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Effectiveness of Non-Elastic Rigid Tape Application on Static and Dynamic Balance in Players with Chronic Inversion Ankle Sprain- A Pilot Study

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Abstract

Chronic Inversion Ankle Sprain is one of the common injuries that occurs in sports especially combat and jumping sports. As this injury is directly related to the ligament, proprioceptive deficit is observed in players with chronic inversion ankle sprain. The effect of taping on functional performance is still a topic of discussion. The need of this pilot study is to evaluate whether players with chronic inversion ankle sprain have any functional balance deficit and whether taping with non-elastic rigid tape improves static and dynamic balance. Players playing contact sports between the age of 18-24 years were included in the study after the initial screening for chronic inversion ankle sprain using a IdFAI index and history of their injury. Static balance was assessed using Sensamove Mini Balance Board and Dynamic Balance was assessed using Single Leg Hoping Course Board. Data was collected on three intervals, i.e. immediate post-application of tape, post-3 days and post-14 days of application of tape. Collected data was analyzed using One-way ANOVA test and the result showed statistically significant improvement in static and dynamic balance, i.e. p=0.048 & p=0.040 respectively. These results suggest that after immediate post-application of tape and post-3 days of the application of tape there is an improvement in static and dynamic balance while no improvement post-14 days of application of non-elastic rigid tape. Non-elastic rigid tape application significantly improves static and dynamic balance in players with chronic inversion ankle sprain.

Keywords: *Ankle Sprain; Dynamic Balance; Functional Balance Deficit; Static Balance; Taping*

1. Introduction

Ankle sprains are common sports injuries that can lead to chronic instability and impaired balance. Athletes with recurrent ankle sprains often experience decreased proprioception and compromised balance control, which can impact their performance and increase the risk of further injury. Non-elastic rigid tape is frequently used in clinical practice to provide mechanical support and proprioceptive feedback to the ankle joint. Despite its widespread use, the specific effects of non-elastic rigid tape on balance parameters in athletes with chronic ankle instability remain unclear. This pilot study aims to explore the effectiveness of non-elastic rigid tape application on both static and dynamic balance in athletes with chronic inversion ankle sprains. Lateral ankle sprains (LAS) are one of the most common musculoskeletal injuries of the lower limb [1]. Yet, the true incidence is underestimated, as many patients do not seek medical attention [2]. However, the majority of people with LAS suffer long-term consequences, as they reinjure or develop long-lasting functional instability [3]. Ankle injuries can be defined either acute or chronic, with ligamentous injury the most common acute diagnosis. About 85% of all ankle injuries are ankle sprains involving the lateral ankle ligaments. Chronic injuries are often related to, or are the sequellae of acute sprains, or overuse syndromes of the

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surrounding soft tissues. Intuitively, ankle sprains are most common in contact sports, indoor sports, and sports with high frequency of jumping [4]. Functional ankle instability (FAI) is seen in about 40% of all patient that sustain an ankle sprain [5][6] and is defined as a "disabling loss of reliable static and dynamic support of a joint" and a "tendency for the foot to give way" [7]. Researchers have hypothesized that people with FAI have functional performance deficits [8][9][10]. Functional performance tests are used to measure joint stability, muscle flexibility, muscle strength and power, proprioception, dynamic balance, and agility [7].Many athletes from different sports think that taping and bracing is important in acute and chronic phases of an ankle injury. Certainly, many athletes believe that ankle support is important for their performance [11]. Ankle injuries are quite common in the sport of basketball, and they are among the most severe as defined by time loss during the season [12][13][14].

1.1. Need for the study

Chronic Inversion Ankle Sprain is one of the common injury that occurs in sports especially combat and jumping sports. As this injury is directly related to the ligament, proprioceptive deficit is observed in players with chronic inversion ankle sprain. Proprioceptive deficit meaning difficulty walking on an uneven path, standing on one-leg, balancing on uneven surface, etc. As balance is one of the major component in almost every sport, it becomes important to restore the balance at the earliest. So, the need of this study is to evaluate whether players with chronic inversion ankle sprain have any functional balance deficit and whether non-elastic rigid tape application improves static and dynamic balance.

1.2. Aims & Objectives

- To identify players with chronic inversion ankle sprain.
- To assess players for static balance and dynamic balance without application of non-elastic rigid tape.
- To assess players for static balance and dynamic balance immediately post-application of non-elastic rigid tape.
- To assess players for static balance and dynamic balance post-3 & post-14 days of application of non-elastic rigid tape.
- To compare the pre-post measures.

2. Method

2.1. Participants

Twenty players between the ages of 17 and 24 (mean age: 20.1 ± 1.79yrs) were eligible to participate in the study. Demographic characteristics of the participants are shown in Table 1. Ethical approval from the Ethics Committee at University was obtained and written informed consent was obtained from all subjects. The inclusion criteria were having sustained recurrent ankle inversion sprains (at least three sprains), participation at state/national level competitions, had practice session of minimum three days in a week while the exclusion criteria were 1) history of ankle fracture, 2) ankle injury within three months of participation, 3) history of anterior cruciate ligament injury, 4) current participation in supervised physical rehabilitation, 5) any neurological deficit.

2.2. Test Procedures

Functional ankle instabilities ofsubjects were classified according to the IdFAI. The participants were unaware of which criteria shows functional ankle instability. Selection of subjects was on the basis of result of Idendtification of Functional Ankle Instability (IdFAI) (score >11 indicates Funactional Ankle Instability while scores ≤10 indicates Stability). The pre & post-performance tests mentioned below were performed by all subjects in two different conditions: without any taping and with non-elastic rigid taping.

2.3. Identification of Functional Ankle Instability (IdFAI)

The Identification of Functional Ankle Instability questionnaire (IdFAI) is specifically designed to detect whether individuals meet a minimum criteria necessary for inclusion in an FAI population. The IdFAI is based on two previous FAI instruments: The CAIT (Cumberland Ankle Instability Tool) and the AII (Ankle Instability Instrument). The underlying concept of the IdFAI is to consolidate the elements of each instrument and combine them in a manner that results in a simple and concise means to identify individuals with FAI. One of the main elements

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included in the IdFAI, which is not in any other questionnaire, is a specific definition of giving way. This definition was provided to ensure that all individuals understood the term and answered questions based on the same definition.

2.4. Sensamove Static Balance Test

The Sensbalance Measuring & Exercise Software shows the sensor signal as a red cursor within concentric circles on the screen either during or right after the exercises. By seeing the tilting results real-time on the screen, the users can easily and effectively train neuromuscular control by correcting and improving their exercise movements on the fly. The sensitivity of the sensor is adjustable. This enables dedicated mobility or stability training. Movement trajectories can be measured and saved for future reference (Figure 1).

2.5. Single Limb Hoping Board Test

This test assesses single limb agility and motor control on uneven surfaces. The course consists of leveled squares and 4 squared with a 15° incline in different directions. Subjects will be instructed to hop around the squares and finish the test as fast and accurately as possible. Each time they stepped out of the square or use an uninjured foot, one second will be added in the final time (Figure 2).

2.6. Taping Method

2.6.1. Non-Elastic Rigid Tape

Subject sitting with foot and lower 3rd of the leg off the bed. Foot in neutral or dorsiflexion and neutral with respect to supination/pronation. Apply anchor at Lower 3rd of the leg. Apply stirrups from medial side of anchor passing over calcaneum and malleoli to the lateral side of the anchor or hold both the ends of the tape and apply the tape however do not go distal to the calcaneum. Apply tape (as in Figure 3) starting from medial side of anchor passing under the calcaneum and cross over the anterior aspect of ankle to finish on the anchor on the medial side as shown in Figure 4. Repeat the same in reverse direction. Apply tape starting from medial side of anchor passing under the calcaneum and cross over the posterior aspect of ankle wrapping around the anterior aspect (medial to lateral) to finish on the lateral side. To apply Heel-lock apply the tape from Lateral side of anchor – under calcaneum – medial side – place left thumb on medial calcaneum to change direction of the tape – pull tape postero-superiorly around medial side – diagonally around Achilles tendon – finish on anchor on lateral side. Repeat the same in reverse direction [15].

Table 1 Demographic Characteristics of Players

N=10	Age (year)	Weight (kg)	Height (cm)	BMI (kg/m2)
Mean	20.1	68	159.5	26.588
Max.	23	113	185	37.36
Min.	17	43	135	17.22
SD	1.79196	21.48902	13.97021	6.78589845

Figure 1 Sensamove Mini-Balance Board

Figure 2 Single-limb Hopping Board

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Figure 3 Non-elastic Rigid Tape (Brown)

Figure 4 Application of Rigid Tape

3. Results and Discussion

3.1.Results

SPSS Version 21 software was used. Statistical analyses performed consisted of one-way ANOVA tests to examine difference in pre-post measurements while post-hoc analysis was done to analyze improvement on frequent time-intervals. The means and standard deviation scores on each of the functional performance tests are presented in Table 2 & Table 3.

Table 2 Baseline/pre-data of Outcome Variables

Variables	Mean	S.D.
Static Balance	1.74	0.68399697
Dynamic Balance	9.107	0.557614961

Table 3 Baseline/post-data of Outcome Variables

Variables	Immediate (Mean ± SD)	Post 3 days (Mean ± SD)	Post 14 days (Mean ± SD)
Static Balance	1.54 ± 0.59020	1.41 ± 0.48640	1.40 ± 0.49126
Dynamic Balance	8.80 ± 0.55568	8.82 ± 0.53050	8.83 ± 0.54777

The collected data of static and dynamic balance was analyzed using one-Way ANOVA to examine the pre-post statistical difference (Table 4 & Table 5) while the post-hoc analysis was done using Bonferroni test (Table 6).

Table 4 One-way ANOVA for Static Balance

Static Balance	Sum of Squares	df	Mean Square	F	Sig.
Between Group	1.750	2	.875	3.395	.048
Within Group	6.959	27	.258		
Total	8.709	29			

Table 5 One-way ANOVA for Dynamic Balance

Dynamic Balance	Sum of Squares	df	Mean Square	F	Sig.
Between Group	1.214	2	.607	3.631	.040
Within Group	4.514	27	.167		
Total	5.728	29			

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Table 6 Post - hoc Analysis Results

VARIABLE	(I) GROUP	(J) GROUP	M.D.	Sig.
Static Balance	Immediate	Post-3 days	-.319	.514
		Post-14 days	-.591	.044
	Post-3 days	Immediate	.319	.514
		Post-14 days	-.272	.724
	Post-14 days	Immediate	.591	.044
		Post-3 days	.272	.724
Dynamic Balance	Immediate	Post-3 days	-.200	.851
		Post-14 days	-.490	.037
	Post-3 days	Immediate	.200	.851
		Post-14 days	-.290	.373
	Post-14 days	Immediate	.490	.037
		Post-3 days	.290	.373

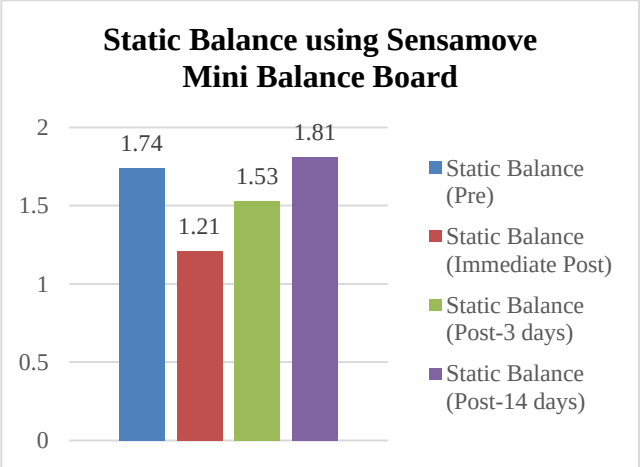

Figure 5 Mean Values of Static Balance

These data points show how the static and dynamic balance measurements change over time intervals (immediate post, post 3-days, post 14-days) after the application of tape. The effect sizes provided (0.53966 for static balance and 0.48484 for dynamic balance) indicate the magnitude of change observed from baseline. The one-way ANOVA tests showed significant differences in both static balance (p=0.048) and dynamic balance (p=0.040) post-application of tape (Table 4 & 5) (Figure 5).

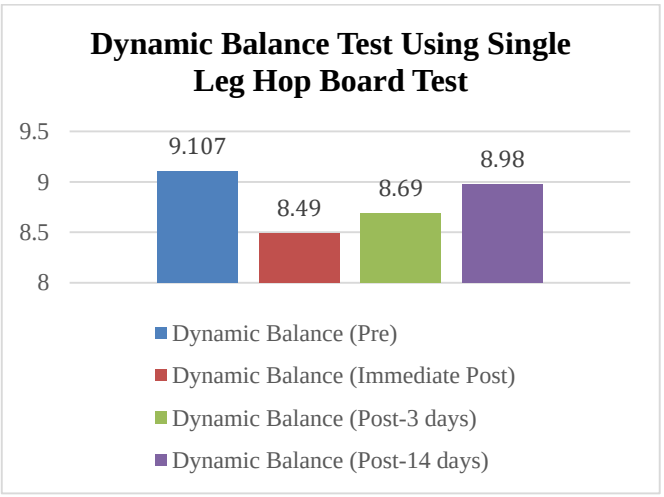

Figure 6 Mean Values of Dynamic Balance

The post-hoc analysis further explored the specific time intervals to understand the prolonged effects of tape on static and dynamic balance. Results of post-hoc analysis for static balance showed Significant differences between immediate-post and post 14-days (p=0.044), indicating that the improvement observed immediately after tape application was maintained significantly after 14-days while non-significant differences were observed between post 3-days compared to both immediate post (p=0.514) and post-14 days (p=0.373), suggesting that the balance improvements may stabilize after the initial days but remain higher than baseline. Results of post-hoc analysis for dynamic balance showed Significant differences between immediate-post and post-14 days (p=0.037), indicating sustained improvement in dynamic balance over this period while non-significant differences were observed between post-3 days and both immediate post (p=0.851) and post 14 days (p=0.373), suggesting stability in dynamic balance improvement over time (Figure 6).

4. Discussion

The result of the current study showed that there is an immediate improvement in static and dynamic balance immediately post-application of non-elastic rigid tape and it was sustained for next 3 days until

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the removal of the tape. The significant results from the one-way ANOVA indicate that tape application had a measurable effect on both static and dynamic balance in the players. The post-hoc analysis provided deeper insight. For static balance, Immediate improvements were sustained after 3 days and this is the reason for non-significant results between immediate post & post-3 days (p=0.514). Though the significant differences at post-14 days compared to other intervals indicate that the initial improvement may not stabilize rather it increased further (p=0.044). For dynamic balance, Immediate improvements were sustained after 3 days and this is the reason for non-significant results between immediate post & post-3 days (p=0.851). Though the significant differences at post-14 days compared to other intervals indicate that the initial improvement may not stabilize rather it increased further (p=0.037). Similar to static balance, improvement in stability was noted after the initial post-application phase. The sustainability of the immediate results to post-14 days was not seen in static and dynamic balance. Possible rationale for not getting prolonged effect may be that the tape was applied for a single time. Ankle injuries, especially lateral ankle sprains, are common during sports activities, and the popularity of prophylactic ankle supports has increased in recent years [16]. A recent Cochrane review (22) evaluated 14 randomized trials of ankle bracing (with data for 8279 participants). A significant reduction in the number of ankle sprains was evident for players using external ankle support. Although the findings of the present study suggest that some prophylactic benefits could be obtained for taping of the ankle, our results suggest these may be task specific [17].

5. Practical Implications

These findings suggest that tape application can be beneficial for enhancing balance in athletes over both short and medium-term durations. Understanding the time course of these effects helps in planning interventions and monitoring athletes' progress during rehabilitation or training phases.

6. Limitations and Considerations

The study's small sample size (N=10) might limit generalizability, and the specific characteristics of the sample (e.g., age range, BMI) could influence the outcomes. Further studies with larger sample sizes and diverse populations are needed to confirm and generalize these findings.

Conclusion

The statistical analyses and results provided valuable insights into the effects of tape application on balance in athletes. They underscore the importance of using both ANOVA and post-hoc analyses to comprehensively understand the temporal dynamics of treatment effects.

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