THE EFFECTIVENESS OF ANKLE TAPING AND CONSIDERATIONS FOR ALTERNATIVES

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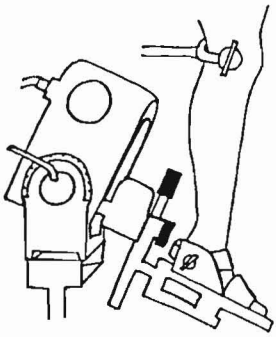
Introduction

The use of ankle taping techniques as both a treatment and prevention modality is an accepted practice throughout the amateur and professional athletic world, particularly in North America. The need for an effective support device and the vulnerability of the ankle joint to injury is well supported in the literature. (Gross, Bradshaw, Ventry, and WEller, 1987; Mack, 1975; Distefano, 1981) Researchers have demonstrated the effectiveness of a number of ankle support systems including adhesive tape, non-adhesive strapping lace or supports and semi-rigid orthotics. (Gorss et al, 1987; Mack, 1975, Distefano, 1981; Robinson, Frederick, Cooper, 1986; Hamil, Knutzen, Bates, 1987) Based on the present research there is question as to which of the ankle support devices presently in use is the most effective. (Gross, et al, 1987; Hamill, 1987; Davies, 1977) Adhesive ankle taping is traditionally the method used at present by a wide cross section of the athletic population. This study is designed to reinforce and verify the present evidence indicating the extensive increase in range of motion (R.O.M.) of the taped ankle due to the effects of exercise. (Glick, Gordon, Nishimoto, 1976; Ensberg, Andrews, 1987; Davies, 1977, Ferguson, 1973; McCluskey, Blackburn and Lewis, 1976; Simpson, 1966) Considering the application time, skin preparation procedures, taping skill required and cost time convenience of traditional taping methods, alternative ankle support systems should be seriously considered. Trainers and physicians should consider a variety of reusable prosthetic supports which may be equivalent or superior to athletic tape. Some of these devices may be used in combination with traditional taping techniques. Comprehensive research, designed to quantify the effectiveness of the more recent ankle support devices is presently lacking.

FIG. 1 Cybex II Inversion - Eversion R.O.M. plate. Knee immobilisation and upper body support frame.



This procedure effectively balanced the torques applied to the Cybex shaft. The foot plate was modified by the addition of two adjustable padded screws to stabilize the calcaneum and control heel slippage. This ensured greater sensitivity in detection of the inversion movement and a more accurate transmission to the testing device. The foot plate was lined with emery paper and velcro fastenings were used to secure the foot in position. The footplate was positioned with the rotating arm of the Cybex aligned at the level of the sub-talar joint. The Cybex II system was angled so that the foot plate was placed in plantarflexion. The measurement system was limited by the restrictions of the mechanical device not allowing for total multi-axial movement within the ankle joint. The Cybex rotational axis was limited to a fixed plantarflexed position with inversion rotation about a longitudual axis through the sub-talar joint.

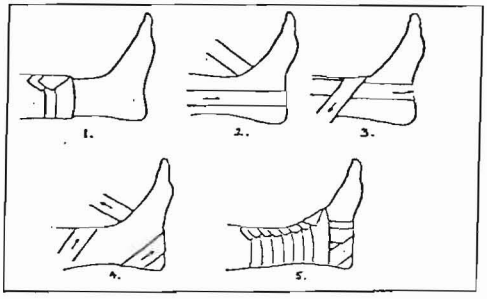
Test measurement validity was based on the angular position repeatability of the X-Y recorder which was 2.5%. A test retest reliability study was completed during a pilot study using 5 subjects over 5 days and provided a repeated measures r factor of .92. Due to the high reliability of the instrument plus the set up time to repeat the test on both legs, one leg and one measure only was taken at each exercise interval. During measurement, the subjects were positioned standing to allow full weight bearing onto the angled foot plate. The upper body was balanced using support hand rails. The free leg was not weight bearing and was supported on an adjoining level surface. To

accommodate for undesired lower limb movement due to upper body motion the subject was stabilized in an adjustable padded knee brace. Maximum range of active inversion was encouraged during each measurement and all tests were conducted on the preferred ankle.

Taping Method

The taping procedure was based on the technique promoted by the Australian Sports Injury Prevention Program (A.S.I.P.P.) at the Sports Science and Research Center, Cumberland College of Health Sciences, Sydney, Australia. (Figure 2) The athletic tape was manufactured by Beiersdorf (BDF) and was 3.5 cm in diameter. To prevent inter-taping variation and to standardize application, one proficient taper applied the tape to all subjects. Low cut running shoes, providing minimal ankle support, were worn without socks during the exercise routine. Subjects were encouraged to relax their lower limb musculative and allow the ankle to move through its maximum range.

FIG. 2 Tape method to prevent inversion



The taping technique utilized during testing entails the following method:

1) Application of two proximal circumferential anchors.
2) Three stirrups, overlapped by half, applied with a medial to lateral torque.
3) Two figure six configurations applied with a medial to lateral torque.
4) Lateral and medial heel locks.
5) Consecutive circumferential anchor strips applied over entire length to close down taping.

Protocol of Exercise and Resting Procedure

Each subject was measured before tape was applied, then after the tape application. Subjects then completed six 5-minute exercise bouts with ankle range of motion measurements recorded after each 5 minute bout. (Table 3) The content of the exercise program was designed with the intention of simulating as many lower extremity motions as possible and relating the movement to an activity situation.

TABLE 3 Five minute exercise protocol repeated six times during a thirty minute exercise period.

Reps	Exercise	Minimum repetitions or distances
40	seconds jogging	200 metres
15	seconds bench step ups	10 times
15	seconds vertical jumps	10 times
50	seconds zig-zag running (6 x 3 m)	1 1/2 times
60	seconds figure "8" runs (3 x 2 m)	7 times
30	seconds side stepping (10 m)	
30	seconds sprints with direction changes	50 metres
40	seconds jogging	
20	seconds vertical drop jumps (height 1 m)	7 times
Total Time - 300 seconds		
Exercise Surface - Paved Tennis Court		

The testing procedure was conducted in the following manner. A measurement of untaped ankle inversion was taken on the testing apparatus. The lower limb was washed, shaved and thoroughly dried, then an adhesive spray was applied to maximize tape adhesion. The effects of individual subject's fluid accumulation due to perspiration could not be controlled. Tape was applied directly to the skin using the method demonstrated in Figure 2. A measurement of taped ankle inversion was taken. Subjects then complete one of six five minute exercise bouts. Each exercise period contained the same number and intensity of exercises. The test period enabled the subject to rest between bouts. A post exercise period contained the same number and intensity of exercises. The test period enabled the subject to rest between bouts. A post exercise measurement of taped active ankle inversion was taken immediately following the exercise. A total of six identical exercise bouts were completed with measurements taken after each (ie. 5,10,15,20,25 and 30 minute intervals). After the six exercise periods the tape was removed and a measurement of untaped active ankle inversion was completed. As the test period progressed the

physical demands increased for each subject due to fatigue. However all subjects were in adequate physical condition to complete the total exercise period.

Results

Range of motion measures for plantarflexed inversion were provided from the taped ankle for each of the five minute exercise intervals. Pre-exercise untaped and taped R.O.M. plus foot exercise untaped measures were also recorded. Table 4 provides the mean R.O.M. plus standard deviations for each of the nine testing sessions.

Table 4

Means and Standard Deviations for Inversion Range of Motion

	Pre-exercise		Exercise Period						
Measures	1	2	3	4	5	6	7	8	9
Subject	Pre-taped	taped	5 mins	10 mins	15 mins	20 mins	25 mins	30 mins	Post-taped
x	54.5	32.0	43.9	47.1	53.6	57.0	58.8	58.4	63.1
SD	9.12	7.90	8.14	8.99	9.12	8.50	8.38	8.15	7.43

The results of a one way ANOVA provided a significant interaction between each of the tests ($p<.05$). A Tukey Pairwise Comparison of mean R.O.M. by trial indicated the significant differences between each exercise period.

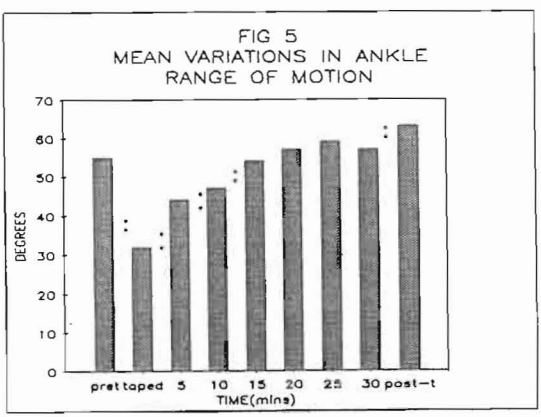


TABLE 6 Analysis of Variance Table for ankle Range of Motion (ROM)

and

Tukey Pairwise Comparison of ROM by trial

Source	DF	SS	MS	F	P
Subject (A)	16	7992.3	444.02	15.43	0.000
Trial (B)	8	1.392E+04	1740.7	60.47	0.000
	144	4144.9	28.784		
Total	170	2.5063E+04			
Grand Average	1	4.6404E+05			

Tukey (HSD) Pairwise comparisons of ROM by trial

Exercise Period	Mean ROM	Significance (.05)
1	54.5	*
2	32.0	*
3	43.9	*
4	47.1	*
5	53.6	-
6	57.0	-
7	58.8	-
8	58.4	*
9	63.1	

Rejection level = .05 Critical value for comparison = 5.3

Standard error for comparison = 1.7 * Significance

table 6

Significant differences in inversion range of motion was shown between the pre-exercise taped and untaped ankle, a predictable result. Significant increases in R.O.M. were demonstrated between 0 to 5 minutes, 5 to 10 minutes, 10 to 15 minutes and 15 to 20 minutes of exercise. There were no significant increases in range during the last 10 minutes of exercise. When the tape was removed after 30 minutes of intense exercise there was a significant increase in R.O.M. Consideration must be given to the effects of the exercise on the R.O.M. of the ankle. Figure 5 presents the R.O.M. variations and demonstrates the considerable increase from the pre-exercise to post exercise range. The specific effects of exercise without the tape at each of the test intervals could only be measured through removing the tape and measuring the R.O.M. This was not the objective of the study.
Table 6

To provide additional data for comparison, percentage increases in R.O.M. were calculated.

FIG. 7

CHANGE IN R.O.M. PERCENTAGE	
PRE-EXERCISE RESTRICTION	41.6%
EXERCISE 0-5 MIN	21.6%
5-10	6.0%
10-15	12.0%
15-20	6.0%
RESIDUAL RESTRICTION 30 MINS.	6.6%

Tape provided 41.6% restriction before exercises but R.O.M. increased 46% over the first 20 minutes of exercise. At the end of the 30 minute exercise period a residual restriction of 6.6% remained.

Discussion

The results presented provide a number of points which deserve consideration by athletic therapists, trainers, physiotherapists and

researchers in the field.

The significant increases in R.O.M. of plantarflexed inversion are indicated during the first 20 minutes of an intensive 30 minute exercise period. Approximately 45% of the full R.O.M. is regained in the first 20 minutes with 6.6% residual restriction remaining at the end of the exercise. It is questionable whether this degree of tape restriction would prevent an inversion injury. The effects of the exercise on increasing the joint R.O.M. was indicated by a significant increase in R.O.M. between the pre and post exercise period. Considering the relative increase in joint forces in a dynamic inversion injury the restriction provided by the tape would appear to be limited.

The measurement methods utilizing the Cybex II dynamometer is significant in providing an effective improvement over similar procedures used by Gross (1987). The standing weight supporting procedure adds a necessary force dimension which must be considered for maximal R.O.M. measurement. Providing the subject effectively relaxes the musculature, controlling the joint, maximal ranges can be achieved. Considerations must be given to the dynamic nature of the reaction forces transferred through the joint during foot strike. The ideal measurement method would be that which effectively measures the dynamic R.O.M. during the foot ground interaction. The major limiting factor however is forcing the joint into a potential position where the extreme R.O.M. causes injury. Future study should be directed toward comparing the various support devices including lace on devices, external athletic shoe supports and semi-rigid orthoses. Researchers should consider measurement over more extensive exercise periods simulating true athletic situations.

It is recommended that consideration should be given to providing additional support to the ankle during the loosening process. Retaping or applying additional support devices are the alternatives. The effectiveness of the additional or alternate devices has not been fully substantiated through the present research. It is hoped that the methods developed in this study will provide an effective measurement tool for the evaluation of ankle support systems.

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