary participation. Of these, 20 participants completed the full experimental protocol and were included in the final analysis. Eligibility criteria required participants to be free from upper extremity or shoulder musculoskeletal injuries in the preceding six months, without neurological or cardiovascular disorders, and not taking medications that could interfere with neuromuscular performance. Exclusion criteria included a history of shoulder surgery, chronic pain conditions, or prior experience with kinesiology taping in the past year, to avoid bias in proprioceptive adaptation (Chen et al., 2016). All participants provided written informed consent prior to study commencement, and the study adhered to the principles of the Declaration of Helsinki.

2.1.2 Sample Size Estimation

Sample size was determined a priori using G*Power 3.1.9.7 (Heinrich Heine University, Düsseldorf, Germany). Based on repeated-measures analysis with an effect size of 0.3, alpha level of 0.05, and statistical power of 0.80, the required minimum sample size was 20. To account for possible attrition, three additional participants were recruited, resulting in 23 enrollees.

2.1.3 Randomization and Experimental Protocol

Participants were randomly assigned to begin with either the conventional garment or the taping garment condition using a computer-generated randomization sequence. To mitigate fatigue and carryover effects, a minimum 24-hour washout interval was provided between the two testing sessions. Each session was conducted at the same time of day to minimize circadian variation in muscle performance (Tanaka & Sato, 2019). Prior to each assessment, participants underwent a standardized warm-up protocol consisting of five minutes of light treadmill walking and dynamic shoulder stretching.

2.2 Measurements

1. **Range of Motion (ROM) and Spinal Alignment**

Shoulder flexion ROM was measured using a three-dimensional motion analyzer (Motion Analyzer System, Korea). Anatomical landmarks (acromion, lateral epicondyle, and greater tubercle) were digitally marked to ensure accuracy. Spinal alignment was assessed by measuring the angle formed between the spinous processes of C7, T3, and T7, as well as the linear distance between bilateral scapular spines. Reliability of the motion analyzer in previous studies has been reported with intraclass correlation coefficients (ICC) > 0.90 (Lee & Park, 2019).<figure 1>

2. **Muscle Strength**

Isometric shoulder flexion and abduction strength were measured with a calibrated handheld dynamometer (JTECH Commander, USA). Participants were seated upright with the trunk stabilized and the elbow extended. Three maximal voluntary contractions were performed for each movement, with a 60-second rest between trials to minimize fatigue. The highest recorded value was used for analysis (Al-Mohrej & Al-Shibani, 2018).

3. **Muscle Activation**

Surface electromyography (sEMG; Noraxon USA Inc.) was used to record muscle activity of the pectoralis major, biceps brachii, triceps brachii, and rhomboid major. Bipolar Ag/AgCl electrodes were placed on the dominant side following SENIAM guidelines, with interelectrode distance standardized at 20 mm. Skin was prepared by shaving, abrading, and cleansing with alcohol to minimize impedance. EMG signals were band-pass filtered (20–500 Hz), sampled at 1,000 Hz, and processed using root mean square (RMS) methods. Each muscle's activation was normalized against maximal voluntary isometric contraction (MVIC), recorded via manual resistance testing (Bansal & Khare, 2020).

(1) (2) (3) (4)

Figure 1. Mesurement (1) range of motion, (2) spinal alignment, (3) muscle strength, (4) muscle activation

2.3 Procedure

Participants completed two identical experimental sessions under the different garment conditions. The order of tests was as follows:

1. Measurement of demographic and anthropometric variables (height, weight, BMI).
2. Assessment of shoulder flexion ROM and postural alignment via motion analysis.
3. Measurement of isometric shoulder strength in flexion and abduction using a dynamometer.
4. Recording of EMG signals during standardized isometric contractions of the target muscles.

Each task was explained in detail, and practice trials were provided to ensure familiarity. A rest period of at least two minutes was allowed between each major measurement to prevent cumulative fatigue effects. <figure 2>

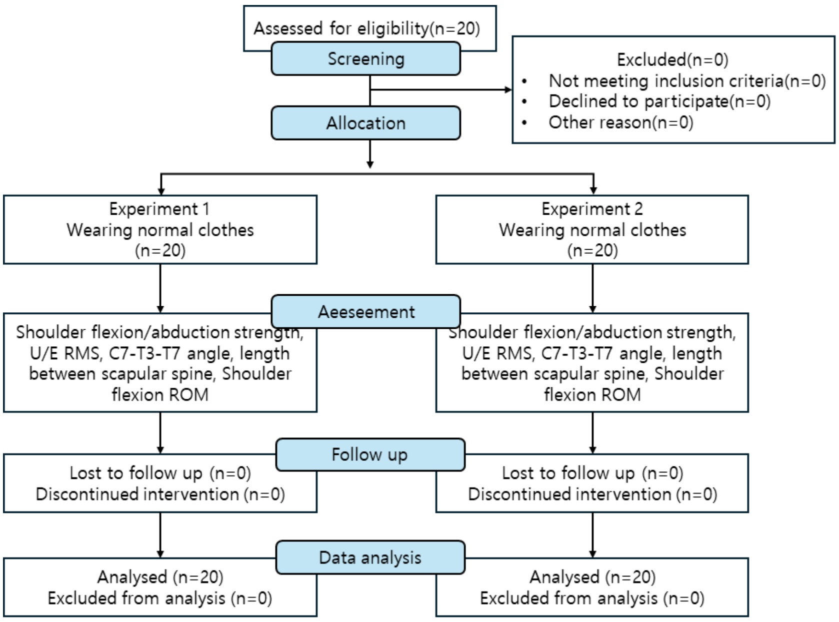

Figure 2. experimental procedure

2.4 Statistical Analysis

All data were analyzed using SPSS version 25.0 (IBM Corp., Armonk, NY). Descriptive statistics (mean ± standard deviation) were calculated for all variables. Normality of distribution was assessed using the Shapiro-Wilk test. Paired-sample t-tests were used to compare outcomes between the conventional garment and taping garment conditions. Statistical significance was defined as $p < 0.05$.

3. RESULT

3.1 General Characteristics

The participants' demographic characteristics are summarized in **Table 1**.

Table 1. general characteristics

General Characteristics	Mean	Standard Deviation	Range
Gender (Male/Female)	9/11	-	-
Age (years)	22.30	1.59	19-25
Height (cm)	170.75	6.98	163-187
Weight (kg)	71.40	10.88	53-90
BMI (kg/m^2)	24.43	3.01	19.0-30.1

3.2 Range of Motion and Strength

Shoulder flexion ROM was significantly greater in the taping garment condition (167.00° ± 8.34°) compared with conventional garments (158.50° ± 7.80°; t=3.331, p=0.002). No significant differences were found for flexion or abduction strength ($p > 0.05$).<table 2>

Table 2. Shoulder Range of Motion and Strength

	Taping Garment	**Conventional Garment**	**t**	***P***
Shoulder Flx. ROM	167.00±8.34	158.50±7.80	3.331	.002*
Shoulder Flx. Strength	8.65±2.88	7.86±2.57	0.911	.369
Shoulder Abd. Strength	8.87±2.72	7.86±2.28	1.272	.211

*p<0.05, mean±standard deviation

3.3 Spinal Alignment

Thoracic angle was significantly larger with taping garments (167.14° ± 4.52°) versus conventional garments (160.66° ± 6.14°; t=3.802, p=0.001). Scapular distance was significantly reduced (16.10 ± 1.69 cm vs. 17.39 ± 2.22 cm; t=-2.065, p=0.046).<table 3>

Table 3. Shoulder Range of Motion and Strength

	Taping Garment	**Conventional Garment**	**t**	***P***
Spine Angle (°),	167.14±4.52	160.66±6.14	3.802	.001*
Scapular Distance (cm)	16.10±1.69	17.39±2.22	-2.065	.046*

*p<0.05, mean±standard deviation

3.4 Muscle Activation

Taping garments significantly enhanced muscle activation in the pectoralis major (p=0.018), biceps brachii (p=0.037), and rhomboid major (p=0.031). No significant difference was found for triceps brachii (p=0.181).<table 4>

Table 4. Muscle Activation Levels

Muscle	Taping Garment	Conventional Garment	t	*p*
Pectoralis Major m.	62.58±10.47	54.33±10.53	2.483	.018*
Biceps Brachii m.	59.61±11.10	51.93±11.34	2.165	.037*
Triceps Brachii m.	57.06±14.09	51.07±13.75	1.361	.181
Rhomboid Major m.	65.69±12.73	56.95±11.94	2.240	.031*

*p<0.05, mean±standard deviation

4. DISCUSSION

The findings of this study indicate that shoulder taping garments significantly improve shoulder flexion ROM, spinal alignment, and activation of specific muscles, while not significantly altering maximal muscle strength. These outcomes contribute to the growing body of literature supporting the beneficial effects of functional apparel on musculoskeletal performance.

The observed increase in shoulder flexion ROM is consistent with prior studies demonstrating that kinesiology taping facilitates joint mobility by enhancing proprioceptive input and reducing muscular inhibition (Sim et al., 2017; Hsu et al., 2015). It is plausible that taping garments achieve a similar effect by applying consistent, distributed pressure across the shoulder joint, thereby improving neuromuscular control. The garments may stimulate cutaneous mechanoreceptors, altering afferent feedback to the central nervous system, ultimately promoting smoother and broader joint motion (Choi et al., 2018; Ghozy et al., 2020).

The improvements in spinal alignment, characterized by an increased thoracic angle and reduced scapular distance, suggest that taping garments may provide a corrective effect for postural deviations. Rounded shoulder posture is frequently observed in individuals with sedentary habits, contributing to musculoskeletal pain syndromes and compromised functional capacity (Lee & Park, 2019). Our findings align with studies demonstrating that both kinesio taping and compression garments can restore scapular alignment and enhance postural stability (Kim et al., 2018; Tanaka & Sato, 2019). The increased activation of the rhomboid major observed in this study further supports the hypothesis that taping garments encourage scapular retraction and stabilization, which are essential for maintaining upright posture (Uhl & Waldman, 2009).

The enhanced activation of the pectoralis major and biceps brachii under taping garment conditions also deserves attention. Elevated electromyographic activity suggests improved neuromuscular recruitment and potentially greater efficiency during functional tasks (Chen et al., 2016). Such findings are in line with reports that kinesio taping can optimize motor unit recruitment and neuromuscular efficiency (Bansal & Khare, 2020). However, the lack of significant differences in maximal strength output implies that while taping garments modulate muscle activity, they do not necessarily enhance peak force production in the short term (Al-Mohrej & Al-Shibani, 2018). This may be due to the garments primarily influencing sensorimotor control rather than direct contractile capacity.

From a clinical and rehabilitative standpoint, these findings are particularly relevant. Functional garments may serve as an adjunctive tool for patients recovering from shoulder injuries or for individuals with poor posture due to prolonged sedentary behavior. By providing external support and proprioceptive facilitation, taping garments could reduce reliance on direct manual taping by clinicians, offering a more sustainable and user-friendly intervention (Webster & Smith, 2017). Additionally, in sports contexts, such garments may reduce the risk of overuse injuries by promoting proper alignment and efficient muscle activation patterns (Macrae & Macrae, 2011).

Nevertheless, certain limitations should be acknowledged. First, the study included only healthy young adults, which restricts generalizability to clinical populations such as individuals with shoulder impingement syndrome or rotator cuff injuries. Second, the study focused on immediate effects, whereas long-term adaptations to regular garment use remain unclear. Future research should examine clinical populations, investigate chronic usage, and explore garment design modifications tailored to specific pathologies (Kim & Park, 2020).

In conclusion, this study provides evidence that shoulder taping garments enhance ROM, improve alignment, and facilitate selective muscle activation. These findings suggest potential applications not only in athletic performance but also in preventive and rehabilitative strategies for shoulder health.

5. CONCLUSION

This study confirmed that wearing taping garments has positive effects on the range of motion of the shoulder joint, postural alignment, and muscle activation. The detailed findings are as follows.

First, shoulder flexion ROM significantly increased when wearing taping garments compared with conventional garments ($p < 0.05$).

Second, in terms of postural alignment, the scapular angle increased and the distance between the scapulae decreased when wearing taping garments compared with conventional garments, indicating improved shoulder extension ($p < 0.05$).

Third, the muscle activation of the pectoralis major, biceps brachii, and rhomboid major was significantly increased under maximal contraction when wearing taping garments compared with conventional garments ($p < 0.05$).

These results suggest that functional garments may influence proprioceptive feedback and muscle activation, thereby contributing to improvements in posture and movement function. This study highlights the potential application of taping garments as an effective supportive tool in the fields of sports apparel, rehabilitation medicine, and physical therapy to promote shoulder health and enhance functional performance.

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