

# Self-Adherent Underwrap Maintains Range of Motion Restriction After Exercise

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## INTRODUCTION

Ankle injuries are one of the most common injury in athletics (Cordova 2000; Karlsson 1993). One study reports that with ankles taped the chance of injury decreases by 50% (Frier 1990). The use of underwrap when taping an ankle has become popular, especially the use of foam underwrap (Gross 1991, Ricard 2000, Abian-Vicen 2008). Recently, self-adherent underwrap with additional tensile strength and moisture restraint capabilities has been developed (Purcell 2009). The use of athletic tape to decrease ankle range of motion and aid in the prevention of ankle injuries is widespread and has been extensively researched. Most studies have found range of motion to significantly decrease in all directions immediately after tape application, but especially in the inversion and plantarflexion directions; however, many of these same studies report taping loosens with exercise (Cordova 2000; Ricard 2000, Purcell 2009). A lack of research exists concerning the best form of underwrap that should be used with taping to aid in the restriction of ankle range of motion.

## PURPOSE

The purpose of this study is to assess the effectiveness of different underwrap conditions on reducing ankle range of motion before and after exercise.

## METHODS

**Participants:** 11 males and 9 females (20.8±1.5yrs, 175.3±9.2 cm, 74.4±11.8 kg) determined to be physically active via their personal exercise habits, participated in this study.

**Procedures:** All subjects were tested on four separate days. On each day the following occurred: ROM testing, Apply tape condition, ROM testing, Exercise routine for 30 minutes, ROM testing.

**Tape Conditions:** 1) Control (no tape or underwrap), 2) tape to skin, 3) tape to foam underwrap, 4) tape to self-adherent underwrap. The closed basket-weave technique with white athletic tape was used.

### Range of Motion Testing:

- Subjects supine on treatment table with hips/thigh belted to table and the lower leg strapped into electric ankle goniometer (Figure 1)
- No shoes, no socks
- Practice trials for both inversion-eversion and dorsiflexion-plantarflexion ranges
- Mechanical zero or neutral established
- Mean of three trials used for statistical analysis

### Exercise Protocol:

- 5 minute warm-up and 5 minute cool-down
- 20 minute multi-directional drill exercise routine.
- Average of 8.76±1.25 rounds.
  - Forward jogging
  - Back-peddling
  - Lateral shuffling to right and left
  - Agility ladder
  - Figure-8
  - Jogging/shuffling 90° turns
  - Running with cone jumps
  - Zig-zag jog



Figure 1: Electric ankle goniometer

## STATISTICAL ANALYSIS

Two different repeated measures Analysis of Variance (RMANOVA) were performed to establish the differences between the tape conditions: one for the inversion-eversion range (INV\_EV) and one for the dorsiflexion-plantarflexion range (DF\_FF). The RMANOVA included two within subject factors: time at three levels (before tape application [Pre-Tape], after tape application [Post-Tape], and after exercise [Post-Exc]) and tape condition at four levels (control [C], tape to skin [TS], tape to foam underwrap [TF], tape to self-adherent underwrap [TSA]). The priori alpha level was set at  $p < 0.05$ . Tukey's HSD post hoc analysis was performed on any significant findings.

## RESULTS

### Inversion-Eversion:

Significant tape x time interaction,  $F_{6,114}=33.20, p=.001$  (Table 1 & Figure 2)

- All taping conditions were effective in reducing range of motion immediately after application
- Tape to foam and Tape to skin lost some of it's restrictive properties after exercise
- Tape to self-adherent maintained the decreased range of motion after exercise

Significant main effect for taping condition,  $F_{3,52}=35.86, p=.001$

- TSA restricted the most at  $46.82^{\circ} \pm 2.67^{\circ}$
- TS restricted  $49.29^{\circ} \pm 2.64^{\circ}$
- TF restricted  $49.74^{\circ} \pm 2.60^{\circ}$

### Dorsiflexion-plantarflexion:

Significant tape x time interaction,  $F_{6,114}=54.96, p=.001$  (Table 2 & Figure 3)

- All taping conditions were effective in reducing range of motion immediately after application
- Tape to skin lost some of it's restrictive properties after exercise
- Tape to self-adherent and Tape to foam maintained the decreased range of motion after exercise

Significant main effect for taping condition,  $F_{3,52}=60.28, p=.001$

- TSA restricted the most at  $47.25^{\circ} \pm 1.60^{\circ}$
- TS restricted  $48.50^{\circ} \pm 1.81^{\circ}$
- TF restricted  $49.93^{\circ} \pm 1.89^{\circ}$

TABLE 1: Means and SD for Inversion-Eversion ROM (in Degrees)

INV_EV	Pre-Tape	Post-Tape	Post-Exc
No tape/control	59.98±3.48	61.20±3.41	62.46±3.13
Tape-Skin	61.19±3.07	40.41±2.01*	46.28±3.28*†
Tape-Foam	61.01±3.19	41.12±2.57*	47.09±2.65*†
Tape-Self-adherent	59.48±3.57	40.19±2.52*	40.78±2.40*

TABLE 2: Means and SD for Dorsiflexion-Plantarflexion ROM (in Degrees)

DF_FF	Pre-Tape	Post-Tape	Post-Exc
No tape/control	55.71±2.10	56.11±2.02	57.51±2.04
Tape-Skin	55.89±2.05	42.83±1.70*	46.80±1.91*†
Tape-Foam	54.98±2.06	46.54±1.81*	48.27±1.95*
Tape-Self-adherent	56.36±2.09	42.63±1.54*	42.77±1.53*

\*Significantly different from Pre-Tape measure.  
† Significantly different from Post-Tape measure, indicating loosening.

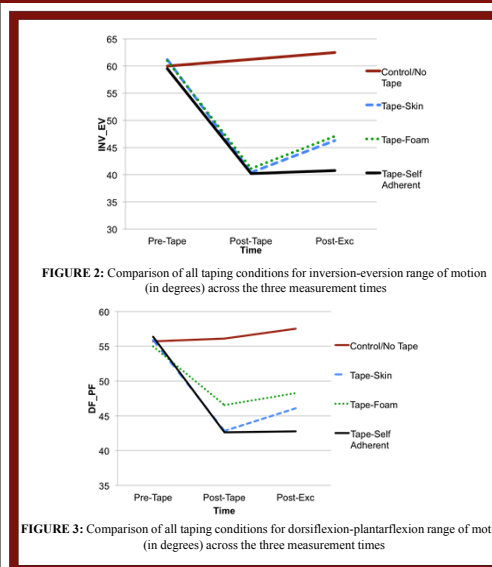


FIGURE 2: Comparison of all taping conditions for inversion-eversion range of motion (in degrees) across the three measurement times



FIGURE 3: Comparison of all taping conditions for dorsiflexion-plantarflexion range of motion (in degrees) across the three measurement times

## DISCUSSION

Our findings indicate that tape to self-adherent underwrap maintains range of motion restriction after exercise for both ranges:

### Inversion-Eversion:

- Tape to self-adherent underwrap restricts 32% of motion and maintains 95% after exercise
- Tape to skin restricts 34% of motion and maintains 75% after exercise
- Tape to foam underwrap restricts 33% of motion and maintains 70% after exercise

### Dorsiflexion-plantarflexion:

- Tape to self-adherent underwrap restricts 24% of motion and maintains 100% after exercise
- Tape to skin restricts 23% of motion and maintains 69% after exercise
- Tape to foam underwrap restricts 15% of motion and maintains 88% after exercise

### Purcell 2009:

- Self-adherent tape to self-adherent underwrap vs. white tape to foam underwrap
- Self-adherent condition restricted 25% of both inversion-eversion range and dorsiflexion-plantarflexion motion, both ranges maintained 57-59% of restricted motion after exercise
- White tape to foam underwrap restricted 13% of motion but maintained less than 1% after exercise for inversion-eversion range, for the dorsiflexion-plantarflexion range it restricted 18% and maintained 67% after exercise

For both studies the self-adherent conditions maintained range of motion. However, the use of white tape to self-adherent underwrap maintained 95-100% of motion after exercise rather than the less than 60% maintained by the self-adherent tape to self-adherent underwrap application. Therefore, use of self-adherent underwrap and white tape appears to increase the efficacy of white tape by acting as a moisture/sweat barrier between the skin and white tape. Self-adherent underwrap may also add tensile strength to the tape application, especially in comparison to foam underwrap.

•Another study also concluded that the use of foam underwrap restricts more range of motion than tape to skin conditions (Delacerta 1978).

•Two studies had conflicting results, stating tape to skin restricted more range of motion (Malina 1963, Keetch 1992).

•However, no adhesive spray was used during the foam underwrap application (Keetch 1992) which was used for our study and is typically used clinically.

By using underwrap the white tape is less likely to rip, ripping causes the restrictive effect of white tape to diminish. Taping with any form of underwrap is more comfortable to the athlete, which will allow for better compliance with those whom need their ankle(s) taped. The tape to skin application restricted more motion originally but loosened notably with the 30-minute exercise routine. We can assume that with continued exercise the tape to skin condition would continue to loosen and eventually restrict less motion than the tape to foam condition. The use of foam underwrap did not restrict as much motion initially or after exercise as the other two applications, but it did not loosen with exercise like the tape to skin condition. However, self-adherent underwrap provides the most range of motion restriction both before and after exercise.

### Future Research:

- Varsity athletes, practices, games
- Alternate taping methods and the use of self-adherent underwrap
- Ankle braces compared to the use of tape to self-adherent underwrap
- Properties of self-adherent underwrap: tensile strength, stretch, moisture/sweat restraint

## CLINICAL APPLICATIONS

•All three taping conditions significantly restrict range of motion immediately after application, and after exercise. This finding solidifies the overall use of ankle taping to decrease range of motion.

•The use of self-adherent underwrap when taping an ankle allows for greater range of motion restriction and it maintains that restriction after exercise, for both inversion-eversion and dorsiflexion-plantarflexion ranges.

- Tape to skin applications:
  - Restrict more range of motion initially
  - Noticeably loosens with exercise
  - Tears
  - Uncomfortable
  - Causes skin irritation

•Self-adherent underwrap does not loosen with exercise and thus maintains restriction, allowing for a better chance of injury prevention.

•The use of self-adherent underwrap assists in the efficacy of white tape at reducing ankle range of motion

•The use of self-adherent underwrap should be used especially during the functional and sport-specific rehabilitation phases and when an athlete is returned to participation.