Original Article

Physical Therapy Rehabilitation Science

https://doi.org/10.14474/ptrs.2020.9.4.275
pISSN 2287-7576
eISSN 2287-7584

Phys Ther Rehabil Sci
2020, 9 (4), 275-280
www.jptrs.org

Relationship between Kinesiotaping and compression wear for postural balance in healthy men: a cross-sectional study

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Objective: Compression wear is an external aid which promotes performance and recovery, diminishes muscular microtrauma, reduces muscle fiber recruitment, improves neuromechanics, enhances coordinative activities, and reduces the perceived exertion. The purpose of this study was to investigate the relationship between athletic taping and compression wear on dynamic postural balance in healthy young men. The hypothesis was that the athletic taping and compression wear would affect dynamic postural balance, with athletic taping having a different effect on dynamic postural balance in healthy young adults.

Design: Cross-sectional study.

Methods: Thirty-seven healthy young men participated in this study. To examine the association between athletic taping and compression wear, 3 clinical measurement tools, including 5 times sit-to-stand (5xSTS), one-leg standing (OLS) test, and Y-balance test (YBT) in 5 different conditions, namely (1) non-supporting, and support with (2) athletic taping, (3) regular compression wear, (4) silicon compression wear, and (5) double-fiber compression wear were used.

Results: The distance of the Y-balance test (YBT) on both the dominant and non-dominant sides showed a statistically difference among the 5 supporting conditions ($p<0.05$). The distance measured via the YBT in the non-support condition was significantly different than that in the other four supporting conditions ($p<0.05$). However, 5xSTS and OLS were not significantly different in these supporting conditions.

Conclusions: The results of this study suggest that athletic taping, silicon compression wear, and double-fiber compression wear were more effective for dynamic balance than non-supporting and regular compression wear.

Key Words: Athletic tape, Compression, Postural balance

Introduction

Athletic performance is a specific physical routine or procedure related to higher-quality professional sports such as sprint-running, skiing, basketball, volley ball, football and other, which is performed by individuals who is trained or skilled in physical activities [1]. Since performance is a complex mixture of biomechanical function, emotional factors, and training technique, it is influenced by a combination of physiological, psychological, and socio-cultural factors [1,2]. To engage in the aforementioned sports an athlete should have the maximum level of fitness in terms of aerobic endurance, strength, power, speed, agility and flexibility [3,4]. The athlete must ensure his/her fitness before entering into a competition. According to a previous study, the results in missing out at least one day of sports activity showed that approximately 77% of these injuries involved the lower extremity, ankles, or feet [5]. Another important aspect of sport injuries is prevention, therefore, effective preventive measures must be developed [4,6].

Received: 30 November, 2020 **Revised:** 7 December, 2020 **Accepted:** 7 December, 2020

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It is important to establish sport-specific dynamic warm-ups, stretching exercises, and exercise that can help in preventing injuries common to each individual sport [4,7]. Owing to the development of sports science, assistive techniques have been reported to prevent sports injuries and support muscle performance [8]. Athletic taping (AT) is a simple clinical process of applying a tape directly on the surface of the skin to support muscle activation and maintain a stable skeletal position during athletic activities [9]. Moreover, taping helps to recover from muscle overuse, reduces pain, and provides stability to the injured joint for a temporary period. It compresses soft tissues to reduce swelling, supports anatomical structures involved in the injury, serves as a splint or secures a splint, secures dressing or bandages, and protects the injured joint from re-injury, while it is in the healing process [10,11]. Another assistive technology for improving postural balance is compression wear, including socks, sleeves, shorts, tights, and/or shirts or long-sleeved shirts, and whole-body suits, which improves the athletes' performance and facilitates recovery [12,13]. Compression clothing is an external aid which endures performance and recovery, diminishes muscular microtrauma, reduces muscle fiber recruitment, improves neuromechanics, enhances coordinative activities, and reduces the perceived exertion [13]. Most previous studies reported the effectiveness of AT or compression wear on oxygen uptake and heart rate during endurance exercise [10,12,13]. However, information regarding the comparative effectiveness of AT and compression wear on dynamic postural balance is insufficient. This study focused on supporting the hip joint, as the hip joint does not have regular supporting splints such as those of the knee and ankle joints, it is a weight-bearing joint and is directly affected by the ground reaction force during various athletic performances, including jumping, changes in dynamic position, and others.

The purpose of this study was to investigate the relationship between AT and compression wear for dynamic postural balance in healthy young men. The hypothesis was that the AT and compression wear would affect the dynamic postural balance, with AT having a different effect on dynamic postural balance in healthy young adults.

Methods

This was an observational, cross-sectional study, that was approved by the Baekseok University's Scientific Ethical Committee (approval No. BUIRB-201911-HR-022) and was conducted in accordance with the Declaration of Helsinki. All study participants provided written consent before the commencement of the study. G*Power 3.1 (Universität Kiel, Kiel, Germany) analysis was conducted to calculate the sample size of this study before measuring the primary outcome measures.

Participants

Thirty-seven heathy young men participated in this study. The inclusion criteria were as follows: (1) healthy young adults, (2) those without any orthopaedic diseases to affect the results of this study, (3) persons without any neurological diseases, (4) persons without any psychological problems, (5) those who followed the instructions of the assessors, and (6) those who spontaneously registered for participation. All participants who did not continue to participate until the end of the study were excluded. Table 1 shows the general characteristics of this study subjects.

Procedures

This study involved 5 different supporting conditions including non-supporting (NS, 1), athletic taping (AT, 2), regular compression wear (RCW, 3), silicon compression wear (SCW, 4), and double-fiber compression wear (DCW, 5). To measure the dependent variables, the participants themselves undertook the measurement orders among A (1, 2, 3, 4, 5), B (2, 3, 4, 5, 1), C (3, 4, 5, 1, 2), D (4, 5, 1, 2, 3), and E (5, 1, 2, 3, 4), and were therefore involved in the selection of their order. All 3 clinical measures such as the 5 times sit-to-stand (5xSTS), one-leg standing (OLS), and Y-balance test (YBT) were measured thrice and mean values were

Table 1. Common characteristics of the participants (N=37)

Variables	Mean (SD)	Minimum	Maximum
Age (y)	29.68 (4.01)	22.0	37.0
Height (cm)	180.62 (7.71)	168.0	199.4
Weight (kg)	82.86 (11.27)	64.0	107.1
Body mass index (kg/m^2)	25.41 (3.04)	20.7	34.1

used to analyze the data.

Outcome measures

This study considered 3 clinical measures, including 5xSTS, OLS, and YBT. The 5xSTS is a performance-based measurement tool, which assesses functional lower-extremity strength, transitional movements, postural balance, and risk of falling in older adults. The minimal detectable change time for the test is between 3.6 to 4.2 seconds and the minimal clinically important difference is 2.3 seconds. The test has excellent intra-rater reliability (intra- class correlation coefficient [ICC]=0.914－0.933) and excellent test-retest reliability (ICC=0.988－0.995) in healthy older adults [14]. It also has a good validity of anticipatory postural balance in older adults in comparison of its performance with the timed up-and-go test (r=0.64) [15,16].

The OLS is a simple and single task used for evaluating postural balance and for therapeutic exercises. The assessor asks the participant regarding how they perceive their postural balance is while performing the OLS. After all, one does not go around for extended periods of time standing on one leg. The test-retest reproducibility and inter-rater reliability are acceptable in the elderly population [17].

The YBT measures the athlete's strength, postural stability, and postural balance in 3 directions developed to refine the lengthy process of performing the star excursion balance test. During the YBT, the athlete is instructed to maintain postural balance on one-leg whilst simultaneously reaching the maximum distance with the other leg in 3 different directions: (1) anterior, (2) posterolateral, and (3) posteromedial. The YBT has been proven to have excellent inter-rater (ICC=0.80－0.85) and intra-rater reliabilities (ICC=0.91－0.99) [18-20].

Statistical analysis

The independent variables of this study were 5 different conditions as mentioned previously, and the dependent variables were the 5xSTS and OLS, and the distance measured using the YBT. Descriptive statistics (mean, standard deviation, frequency, and percentage) were used to analyze the common characteristics of the participants. The repeated measure analysis of variance was used to investigate the differences among the 5 conditions, and then, the Bonferroni test was used as the post-hoc test. All statistical analyses were performed using the IBM SPSS Statistics for Windows, Version 25.0 (IBM Co., Armonk, NY, USA). The significance level was set at α=0.05.

Results

Common characteristics of the participants

The mean age of the participants was 29.68 years and the mean height was 180.62 cm. The mean weight was 82.86 kg, and the body mass index was 25.41. Table 1 shows the common characteristics of all participants.

Comparison among the 5 different conditions on the dominant side

The distance measured via YBT was statistically different when the participants used their dominant sides in the 5 different aforementioned conditions. The distance measured via YBT in the NS condition was significantly different than that in the other four supporting conditions: AT, RCW, SCW, and DCW. The distance of YBT in the AT condition was significantly different than that in the NS and RCW conditions. The distance of YBT in the RCW condition was signifi-

Table 2. Comparisons among 5 different supporting conditions in participants (N=37)

Variables	Non-supporting	Athletic taping	Compression wear	Silicon compression wear	Double-fiber compression wear	F (p)
Five times sit-to-stand (s)	7.21 (0.91)	7.06 (1.14)	7.15 (1.35)	7.30 (1.21)	7.15 (1.04)	0.719 (0.545)
One-leg standing on the DS	58.33 (15.25)	61.65 (15.61)	57.63 (18.67)	56.91 (16.40)	57.88 (17.11)	0.747 (0.532)
One-leg standing on the NDS	57.56 (14.38)	59.92 (15.24)	60.17 (18.54)	57.67 (17.03)	57.58 (19.06)	0.289 (0.883)
Y-balance test on the DS	83.26 (10.72)[bcde]	87.51 (11.10)[ac]	84.73 (10.65)[abde]	87.83 (11.22)[ac]	87.94 (11.27)[ac]	50.217 (<0.001)
Y-balance test on the NDS	81.87 (11.23)[bde]	84.98 (10.91)[ac]	82.35 (11.39)[bde]	85.16 (11.06)[ac]	85.21 (11.06)[ac]	68.159 (<0.001)

Values are presented as mean (SD).
DS: dominant side, NDS: non-dominant side.
[a]Statistically significant difference with non-supporting condition, [b]Statistically significant difference with athletic taping condition, [c]Statistically significant difference with compression wear condition, [d]Statistically significant difference with silicon compression wear condition, [e]Statistically significant difference with double-fiber compression condition.

cantly different than that in the other four conditions. The distance of YBT in the SCW condition was significantly different than that in the NS and RCW conditions. The distance of YBT in the DCW was significantly different than that in the NS and RCW conditions. However, the 5xSTS and OLS were not significantly different among the 5 different conditions when using the dominant side (Table 2).

Comparison among 5 different supporting conditions on the non-dominant side

The distance of YBT was significantly different on the non-dominant side in the 5 different conditions. The distance of the YBT on the NS condition was significantly different than that in the other four conditions. The distance of the YBT on the AT condition was significantly different than that in the NS and RCW conditions. The distance of the YBT in the RCW condition was significantly different than that in the AT, SCW, and DCW conditions. The distance of the YBT in the SCW was significantly different from the NS and RCW. The distance of the YBT in the DCW condition was significantly different than that in the NS and RCW conditions. However, the 5xSTS and OLS were not significantly different among the 5 different conditions when using the non-dominant side (Table 2).

Discussion

The purpose of this study was to investigate the effectiveness of the AT and compression wear on dynamic postural balance in comparison with the NS condition in healthy young men. This study also compared the effectiveness of AT and compression wear. The study involved the use of 3 different under control short wears, including NCW, SCW, and DCW. The main results of this study were as follows: First, postural balance was better with AT and compression wear than in the NS condition. Second, the RCW was not more effective than AT or SCW and DCW in imparting postural balance. Third, there were no differences among the AT, SCW, and DCW methods on postural balance.

This study used the AT, as an athletic tape, which supports unstable joints by limiting excessive abnormal movement or anatomical activities, and enhances proprioceptive feedback from the limb or joint [21]. Several previous studies have been reported the effectiveness of AT on athletic performance [9,22,23]. Williams *et al*. [23], in a meta-analysis, evaluated the effectiveness of AT in the treatment and prevention of sports injuries. They reported that AT may have a beneficial role in improving strength, range of motion (ROM) in certain injured-cohorts subjects, and force sense error compared with other rehabilitation tapes. Thelen *et al*. [24] studied to investigate the effect of AT on pain and ROM in healthy young adults using a randomized blinded clinical trial. They also reported the possible benefits of AT in reducing pain and improving ROM in healthy young adults. Yoshida and Kahanov [25] reported the effect of AT and its likely benefits on trunk flexion, extension, and lateral flexion using randomized crossover, pre- and post-test repeated measures design for healthy individuals. However, Drouin *et al*. [9] systematically searched and assessed the quality of the literature on the effect of AT on athletic-based performance outcomes in healthy, active individuals. They suggested lack of evidence to support the use of AT as a successful measure for improving athletic-based performance outcomes in healthy individuals. The results of this study demonstrated the benefits of AT on dynamic postural balance in healthy young adults. This study involved AT on the gluteus maximus, gluteus medius, and hip adductors to improve the postural stability in the mediolateral and anterioposteral directions. We used YBT for measuring distances in the anterior, posterior-medial, and posterior-lateral directions in the AT condition on the dominant and non-dominant sides. The results of both sides imparted better dynamic postural balance in the AT condition compared with the NS and RCW conditions, while no difference was observed when AT was compared to the SCW and DCW conditions.

The effects of various compression wears have also been reported on physical performances in healthy individuals as well as professional athletes [26-28]. Valle *et al*. [26] studied the use of a short compression garment in delayed-onset muscle soreness (DOMS) prevention. They reported that the compression garment is an effective method to reduce the histological injury in DOMS. Miyamoto and Kawakami [29] examined the effect of pressure intensity of elastic compression short-tights on the metabolic state of the thigh muscles during submaximal running in healthy young adults. They reported that wearing such tight clothing could reduce the development of muscle fatigue during submaximal running exercises in healthy men. This study used 3 different compression wears including the regular-type, silicon, and double-fiber types added on to the gluteus and thigh areas, specifically the gluteus maximus, gluteus medius, quadriceps, and the hamstring muscles. The results of this study did not show significant differences between regular- type compression wear compared with the NS condition; however, the greatest difference was observed between the SCW and DCW conditions compared to NS. Moreover, dynamic postural balance was not significantly different among the AT, SCW, and DCW conditions.

The results of this study show that AT, SCW, and DCW are more effective for attaining dynamic postural balance than NS and regular-type compression were. The AT method has shown several shortcomings such as skin trouble, disposable materials, and high cost, especially when frequently required. However, the compression wear is a positive solution to improve the shortcomings of AT, and various types of compression wear have been developed, owing to the continuous development of textile science such as silicon-added or double-fiber-added type textures. Therefore, this study suggests that SCW or DCW are beneficial for improving dynamic postural balance in healthy individuals. This study only included healthy individuals. This study only included healthy male adults. Future studies involving professional athletes and female are required to examine the effect of compression wear on physical performance. This study only measured the dynamic postural balance. Future studies should measure various physical performances such as anticipation, postural control with various perturbations, jumping, and running, and the possible benefits of compression wear on various athletic performances. However, this study was an observational, cross-sectional study design, and not a randomized controlled trial. Future studies should examine the effectiveness of compression wear on the physical performance of individuals.

Conflict of Interest

The authors declared no potential conflicts of interest with respect to the authorship and/or publication of this article.

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