Does tape facilitate or inhibit the lower fibres of trapezius?

C. M. Alexander*, S. Stynes*, A. Thomas*, J. Lewis†, P. J. Harrison*

*Department of Physiology, University College London, London, UK, †Physiotherapy Department, Chelsea and Westminster NHS Healthcare Trust, London, UK

SUMMARY. The application of tape to the skin overlying the lower fibres of trapezius is generally thought to facilitate this muscle. However, this facilitation has not been thoroughly investigated. In this study, the effect of tape upon trapezius motoneurone pool excitability was assessed using the trapezius H reflex. The amplitude of the H reflex was measured across four conditions: before tape application, with Endura Fix tape, with the addition of Endura Sports tape and finally with the tape removed. Instead of the expected facilitation of lower trapezius, this tape inhibited lower trapezius activity. On average, the application of Endura Fix tape inhibited trapezius by 4%. The application of Endura Sports tape overlaying the Endura Fix tape inhibited trapezius on average by 22%. This inhibition did not last once the tape was removed. This suggests that any change in shoulder girdle symptoms or movement, which occurs with the application of this particular tape is not explicable on the basis of the facilitation of the lower fibres of trapezius. © 2003 Elsevier Science Ltd. All rights reserved.

INTRODUCTION

Tape is in widespread use amongst physiotherapists. One reason for its use is the belief, based, in the main, upon anecdotal evidence, that tape facilitates and inhibits muscles depending upon the way it is applied. For example, tape applied under tension in the direction of the muscle fibres is thought to facilitate the underlying muscle (Morrissey 2000). However, tape applied across the belly of the muscle is thought to inhibit the muscle (Tobin & Robinson 2000). An understanding of the mechanisms by which taping achieves its effects is limited. It has been hypothesized that tape applied in the direction of the muscle fibres is able to draw the origin of the muscle towards its insertion. It is proposed that this muscle shortening optimizes the length-tension relationship of a lengthened muscle, enhancing its ability to generate force (Morrissey 2000). On the other hand, other proposed mechanisms include the biomechanical realignment of a joint, which may optimize its ability to move normally (Host 1995; Turner 1996), as well as cutaneous afferent input from the application of tape, altering motoneurone output (Simoneau 1997; McNair & Heine 1999).

Tape is often applied around the shoulder girdle. One of the most popular techniques is the placement of tape from the medial end of the spine of the scapula extending down to the lower thoracic spine. This application approximately mirrors the direction of pull of the lower fibres of trapezius and is commonly believed to facilitate this part of the muscle.

One way of exploring whether or not taping the muscle does facilitate trapezius is to investigate whether the application of tape affects trapezius reflexes. A change in the amplitude of a reflex reflects a change in the level of facilitation or inhibition acting upon the motoneurone pool. Indeed, if reflex amplitude increases, the motoneurone pool has been facilitated and if reflex amplitude decreases, it has been inhibited. A reflex that lends itself to such a
study is the H reflex. An H reflex is the electrically evoked equivalent of the tendon jerk and has been characterized in the trapezius muscles by Alexander and Harrison (2002). Thus, whether or not trapezius is actually facilitated by application of this tape can be investigated by electrical stimulation of the sensory nerve of trapezius, which then evokes a monosynaptic reflex (see Fig. 1). This, then allows an assessment of the effect of tape applied to the skin overlying and aligned with the lower fibres of trapezius upon the H reflex as an index of trapezius motoneurone pool excitability. This was the aim of the study.

**METHOD**

The H reflex of trapezius was evoked by electrically stimulating the cervical nerve of C3/4 (Alexander & Harrison 2002). The C3/4 cervical nerve is the sensory supply to the trapezius muscle and carries not only the afferent supply to trapezius but also a varying compliment of motor axons (Williams et al. 1989; Krause et al. 1991). Thus, stimulation of the cervical nerve of C3/4 evokes an H reflex and in some subjects, where motor axons are present, an M response is also evoked (see Fig. 1B). Electrical stimulation of a mixed peripheral nerve activates

---

**Fig. 1**—A diagrammatic representation of the H reflex pathway (top) and the trapezius H reflex (bottom). (A) Electrical stimulation of a mixed peripheral nerve evokes two responses from the muscle it supplies. The first response is the motor response (M response). This is from the direct stimulation of the motor axons. The second response (or H reflex) is evoked by stimulation of the afferent supply, which monosynaptically activates the efferent axons. (B) The trapezius responses to electrical stimulation of the cervical nerve of C3/4. The downward arrows mark the responses. The upward arrow marks the onset of the stimulus. This average is the result of 10 stimuli.
both sensory axons and motor axons. Activation of the sensory axons produces monosynaptic activation of the motor neurones and as a consequence the H reflex. Activation of the motor axons causes direct activation of the muscle. This is the M response and is not a reflex. The presence of the M response is useful since it gives an index of consistency in the application of the stimulus to the nerve. As long as the M response is consistent, then consistent changes to the H reflex can be inferred as being changes in motoneurone excitability (see Fig. 1A). This is particularly pertinent as the application of the tape upon the skin can pull upon the stimulation site and possibly alter the effectiveness of the stimulus to the cervical nerve. However, by monitoring the amplitude of the M response, the effectiveness of the stimulus can be monitored and any inconsistent responses can be scrutinised.

Recordings were made, with local ethical approval and informed consent, from 18 healthy subjects aged between 21 and 36 years. Responses of trapezius were evoked by a 1 ms square-wave electrical stimulus (Digitimer D57) applied to the cervical nerve of C3/4, with an inter-stimulus interval of 3 s. The anode, a gauze-covered metal plate, was positioned just below the clavicle. The cathode, a roving and gauze-covered electrode, was used to locate the cervical nerve of C3/4. This is superficially located on the anterior surface of the upper fibres of trapezius above the clavicle. Accurate positioning of the cathode was confirmed by the resulting contraction of the trapezius muscle. The cathode was then replaced with a self-adhesive Ag/AgCl electrode.

Surface EMG was recorded from the lower fibres of trapezius using adhesive electrodes (Blue Sensor) placed edge to edge with the recording area 3 cm apart. The electrodes were positioned in line with these fibres at the level of T6/7. The EMG was amplified (Digitimer NL824) and filtered (Neurolog NL125) with a bandwidth of 30 Hz–3 kHz. The data were converted from an analogue to a digital signal at a sampling frequency of 4 kHz (CED 1401) and stored for later analysis by CED Signal software.

The experiments were carried out with the subject sitting. Subjects performed a maximum voluntary contraction (MVC) of the lower trapezius, which was determined by a combined retraction and depression of the shoulder girdle. Particular levels of contraction were controlled with the aid of a visual feedback device. Throughout the experimental procedure the subject contracted the lower fibres of trapezius at 10–20% of MVC. The procedure began by evoking a control sequence of approximately 50 trapezius reflexes. An under-tape (Endura Fix tape) was then gently applied so as not to create tension upon the skin. It was aligned with the lower trapezius fibres as per Figure 2A and a further 50 reflexes were evoked. Rigid tape (Endura Sports tape) was then applied over the under tape ‘under tension’ as applied in common clinical practise (see Fig. 2B). A further 50 reflexes were evoked. Finally, the tapes were removed and 50 more reflexes were evoked.

The amplitude (measured from peak to peak) of the M response and the H reflex were then measured. The stability of the M response was then scrutinised before assessing any change in the amplitude of the H reflex. Thus, for each subject it was ensured that the amplitude of the M response was not significantly different throughout the four experimental conditions by removing any spurious M responses. The H reflexes accompanying spurious M responses were also discarded. In two subjects the amplitude of the M response could not be accurately assessed and so the results of these two subjects were removed from the data. In the remaining subjects, the consistent amplitude of the M responses was tested using a one-way analysis of variance (ANOVA). Thus, for each subject, the H reflex data set was accompanied by M responses of consistent amplitude. The amplitude of these H reflexes was then compared across the four experimental conditions using a two-way ANOVA with replication. A post hoc Tukey test was used to identify differences.

RESULTS

It was expected that the tape would facilitate the lower fibres of trapezius. For this to occur, the peak-to-peak amplitude of the H reflex would increase. In fact, the trapezius H reflex decreased in amplitude with application of tape. Figure 3 illustrates a typical result. Here, the under tape had little effect. However, the application of rigid tape inhibits the trapezius reflex. Upon removal of the tape, the trapezius H reflex amplitude returns to near baseline levels. As illustrated by the stability of the M response, these.
changes occur independently of the effectiveness of the stimulus.

Averaging the results from all 16 subjects in which the M response was stable gives the population data (Fig. 4). This reveals that the application of the under tape produced a mean decrease of 4% of the amplitude of the H reflex, while the application of the rigid tape produced a mean decrease of 22%. This 22% inhibition was not sustained when the tape was removed. In fact, on average the H reflex immediately returned to within 2% of the baseline activity upon removal of the tape (see Fig. 4). A two-way ANOVA with replication reveals that these changes in H reflex amplitude across the four conditions reached significance ($P < 0.001$). In addition, a post hoc Tukey test reveals that the H reflex amplitudes compared across all conditions were significantly different from each other ($P < 0.05$). Consequently, application of the under tape inhibited trapezius activity, the additional application of rigid tape inhibited trapezius further and finally the removal of the tapes removes this inhibition, although the activity did not quite return back to pre-tape levels.

**DISCUSSION**

The results of this study show that taping the skin overlying the trapezius muscle, as performed in this study, inhibits its reflexes. This effect does not last, as upon removal of the tape the trapezius reflex returned to within 2% of the pre-tape amplitude. This result is surprising in view of the fact that taping is thought to facilitate the lower fibres of trapezius. However, a review of the literature suggests that this belief is based upon case studies, course notes, clinical experience and anecdotal claims (McConnell 1994; Host 1995; Mottram 1997; Morrissey 2000).

Irrespective of clinical observations, the results of this study clearly shows that taping inhibits the H reflex. However, while this result is not in doubt the present experiments shed no light on the mechanisms involved. Consequently, the mechanisms involved are...
open to speculation. For example, one way by which this inhibition may have occurred may be due to an alteration of the length of the muscle when tape is applied under tension. Thus, if the muscle was held in a shortened position by the tension of the tape, a reduction in tonic muscle spindle activity may result. This would reduce the spindle afferent input upon the trapezius motoneurone pool, which may lead to its inhibition.

A small, though significant inhibition of the trapezius H reflex did occur with the application of the under tape, which was not applied under tension. This suggests that mechanisms other than those evoked by changes in muscle length may also be involved. Cutaneous afferents are well known to affect reflex activity (Jenner & Stephens 1982). These afferents have both facilitatory and inhibitory effects upon local motoneurone pool excitability. Although there is little understanding of the effect of local cutaneous afferents upon the activity of trapezius, the inhibitory effects observed here could be explained on the basis of cutaneous effects being produced by laying the tape upon the skin.

Another possible mechanism may be related to the subject's subjective reduced sense of effort in contracting trapezius with the application of tape. Thus, the presence of the tape increases afferent input, which may lead to a corresponding decrease in volitional drive to the motoneurone pool from descending pathways. This might effectively change the motor 'set'.

In conclusion, the results of this investigation suggest that we must reconsider the presumption that taping along the length of a muscle tends to facilitate whereas taping across the length of the muscle inhibits it. However, whatever the mechanism, the results of these experiments should be taken in the context that these were normal healthy subjects, i.e. without shoulder pathology, nor were they in pain.

Although the effect of tape upon these normal subjects was clearly inhibitory, it may be the case that tape has a different effect in subjects with shoulder pathology. Thus, further examination of these issues should be explored in order to understand the underlying mechanisms of its effect.

Acknowledgements
This work was supported by the Wellcome Trust, grant number 054895. C.M.A. is a recipient of a postgraduate training bursary from the Arthritis Research Campaign.

References
Turner 1996 Rehabilitation of the sporting shoulder. Physiotherapy in Sport XIX: 6–11

© 2003 Elsevier Science Ltd. All rights reserved.


Diese Studie legt auch einen signifikant effect an Gesunder Patienten.