

Original Research

Treatment With Therapeutic Bandages to Control Equine Postarthroscopic Tibio-Patellofemoral Swelling



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ABSTRACT

The aim of this study was to evaluate the effect of therapeutic bandages, the Kinesio Taping Method (KTM), in controlling swelling following arthroscopic tibio-patellofemoral surgery in horses. In vivo experimental study was studied. Twelve horses undergoing experimental tibio-patellofemoral arthroscopy were divided into two groups: six animals in the control group (CG) (without tape) and six animals in the treatment group (TG) that received therapeutic bandages based on the KTM. All of the horses were evaluated by thermography of the lateral and cranial aspect of the joint as well as by a perimeter assessment of the tibio-patellofemoral joint. The TG showed greater control of postoperative swelling with a significant reduction in swelling after 24 hours of treatment compared to the CG staying up to 72 hours, but there were no significant differences in temperature based on the thermography. In this study, which was unprecedented in horses, the use of therapeutic bandages resulted in a significant reduction in postoperative swelling of tibio-patellofemoral arthroscopy in horses compared with CG. Although often employed in human rehabilitation, this therapy is potentially beneficial for veterinary rehabilitation, specifically in horses.

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1. Introduction

Arthroscopy is a minimally invasive procedure that provides magnification of the structures being evaluated and the possibility of washing the joint cavity to remove articular debris, but it requires skill and surgical training. Among the joints that are commonly subjected to arthroscopy, the tibio-patellofemoral joint accounts for 50% of all of the outpatient orthopedic surgeries performed on humans with low tax of complications as the reviews studies cited with 1.68% of 10,262 procedures [1,2] in 1988

and 0.8% of 118,590 arthroscopies carried out by the Arthroscopy of North America [3]. In horses, arthroscopy is an advance that has replaced arthrotomy in 90% of the author's cases and considered to be a low-risk procedure and is used for the treatment of various clinical situations involving joints [1,4]. The possible complications are hemarthrosis and periarticular and intraarticular edema (60.1%), synovitis, infection (12.15), neuropathies and myopathies (1.8%) and, especially, distension and compartment syndrome (2.3%), which is most responsible for the painful process of capsular distension and the stimulation of neurologic receptors [1,2,5,6].

The use of therapeutic bandage began with treatments related to musculoskeletal disorders and progressed to use in clinical situations [7] including neurologic rehabilitation [8–12], pain control [7,13–15], and the treatment of muscular and postural issues [16–20] and, especially, problems related to the circulatory and lymphatic systems [21–26].

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About this therapy/methodology, the specifications for the materials and specific techniques were originated of Kinesio Taping Method (KTM), which aims to regulate the homeostasis of the tissues adjacent to the skin, activate lymphatic and vascular flow, decrease pain, and help to correct joint misalignment [27–29]. The tape used for this therapy is composed of 100% cotton without the presence of drugs or other substances and manufactured with 10% tension of the tape already applied to the paper [7,9,30].

For the conditions that require the functional improvement of the lymphatic system, tapes are apply to stimulate the compressive effect of pumping muscles and avoid lymphatic buildup in the extremities [31]. Therapeutic bandages have, inside all properties, a mechanism of action that causes microconvolutions (small ripples that form by lifting the skin but without causing damaging) due to the effect of elastic recoil of tape. This effect stimulates periodic compressions and expansions of the vessels by the movement of tissue, favoring a pumping of vessels [9,24,25,32,33].

Studies of this therapy in animals are limited even though it is based on established methods for humans. However, there are equine features that are different from those of comparable structures in humans; for example, the pain threshold is lower and the number of mechanoreceptors in the skin is greater than in humans, and the lymphatic ducts of horses are characterized by the presence of small muscle fibers. The existing clinical reports describing the effects to this therapy in veterinary medicine are positive, but due to the low number of studies, there is still much debate about the actual mechanism of action as well as some controversial results [28,34–37].

The aim of this study was to evaluate the effect of therapeutic bandages using the KTM on the control of swelling following tibio-patellofemoral arthroscopy in horses.

2. Materials and Methods

The study was conducted at the Veterinary Hospital of the Faculty of Veterinary Medicine and Animal Science, São Paulo State University “Julio de Mesquita Filho,” Botucatu Campus, São Paulo, under the approval of the ethics committee established by permit number 225/2011—CEUA.

This study followed a randomized clinical trial format in which the animals were placed in their respective experimental groups at random, and the standard surgical procedure was performed on all of the animals by a qualified surgeon. The study was divided into four time periods, over that were distributed evaluation and treatment points of time (Fig. 1).

2.1. Animals

Twelve mixed breed horses, aged 3 and 5 years, undergoing tibio-patellofemoral arthroscopy were divided into two groups: a control group with six animals without tape (CG = 6) and a treatment group with six animals that received therapeutic bandages (TG = 6). All animals received immediate postoperative treatment with anti-inflammatory phenylbutazone (4.4 mg/kg; each 24 hours per 3 days). The animals were at rest during the postsurgical period and remain free to wade in their stalls during 7 days.

The arthroscopy was performed based on the protocol of hospital with the animal in a dorsal decubitus and the semiflexed hind limb. There were used two-access portal of 1 cm each—first between middle patellar ligament and medial patellar ligament and second between middle patellar ligament and lateral patellar ligament. We used physiological solution 0.9% with a pressure of 10% according to infusion pump of the arthroscope. The procedure time was 1 hour on average each animal.

2.2. Experimental Treatment

The Kinesio Taping application to TG began at time T-1, 12 hours after the arthroscopic procedure and after the formation of postsurgical swelling. A technique “FAN” was used at 10% tension of elasticity (tension original applied by manufacturer) to perform the lymphatic and circulatory activation technique, based on the KTM [27]. Each animal used two 30 cm × 5 cm strips of Kinesio Tape Finger Print divided in three parts: initial anchor at the popliteal lymph node region; therapeutic zone (middle of strips) on the lateral-cranial aspect; and end anchor of each strip at the cranio-medial aspect of the tibio-patellofemoral joint (Fig. 2). The tapes were removed prior to thermographic assessment at time T-4, 72 hours after the initiation of the treatment.

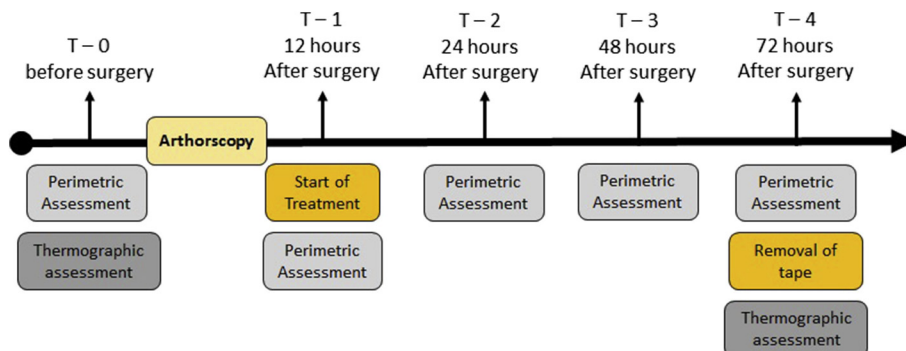


Fig. 1. Representative temporal scheme of evaluation and procedures.



Fig. 2. Application Tape Kinesio Tape in tibio-patellofemoral joint. (A) Initial anchor in the popliteal lymph node region and the therapeutic zone on the lateral-cranial aspect of tibio-patellofemoral joint; (B) end anchor on the cranio-medial aspect of tibio-patellofemoral joint.

2.3. Assessment Methods

The evaluation protocol (Fig. 1) consisted of five perimetric assessments with a 100-cm tape measure following three different lines around the hind limb (3 cm proximal to the patella, the patellar apex, and 3 cm distal to the patella) with the animals in standing position. After the completion of all of the measurements, the average values for each time point (T-0, T-1, T-2, T-3, and T-4) were calculated for each animal.

Thermographic evaluation was performed on all animals at two time points (T-0, after 30 minutes of trichotomy, and T-4, 5 minutes after the removal of the tapes), and it covered the cranial and lateral aspect of the patellofemoral joint using a thermographic camera. To acquire the images, the animals were placed in the station in their stalls for 30 minutes, and the images were taken by the same operator at a distance of 40 cm from the animal. The temperature scale was regulated, and the images at moment T-4 were acquired 5 minutes after the withdrawal of the tape under the same conditions as described for T-0. Image processing and measurement values were corrected for local temperature and humidity using specific software. The temperature of the rectangular area covering the lateral and cranial aspect of the entire tape application area was recorded.

2.4. Statistical Analysis

Statistical analyses of both the perimeter and thermographic evaluations consisted of a two-way analysis of variance with a Bonferroni posttest in GraphPad Prism

version 5.00 for Windows (GraphPad Software, San Diego, CA [www.graphpad.com]). To the statistical evaluation, the perimeter assessment values were calculated based on the difference between the absolute value at T-0 and that at each time moment (T-1–T-0; T-2–T-0; T-3–T-0; T-4–T-0), excluding the influence of any initial differences between the groups.

3. Results

By statistical evaluation, the groups presented for the perimetric evaluation without statistical difference at time T-0, demonstrating that there was no difference between the measurements. The differences between the moments between each group were chosen by the statistical evaluator based on the analyzes of the animals.

Comparing the perimeter evaluations between the experimental groups, the CG presented an average perimeter of 64.00 ± 2.05 cm at the end of the study, whereas the TG average was 58.38 ± 4.25 cm, a statistically significant difference ($P = .002$). A significant difference was presented beginning at T-2, only 24 hours after the initiation of treatment, at which time the TG value was 58.55 ± 4.25 cm compared to the CG value of 63.26 ± 3.38 cm, a statistically significant difference ($P = .01$). An examination of the plot showing the development of local swelling (Fig. 3) shows that the hind limb perimeter of the CG exhibited an upward trend of 2.67 cm, whereas the perimeter of the TG remained similar to that at the moment of the surgical procedure (T-0).

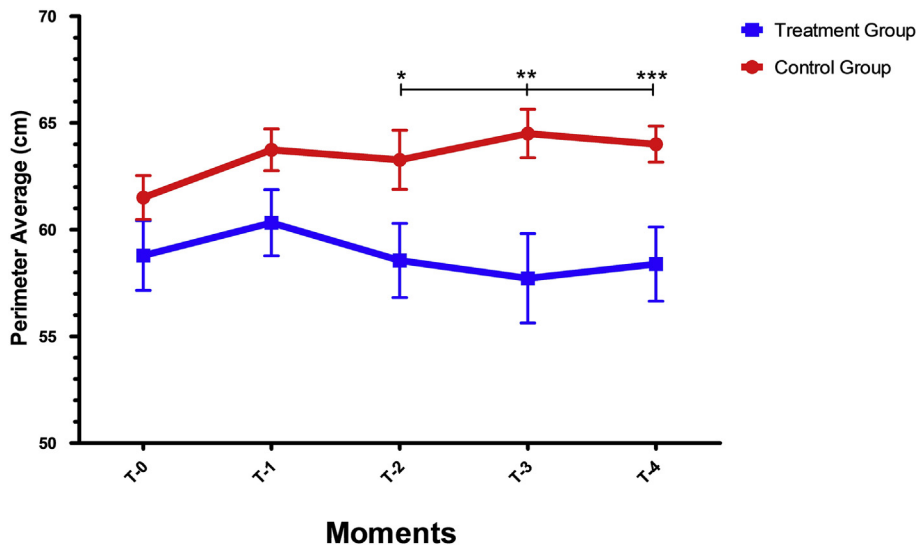


Fig. 3. Average perimeter between treatment groups (TGs) and control group (CG) between the moments. T-0 (before surgery); T-1 (12 hours after the surgical procedure); and T-2, T-3, T-4 (every 24 hours after tape application). Significant differences: * T-2 ($P = .01$); ** T-3 ($P = .004$); and *** T-4 ($P = .002$).

After analyzing the thermographic assessments of the lateral aspect of the hind limbs of the horses, the CG showed a difference of 3.95°C compared to the initial moment (T-4–T-0), whereas the TG showed a difference of 3.13°C . The evaluation of the cranial aspect found differences similar, that is, CG = 3.95°C and TG = 2.65°C , but both groups showed no significant differences between the measurement times. When the differences between the groups were analyzed, both the lateral and cranial aspect thermographic evaluations exhibited no significant differences (Fig. 4).

4. Discussion

Swelling or effusion after arthroscopy, even though it occurs at a low rate (0%–15%), may be responsible for postoperative pain and may delay rehabilitation, mainly from degenerative diseases [1]. In this study using therapeutic bandage, we can confirm that the lymphatic activation was effective when applied after 12 hours of surgery due to higher decrease of swelling in TG, demonstrating a positive effect in reducing swelling 24 hours after the procedure that persisted for up to

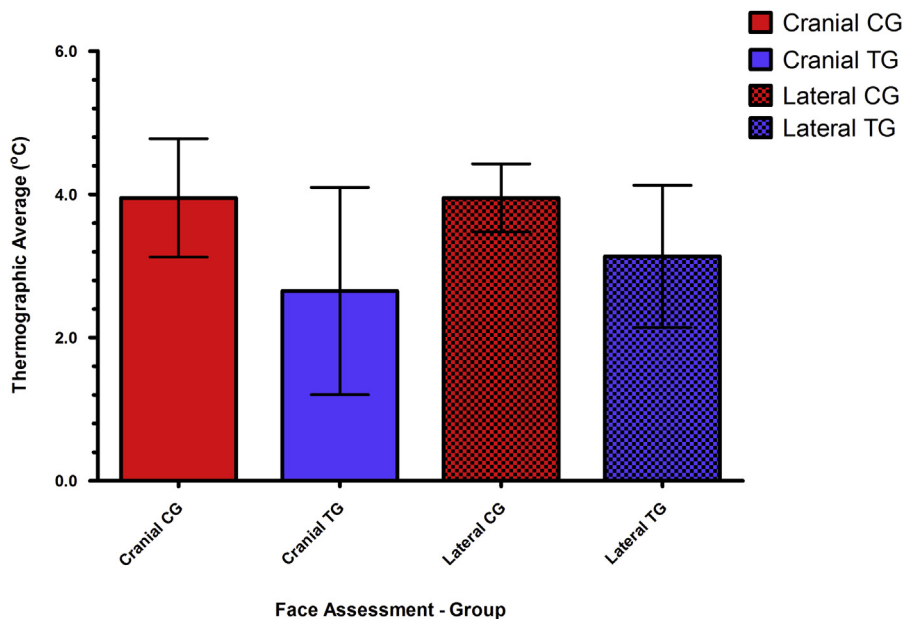


Fig. 4. Difference between the average temperature T-0 and T-4 moments for the thermographic assessment in tibio-patellofemoral joint between the groups.

72 hours relative to the CG (without tape application). This result corroborates with Shim et al [32] who observed lymphatic activation in rabbits with higher flux of lymphatic fluid in the group submitted to passive exercise after the application of tapes.

This result enhance the importance of applying therapeutic bandages after surgery, promoting local lymphatic activation and preventing the side effects of joint capsule distension and the subcutaneous tissue by gas or liquid, caused during arthroscopy and responsible for the stimulation of neurologic pain receptors, cited by Allum [1] and Goodrich and McIlwraith [5]. This study recommended the use after 12 hours; however, it is necessary future studies with evaluation of the application of the bandages in the immediate postoperative period.

Pamuk and Yucesoy [38] demonstrated, through magnetic resonance imaging, that Kinesio Tape application promotes acute changes (stretching and shortening) in the target tissue throughout the application of the tapes. Nontarget tissues may also be changed but at smaller magnitudes.

The mechanism of action of this therapy is still discussed, but based on Pamuk and Yucesoy [38], we believe that bandage application creates convolutions [27,28] due to elastic recoil of tape. This effect promotes a lifting in the skin and creation of space and free movement of fluids between the tissues under the strips, similar the cannulae, facilitating drainage that targets the lymphatic system [28].

An important difference in horse anatomy, in comparison to studies related to human medicine, is the presence of large numbers of myofibroblasts in the lymphatic vessels, which act to stimulate the contraction of the smooth muscle cells present in the collecting ducts. Additionally, horses gave a high proportion of elastic fibers (45%) in the lymph collectors that are much greater than the proportion in humans [38,39].

Therefore, because it is known that the bandage promotes compression and decompression effects together with the elastic recoil effect toward the first part of the applied tape (initial anchor), we believe that these effects require a pumping, both muscular and in the myofibroblasts, from the horse lymphatic vessels promoting lymphatic drainage effect.

The results of this study corroborate the results of previous studies conducted in humans that demonstrate the effectiveness of Kinesio Tape in activating the lymphatic and circulatory system. Aguilar et al [21,22,40], in a randomized, double-blind clinical trial involving women with chronic venous insufficiency, found increased vascular filling time as well as a major effect on venous pumping after 4 weeks of treatment with Kinesio Tape compared to a placebo group (treatment with no therapeutic bandages).

Baniszewski et al [23] also evaluated postoperative swelling in a study of 24 patients undergoing limb lengthening with an Ilizarov apparatus. They found that the group treated with the lymphatic technique involving functional elastic tapes showed a greater reduction in postoperative edema compared to patients treated by manual lymphatic drainage. Both groups showed a reduction, but the result occurred more rapidly in the group treated with the therapeutic bandage.

Other studies have discussed the real benefits of Kinesio Taping therapy to control postoperative edema. Chou et al [24], in their clinical report of a patient with breast cancer, stated that treatment with Kinesio Tape to reduce edema can be effective, but it does not replace the manual lymphatic drainage treatment. Kinesio taping is only an option for patients for which compression bandaging over the long term is not an option, which was also reported by Tsai et al [33].

Nunes et al [41], evaluating the effect of treatment with Kinesio Tape in patients with acute edema from twisted ankles, found that there was no difference in volume and perimeter between treated and placebo groups (Kinesio Tape bandaging but without therapeutic application), raising the question of the positive effects reported in the above studies. Therapeutic treatment of acute edemas and swellings with therapeutic bandages was not effective in this previous study.

The above study contradicts the findings in our study; we observed a positive effect on acute postoperative edema. However, the findings of Nunes [41] are important because they raise the clinical discussion of situations in which it is appropriate to use this therapeutic bandage therapy. It is therefore necessary to compare specific clinical conditions, such as chronic and acute edema, as well as to use of tapes alone and a complete treatment protocol to promote the use of functional elastic bandages as a complementary therapy [41–43].

In addition to the study by Shim et al [32], who found increased lymph flow after applying Kinesio Tape to experimental animals, some clinical reports have described the effective control of edema in stringhalt and posttrauma edema syndrome in horses without the presence of a placebo factor. This conclusion supports the results of the present study [34,35] and those found for human rehabilitation [44].

In terms of the thermographic assessments, there were no significant differences in any of the aspects evaluated between both groups. Thermography showed activation (temperature rise) under the skin where the tape was placed, but for the evaluation area on average, there were no differences between the treated and CGs. This presence of a local increase in temperature in the area of tape application was also found in another preliminary study [45], raises the question whether it is due to tape activation in metabolism or if there was the influence of the examination time after withdrawal, and also by the term active adhesive. We believe we have been interference in the valuation technique is to wait longer interval of time after removal of the tape for the acquisition of T-4 time images.

5. Conclusion

The results of this study demonstrate a reduction in the perimeter of the tibio-patellofemoral joint after the application of therapeutic bandages using a cutting “FAN” technique, which is derived from the KTM. Furthermore, there was a demonstrated edema reduction in post-patellofemoral arthroscopy in horses. However, additional studies are necessary to confirm the effects of Kinesio Tape in animals due to the absence of studies related to veterinary medicine.

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The authors have no competing interests.

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