# EFFECTS OF ANKLE BRACE AND TAPE SUPPORT ON FOOT AND ANKLE MOTION ON BASKETBALL-SPECIFIC PERFORMANCE

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Six male basketball players participated in a study to establish the effectiveness of a brace and taping to restrict passive ankle motion and to assess their effects on basketball-specific performance. Results indicated a significant main effect for time of measurement and ankle dorsiflexion (both $p$ = 0.0005). Both support systems significantly restricted inversion and dorsiflexion following application ($p \leq 0.05$), while exercise only affected the support properties for inversion. No significant differences were found for performance of a 20 m sprint, vertical jump and a four-point run. On the basis of the support provided, neither the tape nor brace can be recommended, although the latter has advantages in terms of both cost and ease of use.

**KEY WORDS**: basketball, prophylactic, ankle, performance

**INTRODUCTION:** The high incidence of ankle sprain injuries has prompted the development of protective external support systems. As a result of the external stresses imposed during exercise, however, the support properties of these systems may be reduced, which may limit their effectiveness. Two common methods by which the ankle may be supported are the ankle brace and ankle taping. Evidence suggests that external supports can negatively affect performance (Burks *et al.*, 1991) through the alteration of joint mechanics. Thus, the use of ankle supports may be viewed as a compromise between enhancing injury protection and limiting performance. The aims of this study were to compare the effectiveness of an ankle brace and a tape support in restricting foot and ankle motion before and after playing basketball and, secondly, to assess their effects on performance in basketball.

**METHODS:** Six healthy male basketball players from Leeds Metropolitan University basketball team volunteered to participate in this study (mean ± *s*: 1.81 ± 0.09 m; 83 ± 10 kg; 19.8 ± 1.7 yrs), none of whom had experienced any ankle trauma within the six months prior to the start of this study. Zinc oxide ProCare Sports Tape of width 2.5cm (MediPost, UK) was selected for the tape support due to its non-elastic properties. The Gibney closed basket weave was used, being used in the prevention and treatment of ankle inversion sprains by supporting the lateral ligaments (Macdonald, 1994).

The McDavid Ankle Brace consists of a double layer of cloth material, which conforms to the contours of the foot and ankle. Once applied to the foot, the brace is secured to the wearer's ankle by tightening the laces to allow a tight but comfortable fit. The brace was worn over a sock in order to avoid friction with and any irritation of the skin.

Range of motion was measured on the dominant ankle following the method of Root *et al*. (1971) with participants lying in a prone position on a table. Movements were recorded on two video camcorders, one perpendicular to the frontal plane for subtalar inversion and eversion, and the second perpendicular to the sagittal plane for dorsiflexion and plantarflexion. Both cameras were at the level of the distal one-third of the leg. Measurements were taken later from the projected images.

To assess the influence of exercise on the effectiveness of ankle supports, participants took part in a 30-minute half-court three-on-three basketball game. This allowed participants to be exposed to stresses and movements such as jumping, starting and stopping, and changing direction that are typical of a full-court game. Each participant was measured under three conditions (unsupported, tape and brace) during separate test sessions and in a random sequence.

Ankle range of motion was measured three times: ($t_1$) prior to application of support system, ($t_2$) following application of support system, but prior to exercise and ($t_3$) following exercise. Each condition (unsupported, brace and tape) was tested on a separate day and in a randomised order. In the unsupported condition, ankle range of motion measurements were recorded pre- and post-exercise only.

The motor performance tasks selected for this study included a vertical jump, 20 m sprint and a four-point run, which simulated the vertical jumping and horizontal mobility associated with basketball. After a 10 minute warm up, each task was performed three times in a random order under each condition, with the average value of the three trials being taken as representative of each condition.

Two-way analyses of variance were used to examine the effects of support system type and time of measurement on ranges of motion. Paired t-tests were used to assess the effects of exercise on ankle range of motion in the unsupported treatment between the pre- and post-exercise values. One-way analyses of variance were used to determine whether the support systems influenced the basketball motor performance tasks. *Post hoc* comparisons were made using Tukey's Honestly Significant Difference test.

**RESULTS:** Pre- and post-exercise ranges of motion for the unsupported condition are shown in Table 1. Post-exercise measurements were significantly greater than pre-exercise values for inversion ($p$ = 0.005), eversion ($p$ = 0.002), plantarflexion ($p$ = 0.029) and dorsiflexion ($p$ = 0.001).

**Table 1 Mean Ranges of Motion for Unsupported Condition**

| | **Inversion** | **Eversion** | **Plantarflexion** | **Dorsiflexion** |
|---|---|---|---|---|
| Pre-Exercise | $24.7 \pm 2.3$ | $8.1 \pm 2.7$ | $44.3 \pm 10.2$ | $16.8 \pm 5.2$ |
| Post-Exercise | $30.2 \pm 1.7^a$ | $11.9 \pm 1.9^b$ | $52.5 \pm 4.8^c$ | $19.8 \pm 5.6^d$ |

(a, $p$ = 0.005; b, $p$ = 0.002; c, $p$ = 0.029; d, $p$ = 0.001)

Ranges of motion for each support system across the three times of measurement are shown in Table 2 and Figures 2-5. No significant differences were found between ranges of motion on the two test days prior to application of the two support systems.

**Table 2 Mean Ranges of Motion for Each Support System**

| | ***Brace*** | | | **Tape** | | |
|---|---|---|---|---|---|---|
| | $t_1$ | $t_2$ | $t_3$ | $t_1$ | $t_2$ | $t_3$ |
| Inversion | $20.9 \pm 1.8$ | $17.6 \pm 2.9$ | $20.4 \pm 2.1$ | $21.7 \pm 2.8$ | $14.2 \pm 1.4$ | $20.4 \pm 3.6$ |
| Eversion | $6.6 \pm 2.7$ | $6.1 \pm 1.9$ | $6.9 \pm 1.0$ | $7.9 \pm 1.7$ | $5.5 \pm 1.9$ | $6.9 \pm 2.4$ |
| Plantarflexion | $50.3 \pm 7.5$ | $39.1 \pm 9.1$ | $47 \pm 6.2$ | $49 \pm 7.2$ | $41 \pm 9.7$ | $47.8 \pm 2.9$ |
| Dorsiflexion | $14.4 \pm 5.5$ | $11.6 \pm 3.3$ | $14.6 \pm 4.6$ | $13.4 \pm 4.8$ | $10.5 \pm 3.5$ | $14.9 \pm 2.3$ |

A significant main effect was found for time of measurement for both subtalar inversion ($p$ = 0.0005) and ankle dorsiflexion ($p$ = 0.0005). Neither the main effect for support system nor the interaction between support system and time of measurement was statistically significant.

Tukey's HSD difference indicated that both tape ($p \leq 0.01$) and the ankle brace ($p \leq 0.05$) significantly restricted inversion following application, and that only the tape support system was significantly affected by exercise (in terms of the range of motion allowed). However, neither support system significantly restricted inversion following exercise when compared to $t_1$ measurements.

Tukey's HSD difference indicated that both tape ($p \leq 0.05$) and the ankle brace ($p \leq 0.05$) significantly restricted dorsiflexion following application, and that both the tape ($p \leq 0.01$) and the ankle brace ($p \leq 0.01$) were significantly affected by exercise. However, neither support system significantly restricted dorsiflexion following exercise compared to $t_1$ measurements.

Table 3 shows the data for the 20 m sprint, vertical jump and four-point run. No significant differences were found between conditions for the 20 m sprint time ($p$ = 0.251), vertical jump height ($p$ = 0.39) and four-point run time ($p$ = 0.438). Although not significant, there was a general trend for each support system to have a detrimental effect on performance. Vertical jump height decreased by 3.1% and 3.5% for the McDavid brace and tape support respectively, while four-point run times increased by 1.9% and 0.9% for the McDavid brace and tape support respectively. However, 20 m sprint times showed a 2.1% decrease in sprint time with the tape support.

**Table 3 Mean Scores for Each Motor Performance Task for Each Condition**

| | Unsupported | McDavid Brace | Tape |
|---|---|---|---|
| 20 m sprint (s) | $3.4 \pm 0.13$ | $3.4 \pm 0.13$ | $3.3 \pm 0.13$ |
| Vertical Jump (m) | $0.45 \pm 0.04$ | $0.44 \pm 0.02$ | $0.44 \pm 0.04$ |
| Four-point run (s) | $11.9 \pm 0.70$ | $12.1 \pm 0.74$ | $12.0 \pm 0.63$ |

**DISCUSSION:** The present study aimed to establish the extent to which two commonly used support systems influence range of motion of the ankle and subtalar joints as compared to an unsupported condition, and how each system is affected by exercise. The results showed that 30 minutes of basketball significantly increased both subtalar inversion-eversion and ankle plantarflexion and dorsiflexion, possibly due to increased muscular flexibility.

The major objective of ankle support systems is to prevent medial and lateral ligamentous sprains by restricting the amount of inversion and eversion. Each of the support systems evaluated in the present study is assumed to restrict excessive motion by passive restraint. Controversy exists as to whether the incidence of ligamentous injury is reduced as a result, since the protection desired from these systems need only be present at the limits of anatomical range of motion.

Both support systems reduced all measured ranges of motion following application and prior to exercise. The subtalar inversion restriction offered by the tape support in this study is consistent with the findings of Myburgh *et al.* (1984) who reported a 30% decrease in inversion following tape application. The non-elastic properties of the tape support, compared with the thermo-plastic construction and inherent elasticity of the McDavid brace, may subsequently contribute to the greater restriction of inversion and eversion following its application. A further contributory factor my be the larger contact area and customized fit provided by the zinc oxide tape.

Although each treatment method was effective at providing range restriction following application, a more important criterion of an external support's efficacy must be its ability to provide ankle support during exercise. Indeed, injuries are more likely to occur during the second half of a game (McCoy, 1965). Thus, the ability for a system to retain its support properties over time would serve to limit the greater potential for injury occurrence.

Loss of restriction following exercise varied between subtalar and ankle joint movements, and also between the two support systems. As inversion sprains are the most frequently occurring ankle injury within basketball (Zvijac & Thompson, 1995), the effectiveness of a support system to reduce inversion range of motion is arguably of greatest importance. Exercise significantly decreased the effectiveness of the tape support system to restrict inversion ($p \leq 0.05$) and, although non-significant, the McDavid brace allowed 13.6% more inversion after exercise. Furthermore, all ranges of motion were increased following exercise.

There are several possible explanations for these results.

The greater reduction of subtalar inversion by the zinc oxide tape, which may be due to the direct contact of the tape with the skin, may also result in a greater potential for loss of restriction following exercise (Ferguson, 1973). In particular, the accumulation of moisture (i.e. sweat) together with the movement of the skin surrounding the foot and ankle as a result of exercise may subsequently aid in the loss of restriction of range of motion. The brace must have sufficient elasticity to be pulled over the foot during application. This inherent elasticity may become additionally stretched or loosened during exercise, thereby rendering the device less effective. Secondly, the laces that secure the brace to the foot might have also loosened sufficiently to compromise its initial support. A third possible explanation may be associated with the rotation of the brace relative to the leg during exercise. The two latter possibilities may be minimised by periodic tightening and repositioning of the brace. The significant loss of restriction of subtalar inversion of the tape support following exercise is consistent with research by Greene & Hillman (1990) who reported a 41% initial restriction of inversion following application which reduced to only 15% inversion restriction following exercise. It has also been suggested that the support properties of tape are influenced by the type, configuration, tension and adherence (Pope *et al*., 1987). Although data indicate a significant increase in range of motion between pre- and post-exercise in both support systems, an important consideration is the effect relative to the unsupported ankle. The range of motion post-exercise (unsupported) was not significantly different from that measured pre-exercise (supported). It is not known how long the support provided by the tape and brace system was statistically significant for subtalar inversion and ankle dorsiflexion. However, it is clear that a 30-minute basketball game reduced the ability of both support systems to restrict range of motion. The secondary consideration was to determine the extent to which the support systems affected performance. Both the tape and brace had no significant effect on the 20 m sprint, vertical jump and four-point run performance variables, when compared with the unsupported condition, and supported previous findings (e.g. Beriau *et al.*, 1994). Contrasting findings (e.g. Burks *et al.*, 1991) may be attributed to the use of the support systems on both ankles, thus inhibiting performance to a greater extent. Although non-significant, a general pattern of a decrease in sprint and four-point run times and a reduced vertical jump height were apparent, when compared to the unsupported condition. The extent to which these trends were attributable to changes in joint mechanics or player attitude and psychological influences toward the application of an external support.

**CONCLUSIONS:** If range restriction is a reliable indicator of a support system's protective value, findings would indicate that, initially, tape support provided a greater protection for the ankle. Following exercise, however, the brace demonstrated a greater retention of its support properties, thereby suggesting that it may be superior in preventing ankle injury. Since no significant differences were reported between the effectiveness of the two support systems, neither system can be recommended as preferable. Neither support system significantly impeded performance, although there was a tendency for performance to deteriorate. In light of these findings, budgetary savings may be the critical factor when choosing between either a tape or brace for ankle support. On this basis, and in combination with the specialist knowledge and time necessary to correctly apply the tape, the ankle brace would be the better option.

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