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Ankle kinematics after prophylactic ankle taping during sprinting action in recreational players

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Abstract
Background: Ankle sprains are one of the most common injuries in sports. The combination of high incidence of ankle sprains in sports causing chronic ankle instability has led to implementation of prophylactic measures. When recreational players participate in recreational activities, there is a sudden increase in load on ankle joints thus leading to recurrence of previous injuries? Such players with a history of previous ankle sprains are at a higher risk of incidence of chronic ankle instability. Hence to prevent such recurrences of ankle injuries, prophylactic ankle taping can serve beneficial.
Objective: To study ankle kinematics after prophylactic ankle taping in recreational players.
Method: 10 Recreational players of age group 18-25 years with history of ligament sprain within the duration of one year prior to the study performed who are involved in any sport once fortnight were included in the study. Participants were asked to perform a sprinting action with untapped and taped ankle. The videos of sprinting action were captured in both frontal and sagittal plane. The pre and post ankle taping data were obtained using Kinovea Software and was compared.
Results: Our study shows significant results pre and post intervention in both frontal and sagittal plane of ankle.
Conclusion: Overall, we found out that, ankle tape altered frontal-plane and sagittal-plane kinematics at the ankle during the sprinting action. The changes seen in the taped condition contribute to a reduced risk of ankle sprains in recreational players.

Keywords: prophylactic ankle taping, ankle sprain, sprinting action, recreational players, ankle kinematics, Kinovea software

1. Introduction
Ankle sprains are one of the most common injuries in sports and occur nearly 7 times more frequently than all other ankle injuries [1]. The combination of high incidence of ankle sprains in sports causing chronic ankle instability [2] has led to implementation of prophylactic measures [3].
Recreational players are the players that participate in physical games that are played for fun as opposed to professionally. In day to day activity there is not much load experienced on the ankle. But when they participate in recreational activities, there is a sudden increase in load on ankle joints thus leading to recurrence of previous injuries. Taping remains one of the most common applications for the prophylaxis and rehabilitation of ankle injuries [3, 4]. Such players with a history of previous ankle sprains are at a higher risk of incidence of chronic ankle instability [5]. Hence to prevent such recurrences of ankle injuries, prophylactic ankle taping can serve beneficial [2].

2. Materials and Methods
2.1 Objective
To study ankle kinematics after prophylactic ankle taping in recreational players.

2.2 Study design
A pre and post experimental study design was selected.

2.3 Study population
10 Recreational athletes with history of ankle ligament sprain within the duration of one year prior to the study performed or with a history of recurrence of ankle sprains or giving away of

ankle or feeling of ankle instability. Both male and female in the age criterion of 18-25 involved in any sport at least once a fortnight are included in this study.

2.4 Materials required
Kinovea software (Inter-rater and intra-rater Reliability - 0.79-0.99, Validity - 1) [10], 2 Digital video cameras, Anatomical markers, 10 meters running track, Rigid tape.

2.5 Method
2.5.1 Placement of digital cameras
Two digital cameras were used of which one camera was placed perpendicular to the center of the pathway and 20 cms above the floor for the field of sagittal view, while the other camera was placed at the end of the 10 meters running track for the frontal view. The participants were subjected to simultaneous capture of their motion with a digital video camera filming in the sagittal plane and frontal plane.

2.5.2 Placement of anatomical markers
Fluorescent markers were placed on the anatomical landmarks that is tibial plateau (medially), fibula head (laterally), medial and lateral malleolus, the center of medial and lateral malleolus, head of fifth metatarsal (laterally), head of first metatarsal (medially), head of third metatarsal (superiorly).

2.5.3 Taping technique
The area of the ankle to be taped was cleaned and shaved. An under wrap was applied before taping. The ankle was held actively by the patient in the neutral position at the anatomical 0 position for the foot. The under wrap in a figure of eight position was applied around the ankle joint. This was followed by applying rigid tape in the following sequence-2 anchors, 3 lateral supports, 2 arch support, 2 heel locks followed by 2 anchors [11].

2.5.4. Procedure
The subjects were asked to perform the sprinting action. The videos of the sprinting action was captured in sagittal and frontal view. The ankle ranges of motions were measured using Kinovea software. Prophylactic rigid taping was done to the ankle joint. The subjects were asked to perform the sprinting action again. Again the videos were captured with the ankle taped. The ankle range of motions were measured using Kinovea in different phases of the sprinting action. The data was collected and pre and post taping data were compared. The movements chosen for this analysis were ankle plantar flexion, dorsiflexion, inversion and eversion determined by the calf and foot segments.

3. Results and Discussion
3.1 Result
The data collected was put through normality test.
Since the data passed the normality test, parametric test i.e. t-test was used using primer software with level of significance at $p<0.05$.

3.2 Discussion
There are evidences regarding the role of ankle taping on passive ankle ROM after exercise, little information is available on the changes in ankle joint motion after prophylactic taping during dynamic activities such as walking and running [2].
It may be evident that taping may behave differently when dynamically evaluated. Such dynamic detailed analysis in athletes is done in walking and jogging gait [2], but not done in sprinting gait.
The precise changes in ankle ranges of motion after the application of taping during the sprinting action has not been studied. Thus this study will help understanding the changes in ankle range of motion during the sprinting action after ankle taping if seen.
The ankle kinematics between the untaped and taped conditions while sprinting action in recreational players are described below:

3.3 Plantarflexion

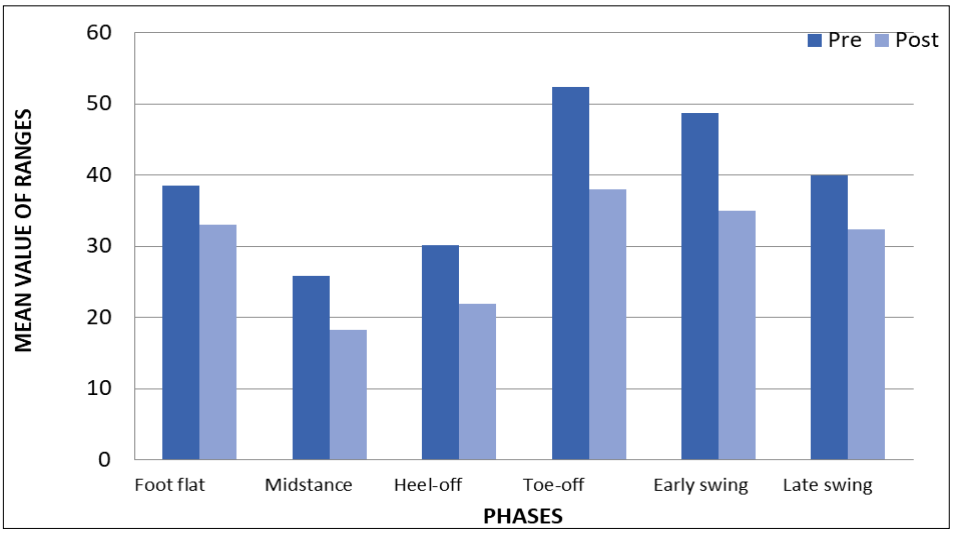

Fig 1: Ankle plantarflexion ranges pre and post taping in each of the sprinting phase

This study shows significant change in the pre and post value of the plantarflexion. The plantarflexion ranges post taping are seen to be decreased as shown in Fig 1. The data has significant changes with p value ranging from 0.000 to 0.007 in all the phases except late swing (p=0.090). Tape application restricts open chain range of motion and laxity [13], indicating the mechanical benefits of support. However, this mechanical restraint of tape may occur at the extreme ranges of motion during a dynamic motion [14]. Changes during sprinting action may be due to the mechanical benefits of tape, given the increased range of motion used at higher speed.

3.4 Inversion

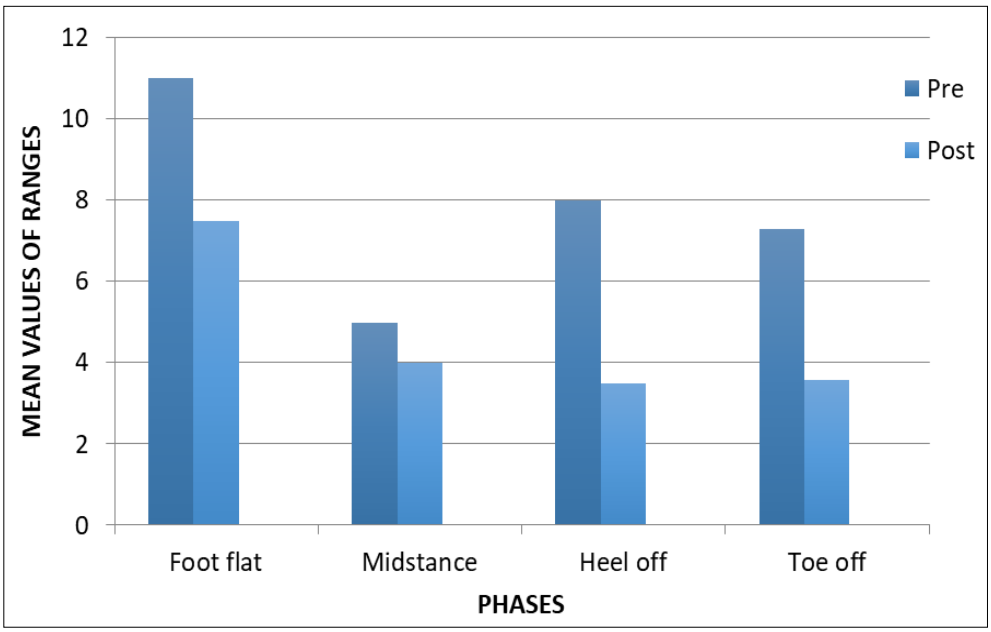

Fig 2: Ankle inversion ranges pre and post taping in each of the sprinting phase

The inversion ranges post taping are seen to be decreased as shown in Fig 2. The data does not have much significance except in the toe off and early swing phase (p=0.006-0.000) statistically.

After the tape application, there was reduced inversion from toe-off to late swing. It has been suggested that ankle sprains occur during initial loading or unloading where the inversion ranges are seen to be at the extremes [15]. Tape positions an unstable ankle in a relatively neutral position restricting the extreme ranges due to the mechanical benefits of the tape.

3.5 Eversion

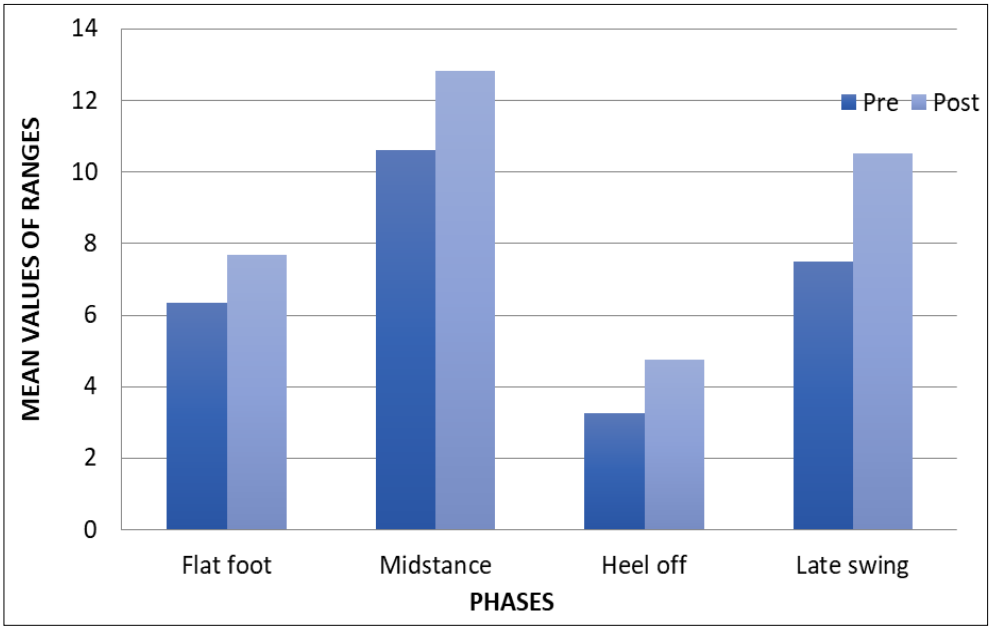

Fig 3: Ankle eversion ranges pre and post taping in each of the sprinting phase

The eversion ranges post taping are seen to be increased as shown in Fig 3. The data does not have any significant changes in any phase statistically. (p=0.302 to 0.808)

The rear foot is everting from 0% to 44% and 70% to 90%, and inverting from 44% to 70% and 90% to 100% of the total gait cycle. The ankle was relatively more everted during foot-floor clearance while sprinting in the taped condition, most likely to ensure adequate clearance.

Successful advancement of the foot from early swing to late swing is essential during gait. Tape may have resulted in better positioning of the foot to avoid contact with the ground [16]. The increased eversion which was obtained post-taping was due to the natural inclination of foot being in eversion pre-taping.

4. Conclusions

Overall, we found that, ankle tape altered frontal-plane and sagittal-plane kinematics at the ankle while sprinting action. In each case, the ankle was positioned more neutrally with tape. The changes seen in the taped condition may contribute to a reduced risk of ankle sprains in recreational players due to better positioning of the ankle throughout the gait.

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