Physiotherapy treatment modalities

Use of adhesive strapping in sport

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Introduction

Strapping is used to prevent injury or to facilitate safe use of an injured part during both the acute and rehabilitation phases following injury. The only demonstrable effect of adhesive strapping is to limit joint range. The commonest site of application is the ankle and foot. The majority of publications on strapping concern American football and the lateral collateral ligament of the ankle joint. The efficacy of adhesive strapping will be reviewed.

Prophylactic role of adhesive strapping

Ekstrand monitored the twelve Swedish first division football sides over a period of six months. Six teams strapped the ankles of players which had been identified as unstable or previously injured. This was done for both training and playing. The other six teams acted as the control. There were nine lateral ligament injuries in the control group and none in the taped group ($P < 0.05$). The most likely explanation for these results is that adhesive strapping limited physiological joint range and controlled talar tilt.

Proposed mechanisms of action

Various authors have used different methods to show the extent to which strapping can limit ankle and subtalar movement. All report that the effect is lessened with exercise. Fumich used the longest exercise period, three hours, at which point the initial limitation of inversion ($9.8^\circ$) was reduced by 50 per cent. Vaes, after screening 268 athletes, performed standardized stress X-rays on 51 ankles and identified the mean talar tilt to be $13.3^\circ$ (the norm is $4-6^\circ$). This was reduced to $4.9^\circ$ by strapping and $6.9^\circ$ after 30 minutes of vigorous exercise. Larson's results were similar for talar tilt. After exercise, however, the reduction of postero-anterior talar glide was not maintained.

Adhesive tape can act as a secondary ligament provided it is applied to areas of skin which are relatively immobile and the tape aligned in such a way to prevent the extremes of physiological joint range. The concept of ligaments as primary and secondary stabilizers is well accepted. In isolation, neither tape nor the strength of the tape/skin interface would resist the predicted force required to rupture components of the lateral ligament, but when combined with the body tissues, strapping improves the capacity to dissipate the energy associated with potentially traumatic forces.

It is generally believed that adhesive tape stimulates the skin receptors and facilitates muscle contraction, although the evidence to support this is difficult to find. Indeed, a study by Sprigings on the effect of sudden inversion of the foot during weight bearing showed no difference in the integrated EMG activity in the peroneous longus between the strapped and the non-strapped ankle. What does appear to occur is that the individual wearing an ankle strapping learns to adjust the muscle control of the joint to prevent skin drag. Observation of subjects walking across a $10^\circ$ incline with and without ankle strapping showed a significant difference in subtalar movement.

Although strapping has the positive effect of reducing ankle injury, the observations of altered use could point to strapping having negative effects on performance or causing injury to other joints. The 'basket weave' strapping initially restricts plantar flexion, although this effect is much reduced after 10 to 30 minutes of exercise. Juvenal reported a significant reduction in vertical jump height when ankle strapping is worn, although tests of sprint speeds showed ankle strapping to have no detrimental effect.

The effect of ankle strapping on knee injury is unclear. Where strapping is applied to limit only the ends of physiological movement, then the prevalence of knee injury is not increased. As with any orthosis, use demands that the advantages outweigh the disadvantages. In the case of strapping much depends on the method of application.

Materials and methods used to limit joint range

One method is to shave the skin, cover it with a chemical adherent containing tincture of benzoin, then apply non-stretch zinc oxide tape. This tape offers the strongest adhesion and since the tape/skin interface is the weakest link, such adhesive properties are important. Non-stretch tape has the advantage over stretch tape (normally 60 per cent extension) for two reasons.

The first is that there is one less variable in achieving the appropriate amount of joint limitation. Secondly,
Use of adhesive strapping in sport: D.A. McLean

the elastic property of 60 per cent extension tape is very short lived and contributes to the loosening effect of use.

Allergy to zinc oxide is a common problem and unfortunately the hypoallergenic tapes are less strong for both adhesion and tensile strength. Foam underwrap can be used with zinc oxide tape although an area of skin is usually left uncovered to act as the anchor point for the tape.

The argument follows that tape, like ligament, requires fixation at its ends and not along its length. Approximately 50 per cent of the articles reviewed used underwrap. Delacerda found the use of underwrap to be superior to direct application of tape on skin in limitation of ankle movement. The subjects also felt that underwrap improved comfort. None of the authors made it clear if anchor areas were used or not.

The configuration of the tape is also important. Rarick identified that angular displacement was further reduced if stirrups and heel locks were added to the 'basket weave' strapping. Pope measured angular stiffness for six different configurations of adhesive inelastic strapping. The results indicate that the amount of angular stiffness depends on the alignment and the number of layers of tape. Three layers of figure of eight strapping with stirrups provided the greatest angular stiffness, equivalent to an inversion torque of three times body weight on the hind foot. These results are probably an over-estimate of the effectiveness of strapping because this study was done on a prosthetic foot and repeated movement was not done to simulate exercise.

The design of the ideal orthosis for preventing injury to the ankle ligaments has yet to appear. The clinical studies reviewed show that the 'basket weave' with heel lock is successful. Comparative studies with the laced ankle brace (Swede-O-Universal) and the Air Stirrup (Air Cast Inc. Summit NJ07801) show these to be even more effective in reducing ankle injuries than the 'basket weave' strapping.

These orthoses also work out cheaper in materials and time although their effect on the user's physical performance has yet to be evaluated. The cost of prophylactic strapping can be reduced by only strapping the players with ankle instability or those suffering from recent ankle injury because it is these groups that are at the highest risk. As injury of the lateral ligament of the ankle accounts for 87 per cent of all ankle ligament injury, a less extensive strapping than the 'basket weave' can be used which is specifically designed to protect only the lateral structures.

The peroneal pad and strapping (Figure 1) which, to my knowledge, was introduced by the Faculty of Physiotherapy in Glasgow is designed for that purpose. Formal clinical studies have yet to be conducted on the effectiveness of peroneal strapping, although in the 18 years that I have used this method with players from soccer and rugby union, not one reinjury of the lateral ligament of the ankle has occurred.

A preliminary laboratory study using electrogoniometry has shown that an average reduction of 22 per cent of the available range of inversion of the hind foot occurs during attempts at full range active movement. To take account of the variability in the force produced during active movement, an external force of 680Newton was used to passively invert the hind foot. The strapping reduced the inversion of the hind foot by 56 per cent during which time EMG activity of peroneous longus remained unaltered from the resting state.

Strapping of other joints

The same principles of tape aligned can be applied to other joints. For example, the range of elbow and knee extension can be reduced by strapping (Figure 2) thus offering protection from over stretch or impingement of non-contractile structures following hyperextension injuries. The effectiveness of this can be checked on each individual initially by trying to reproduce end of range pain with forced passive movement and then by the sportsman's report after exercise.

Conclusion

Adhesive strapping techniques have a place in sport. There are clinical studies to support its effectiveness in preventing injury and reinjury of ligaments of the ankle. Clinical tests performed on each individual footballer can evaluate its ability to allow asymptomatic participation in sport in the presence of minor pathology of non-contractile structures. In the acute phase following injury, the ability of adhesive tape to prevent the extremes of physiological range enables the part to be used more normally where normal use is the goal to facilitate recovery.
References

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