Sports Exercise and Injury (1994) 1, 14–17

SPORTS EXERCISE AND INJURY

Mini-symposium: Non-operative treatment of the knee and ankle ligament injuries

Taping: components, application and mechanisms

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SUMMARY. **This paper gives an overview of the components used in functional taping in sport, and the techniques of tape application. The mechanisms by which tape achieves its effects are also considered with particular reference to the ankle. It is suggested that mechanical support is provided by taping through limitation of joint range and an increase in resistance to movement. Functional support may be achieved by a reduction in muscle reaction time and a facilitation of muscle contraction. This appears to be a proprioceptive mechanism mediated by skin stimulation. A learning process is also proposed.**

Strapping or taping is used extensively in the management of soft tissue injuries. However, the large number of taping materials available, and the sheer variety of application techniques, can leave the practitioner confused about taping practice. This paper seeks to clarify the situation by looking at the more common taping components, and setting out some fundamental principles of both tape application and the mechanisms by which taping achieves its effect.

TAPING COMPONENTS

Various forms of tape are available, either elastic or inelastic. In general, elastic tape is used with injured contractile tissue to provide a graded resistance or compression. Inelastic tape is more often used with non-contractile tissue injuries to take the place of a ligament in reinforcing a joint. Zinc-oxide tape is the most common inelastic type. It is air permeable, allowing the skin to breath and some moisture to escape. The tape is backed with a strong adhesive which may be a hypoallergenic formation. The tape strength is largely dependent on the number of individual threads per inch, a value known as the thread count.[1] The higher quality tapes generally have a higher thread count and are therefore stronger and less affected by body heat and moisture.

The elastic tapes may be either adhesive backed or adherent. Adhesive elastic tapes will normally stretch both longitudinally and transversely. Typically this type of tape will recoil to 125% of its original length when initially stretched lengthways.[2] However, multiple stretching will cause the tape to fatigue. Rather than tensile strength, elastic tape has good compression qualities and will pull on the skin if applied pre-stretched.

Adherent or cohesive tapes are normally impregnated with latex, enabling them to stick to themselves rather than to the athlete's skin. This feature makes the cohesive tapes reusable to a certain extent, giving cost savings. Most tapes are water repellent to some degree, but the latex coated cohesive tapes may also be water resistant enabling an athlete to bathe with them on and so maintain fitness by exercising in water.

Beneath the tape, padded materials are used to protect the skin or bony prominences and to fill in superficial anatomical cavities. The padding may be either foam or fibre based. Polyester urethane foam underwrap is used to prevent tape adhering to the skin and to provide a more even compression. Fibre padding such as orthopaedic felt or its synthetic equivalents is used where thicker packing is required. These have the advantage that they may be cut and shaped. A variety of taping components is listed in Table 1.

APPLICATION

Before tape is applied to the skin, the body area and skin condition is inspected. Sensation and circulation of the skin should be assessed before and after tape application. Minor scratches and abrasions can be protected by petroleum jelly or paraffin gauze, while larger areas should be covered by a sterile dressing.

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Table 1 Taping supplies

Taping and padding materials
Zinc oxide tape (various sizes)
Elastic tape (various sizes)
Cohesive tape (various)
Waterproof tape
Felt and foam padding (various thicknesses)
Underwrap
Tubular elasticated bandage (various sizes)
Blister protectors
Cotton gauze squares (sterile and non-sterile)
Sterile plasters (various sizes)
Paraffin gauze

Skin care preparations
Adhesive spray
Adhesive remover
Antiseptic solution and ointment
Moisturising skin cream
Skin toughener spray
Petroleum jelly

Instruments/apparatus
Razor and soap
Tape cutters, bandage scissors, sharp blunt scissors
Cotton wool, cotton tipped applicators
Surgical gloves

Table 2 Glossary of taping terms

Anchor	The first tape strips applied to the skin, for the attachment of additional tape
Butterfly	Tape strips applied from a single fixed point and fanning out
Buttress	Material used to support or limit movement
Casting strips	Tape placed over reins to hold them firm
Continuous taping	A single length of tape wound around a structure repeatedly
Fixing strip	Tape used to make reins secure
Lock	Inelastic tape which secures an anatomical structure
Padding	Foam or fibre based material used to protect bony prominences or fill superficial cavities
Rein	A strip of tape travelling between two anchor points
Skin toughener	Skin preparation products such as tincture of benzoin or spray adhesive
Stirrup	A 'U' shaped loop of tape
Strip taping	Applying a number of individual strips of tape
Underwrap	Thin polyester urethane foam placed beneath tape to protect the skin

It must be remembered, however, that in cases of a large wound, first aid is required and not simply taping. The skin is lightly shaved or the hair flattened down and an underwrap applied. Skin preparation products such as tincture of benzoin or adhesive spray can be useful where strapping fixation is poor. The use of underwrap does allow the strapping to be applied onto non-shaved skin, but the cutaneous stimulation is likely to be less than with direct skin application. This may make underwrap better where mechanical rather than functional strapping is used. Superficial skin damage occurs more commonly over areas of soft skin such as within the popliteal and cubital fossae. In addition taping over unprotected bony prominences can lead to pressure points if the tape is applied too tightly. This is common over the base of the fifth metatarsal with forefoot taping, for example.

Tape may either be applied in a number of individual strips or as a continuous roll. Application in strips has the advantage of accuracy both in terms of the underlying anatomy and the tension applied to the individual strips. It can, however, be slow. Continuous application, while being considerably quicker, uses more tape and can make tension difficult to control.

To guard against abrasion, excessive movement of the tape layers must be avoided by ensuring a firm contact. Skin contact will be reduced by moisture, dead skin cells and sebaceous oil, so the skin should be cleaned and dried before tape is applied. Allergic reactions can occur to the strong adhesive used in zinc oxide strapping, so an athlete with a known allergic reaction should be treated with hypoallergenic or cohesive tape. Where strapping is applied in layers, the overlap between successive pieces is normally half the width of the tape. This ensures that the tape layers do not part with movement of the body.[3] Gapping of the tape can nip skin between the tape layers and cause damage. The tape should be applied smoothly and moulded to the anatomical contours of the bodypart. Creases should be avoided as these will create pressure spots.

Tape is secured to the skin via anchoring strips (Fig. 1A). These are either elastic or inelastic strips applied directly to the skin without traction. Care must be taken not to compress the skin as the anchor tape is surrounding the limb and can easily impair the circulation. From the anchors, reins or stirrups may be attached, under traction. A rein travels between two anchor strips (Fig. 1B), while a stirrup is a U-shaped loop which passes beneath a bodypart, for example under the heel and up either side of the shin (Fig. 1C). The reins or stirrups are applied along the length of anatomical structures or to pull a joint into a particular position. They relieve stress from ligaments or perform the actions which a muscle would perform were it to contract. Care must be taken to avoid tape slippage which can lead to a friction burn of the skin. The reins are therefore attached to the anchor strips or skin by secure fixing strips. These run at 90° to the reins and attach in a semi-circular fashion, not surrounding the limb (Fig. 1D).

Once the main skeleton of the taping has been formed, the components are supported by casting strips to hold the reins in place and perform a firm cover for the tape. An additional protective layer may be provided by a piece of elasticated stockinette placed over the whole taping.

The aim of functional taping is not to immobilize the limb completely. Instead movement which stresses

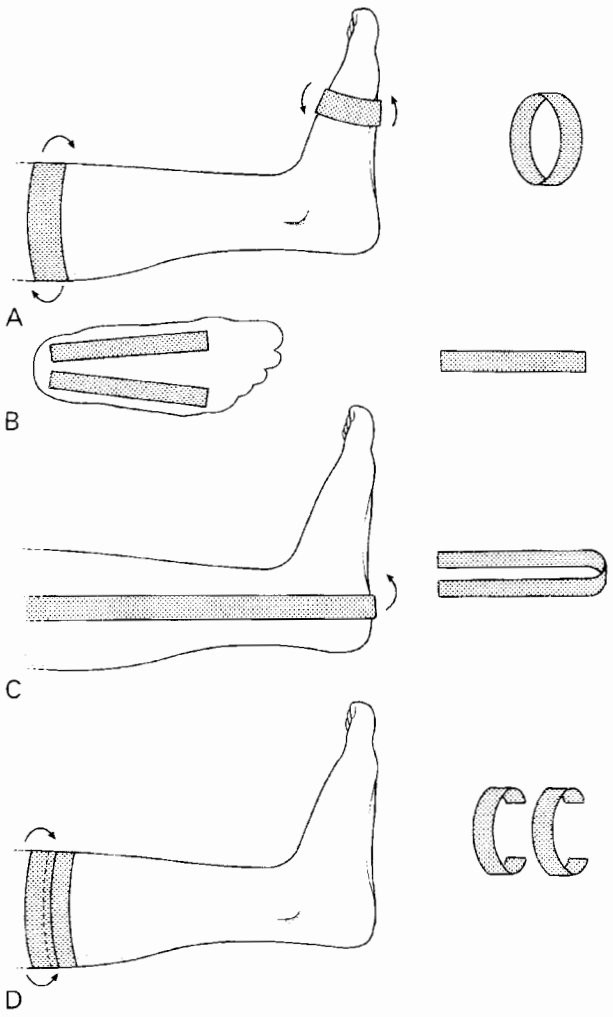

Fig. 1— (A) Anchor; (B) Reins; (C) Stirrup and (D) Fixing strips.

the injured tissues is reduced, while a near normal range of motion is allowed in other directions. This allows the athlete to continue with modified and reduced intensity training while protecting those tissues damaged during the original injury. In addition, the tape may be used to re-educate movement giving the athlete feedback (see below). To achieve this, the limb is positioned with the injured structure to be protected in a shortened position. For example, the lateral ligament of the ankle is strapped with the joint held everted and dorsiflexed. Where a general limitation of all movements is required at a joint, the functional mid-range position is chosen.

The athlete must be observed for 2 or 3 min after taping application to ensure against circulatory complications. The finger or toe nail of the treated limb should be firmly pressed and released to ensure that colour returns readily, demonstrating that an adequate blood flow is reaching the nail bed. However, even with correctly applied strapping complications may occur later, so the athlete must be warned to remove the strapping immediately in the presence of skin discolouration in the fingers or toes, increasing swelling, increasing pain, or numbness/tingling. Both passive and active joint movements are performed to ensure that the tape limits the range of motion correctly, and that it stays on.

The strapping is removed by lifting the end and pressing the skin down to form a tunnel. A tape cutter or bandage scissors are then used (lubricate the tip of the cutter) to cut the tape. The tape should be pulled back on itself and the skin pressed down at the same time to avoid too much skin traction. Residual adhesive should be cleaned from the skin. Frequent tape removal and re-application will increase skin irritation, as will tape slippage which can lead to a skin burn. After the tape is finally removed, a moisturizing cream is used to form a protective cover to the treated area.

TAPING MECHANISMS

Taping appears to achieve its effects by both mechanical and function mechanisms. Mechanically, the range of motion at the joint is reduced by taping and the force required to displace the joint is increased. Radiographic studies of static talar tilt and anterior displacement, for example, have shown significant movement reductions with ankle taping.[4,5] Electrogoniometry has also been used to demonstrate reduced inversion/eversion and plantarflexion during active exercise with the ankle taped.[6,7] The limitation to movement is quickly reduced as the tape degrades with body heat and moisture. 40 of the supportive strength of ankle tape is lost after just 10 min of vigorous exercise.[8] In addition the typical tensile strength of zinc-oxide tape is considerably less than the tensile strength of the anterior talofibular ligament, for example,[9,10] meaning that multiple layer application is required to secure the joint effectively. Although the mechanical stabilizing effect of tape is reduced following exercise, taping has been shown to reduce the incidence of ankle injuries.[11,12] Clearly another mechanism must be working to aid joint stability.

The additional mechanisms may be an enhancement in functional stabilization of a joint through skin stimulation. Two mechanisms seem to act here, firstly direct reflex stimulation, and secondly a learning process. Activation of a cutaneous reflex response is a familiar occurrence, and is demonstrated in both the abdominal reflex and the flexor withdrawal response. Cutaneous stimulation causes muscle contraction within the region of the stimulant. It is possible that the stimulation of adhesive tape and particularly the drag caused by the tape on the skin with movement will initiate this response, as cutaneous receptors can stimulate proprioceptive reflexes.[13] Peroneal reaction time has been shown to shorten with taping application[14] and the peroneus brevis has been shown to function for a longer period at the end of the swing phase of gait.[15] In addition,

during single leg standing peroneal muscle activity has been shown to be significantly greater in taped than in non-taped ankles.[16]

The other way cutaneous stimulation seems to work is by reminding the athlete not to perform an unwanted action. Skin drag is uncomfortable, and can be used to great effect to correct faulty technique through feedback. In this situation the athlete learns to adjust muscle control to prevent the skin drag.[17] A good example is the avoidance of repeated flexion of the lumbar spine. Strips of pre-stretched elastic adhesive tape placed either side of the spine will drag on the skin as the athlete flexes, reminding him or her to avoid this action.

This cutaneous stimulation of underlying protective mechanisms may be used in other regions. For example, it is unlikely that a mechanical strapping could immobilize the hamstrings sufficiently to prevent tearing while still allowing unhindered function. However, elastic adhesive tape applied pre-stretched along the length of the muscle may remind the athlete not to overstretch and could therefore be useful in the sub-acute phase of injury to this bodypart.

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