
ORIGINAL RESEARCH

INVESTIGATING THE EFFECTIVENESS OF KINESIO® TAPING SPACE CORRECTION METHOD IN HEALTHY ADULTS ON PATELLOFEMORAL JOINT AND SUBCUTANEOUS SPACE

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ABSTRACT

Background: Limited quantitative, physiological evidence exists regarding the effectiveness of Kinesio® Taping methods, particularly with respect to the potential ability to impact underlying physiological joint space and structures. To better understand the impact of these techniques, the underlying physiological processes must be investigated in addition to the examination of more subjective measures related to pain in unhealthy tissues.

Hypothesis/Purpose: The purpose of this study was to determine whether the Kinesio® Taping Space Correction Method created a significant difference in patellofemoral joint space, as quantified by diagnostic ultrasound.

Study Design: Pre-test/post-test prospective cohort study

Methods: Thirty-two participants with bilaterally healthy knees and no past history of surgery took part in the study. For each participant, diagnostic ultrasound was utilized to collect three measurements: the patellofemoral joint space, the distance from the skin to the superficial patella, and distance from the skin to the patellar tendon. The Kinesio® Taping Space Correction Method was then applied. After a ten-minute waiting period in a non-weight bearing position, all three measurements were repeated. Each participant served as his or her own control.

Results: Paired *t* tests showed a statistically significant difference (mean difference = 1.1 mm, $t_{[3,1]} = 2.823$, $p = 0.008$, $g = .465$) between baseline and taped conditions in the space between the posterior surface of the patella to the medial femoral condyle. Neither the distance from the skin to the superficial patella nor the distance from the skin to the patellar tendon increased to a statistically significant degree.

Conclusions: The application of the Kinesio® Taping Space Correction Method increases the patellofemoral joint space in healthy adults by increasing the distance between the patella and the medial femoral condyle, though it does not increase the distance from the skin to the superficial patella nor to the patellar tendon.

Level of Evidence: 3

Key words: Diagnostic ultrasound, Kinesio® tape, patellofemoral joint space, tibiofemoral joint

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INTRODUCTION

The application of kinesiology tape is a conservative care therapy often touted as being able to alleviate pain,¹⁻⁴ affect skeletal muscles and joints,⁵⁻⁸ and generally bring about physiological changes in order to improve patient health.⁹⁻¹³ Nevertheless, limited empirical evidence exists to support evidence-based practice,¹⁴ and the wide-ranging methodologies employed in previous research make the rationale for effected change difficult to ascertain.¹⁵⁻²¹ Further compounding this issue is the increasing number of taping protocols and various brands of kinesiology tape, which potentially confound clinically-relevant findings, given the many variables which could contribute to research findings.^{14,20,22,23}

To provide a product-related example, the first type of kinesiology tape, Kinesio® Tape (Kinesio Holding Corp, Albuquerque, NM), was introduced to the market in 1982. The developer of the tape claimed that it was designed to possess elasticity and thickness similar to human skin and would allow for normal range of motion.²⁴ While various kinesiology tape brands are manufactured and marketed as interchangeable in terms of effectiveness, careful consideration should be given to comparability across studies that employ different products.

Of equal methodological concern is the variety of application processes for Kinesio® Taping methods and whether results derived from dissimilar techniques can be compared.^{16,19,25} Campolo et al²⁶ explicitly study this possibility in a comparison of two taping applications, namely Kinesio® Taping Method and McConnell Taping technique for anterior knee pain, and find similar results when compared to a non-taped group. Yet, as Juhn²⁷ and Parreira et al¹⁴ note, the literature on taping has not always been in agreement with respect to clinical effectiveness, potentially indicating discrepancies in study variables such as tape application, placement, or direction.

In the current study Kinesio® Tape was used to examine the Kinesio® Taping Space Correction Method, both developed and proposed by Kase,²⁴ in an effort to understand the underlying physiological effects of its application to the patellofemoral joint and evaluate claims of space correction. Six corrective techniques have been published as means to

treat pathomechanics and pathophysiology, including fascial, space, ligament/tendon, functional, and lymphatic corrections.^{8,24} In the current study, the focus was placed on space correction to evaluate the potential of a Kinesio® Taping Method to lift the structures under which the tape has been applied to increase interstitial space.

The technique under consideration, namely the Kinesio® Taping Space Correction Method, purports to create a suction-like force which lifts structures under the applied tape. Kase²⁴ suggests that the application of Kinesio® Tape in this manner can increase joint space, thereby reducing pain from diminished interstitial space, and that the tape's application can create additional space between the skin and superficial structures for lymphatic correction. In the context of this study, the tape was applied over the patella and diagnostic ultrasound was used as a means to measure space in three anatomical regions unique to the patellofemoral joint. Diagnostic ultrasound has only recently begun to be used in studies focused on the impact of Kinesio® Tape,²⁸ yet its clinical use in diagnosing pathomechanics in joints^{29,30} demonstrates its appropriateness for use in a study of this type. Moreover, the use of similar measurement techniques in both clinical and research settings improves comparability of results and strengthens claims related to evidence-based clinical relevance.

Therefore, the purpose of this study was to determine whether the Kinesio® Taping Space Correction Method created a significant difference in patellofemoral joint space, as quantified by diagnostic ultrasound. The research focused on three different measurements unique to patellofemoral structures: (1) the patellofemoral joint (i.e., underside of the patella to the femur); (2) skin to the superficial patella; and (3) the skin to the patellar tendon. These three measures allow for claims initially proposed by Kase²⁴ with respect to joint space and the potential for lymphatic correction to be empirically tested in healthy tissue.

METHODS

To investigate the anatomical impact of the Kinesio® Taping Space Correction Method on underlying anatomical structures, a pre-test/post-test cohort

study was conducted. This design eliminates potential confounding variables (individual differences) between participants, with each participant serving as his or her own control.

Participants

Thirty-two individuals (16 males and 16 females) with bilaterally healthy knees participated in the study. Approval from the Institutional Review Board (IRB) at a large U.S. university was granted prior to participant enrollment. Participation in the study was voluntary and all participants were provided a written copy of an informed consent. In addition, the study was explained to potential participants and they had the opportunity to ask any questions prior to enrollment. Inclusion criteria for the study included self-report of: (1) bilaterally healthy knees; (2) being recreationally active; and (3) no medical conditions involving bones or joints. Exclusion criteria also included any reported knee pain in the prior six months or any allergy to Kinesio® Tex Gold™ FP 2" Tape. All thirty-two individuals met these criteria and no attrition occurred throughout the study. Participants were between 18 and 30 years of age, with a mean age of 20.69 years \pm 2.681.

Diagnostic Ultrasound

The Terason t3200 diagnostic ultrasound unit was used to measure three areas specific to patellofemoral structures: (1) the patellofemoral joint space; (2) the distance between the skin and the superficial patella; and (3) the distance between the skin and the patellar tendon. The patellofemoral joint space is operationalized in this study as the distance from the underside of the patella to the medial femoral condyle. Diagnostic ultrasound is ideally suited for this type of research, given the ability to visualize both bone and soft tissue, which allows for measurement of joint space. Previous research employing diagnostic ultrasound imaging has shown high degrees of inter- and intra-rater reliability for measurements of a wide range of structures of the knee.³¹⁻³⁴ While much of the literature on diagnostic ultrasound of the knee has measured the tibiofemoral joint, the technique has also been used to image the patellofemoral joint.³⁵ The non-invasive nature of the imaging technique, coupled with the near-real-time measurements, augment the case for using diagnos-

tic ultrasound when investigating these types of conservative care interventions.

Study Procedures

Each participant enrolled in the study had the three anatomical areas measured using diagnostic ultrasound to serve as baseline measures against which the post-tape-application measures could be compared. To do so, the diagnostic ultrasound unit was placed on a high frequency setting. The transducer was then positioned in the long axis view over the patellar tendon in order to ensure viewing of the lower aspect of the patella. From this initial location, the transducer was moved medially ensuring the patella's medial border was detected in the image. Upon visualization of the medial femoral condyle, the screen was frozen and the caliper function was used to collect measurements of the three previously described anatomical regions. The ultrasonographer for this research had one year of experience using the diagnostic ultrasound equipment for the patellofemoral joint. In addition, all measurements were confirmed by an ultrasonographer with over six years of clinical and research experience. One benefit of the measurement technique is that the frozen images are available for remeasurement, allowing a high degree of accuracy and reproducibility. Prior to removing the transducer, the skin of each participant was marked to indicate the position of the superior and inferior borders of the transducer to allow for the same measurements to be made after application of the Kinesio® Taping Space Correction Method.

Kinesio® Tape Application

Once the initial baseline measurements of each participant had been made, the researchers then applied tape over the patellofemoral joint. The tape used in this study is Kinesio® Tex Gold™ FP 2"; tape that is purported to affect superficial structures such as the skin and the superficial patella.²⁴ Tape application followed the Kinesio® Taping Space Correction Method described in the Kinesio® Taping Manuals.²⁴ The skin at the site of application was first cleaned with an alcohol prep pad and excess was hair trimmed to ensure tape adherence. The tape was cut to a length approximately 2" longer

than the patella.¹ Then, the tape was folded in half and three longitudinal cuts were made, keeping the ends intact.

To apply the tape, the tibiofemoral joint was flexed to 120 degrees. A goniometer was used to ensure flexion to the appropriate degree and was read by a certified athletic trainer with more than 10 years of practice. The rationale for knee flexion is the increased epidermal tension under the tape in order to assist with the “lifting phenomenon.”²⁴ The paper on the back of the tape was torn in the middle third and stretched with light to moderate tension (~35%) over the patella.²⁴ For all participants, the tape was applied by a Certified Kinesio® Tape Faculty member with more than seven years of experience to help ensure consistency of tension and placement. Finally, the ends were applied to the superior and inferior aspects of the patella and then rubbed to activate the adhesive. Figure 1 illustrates the tape application. Participants remained on the treatment table for ten minutes in a non-



Figure 1. Completed Kinesio® Taping Space Correction Method with marked borders on the medial aspect of the tibiofemoral joint of the diagnostic ultrasound probe for repeated measures.

¹ If using the measurement markings provided on the back of the tape, this is equivalent to four squares.

weight-bearing position. The taped leg rested on the table in a comfortably extended position with no additional flexion or movement.

After the ten-minute wait period, the diagnostic ultrasound transducer was placed in the same position as the first measurement using the marked borders on the skin with the tape application still intact. The same three measurements were again made using the caliper function of the TeraSon t3200 diagnostic ultrasound unit, set on the high frequency setting (Figure 2).

STATISTICAL METHODS

In light of the pre-test/post-test research design, paired *t* tests were conducted for each of the three measurements ($\alpha = .05$). All collected data were included in the analysis. No confounding variables were controlled for and no tests were conducted on sub-groups of the data. Effect sizes were calculated using Hedges' *g* as an unbiased adjustment of Cohen's *d*.^{36,37}

Power analysis was conducted to determine the appropriate sample for the paired *t* tests using an alpha of 5% and required power of 80%. With these parameters, the sample of 32 participants was deemed sufficient to identify a between-group difference of 2 mm in the patella-to-femur measurement with a standard deviation of 2.5 mm. Lanyon et al report average patellofemoral joint spaces of healthy knees between approximately 4 and 7 mm, which suggests that a change of 2 mm would represent a substantial increase.³⁸

RESULTS

The means and standard deviations for the three measurements of the patellofemoral joint appear in Table 1. The largest mean difference occurred in the first measurement—the underside of the patella to the medial femoral condyle (mean difference = 1.1 mm). A statistically significant difference between pre- and post measurements of the patellofemoral joint space with a medium effect size was observed ($t_{31} = 2.823, p = .008, g = .465, 95\% \text{ CI } [0.30, 1.89]$). Analysis of the pre-test/post-test measurements between the skin and the superficial patella were not statistically significantly different (mean difference = .045 mm, $t_{31} = 1.211, p = .24, g = .213, 95\%$

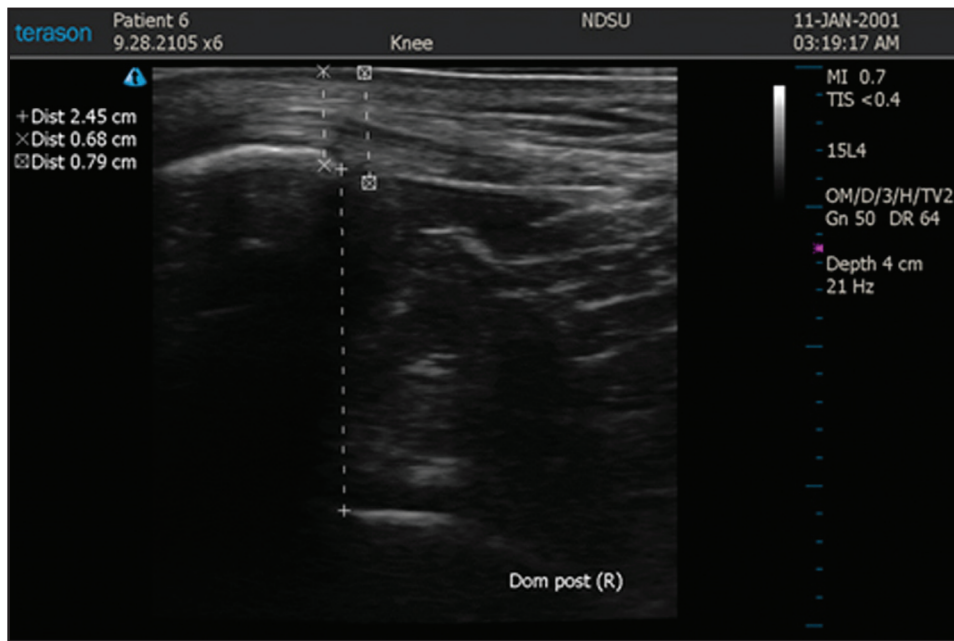


Figure 2. Images from Terason t3200 diagnostic ultrasound.

Table 1. Descriptive measurements (in mm) and results of paired t-tests

	Pre-tape		Post-tape		p-value
	Mean	SD	Mean	SD	
Patella to femur	2.405	0.241	2.515	0.230	.008
Skin to patella	0.745	0.250	0.700	0.164	.235
Skin to patellar tendon	0.856	0.149	0.856	0.170	.987

CI [-3.1, 1.21]). The third measurement between the skin and the patellar tendon also was not statistically significantly different (mean difference = 0.0 mm, $t_{31} = .017$, $p = .99$, $g = .002$, 95% CI [-0.38, 0.37]). It should be noted that the means of the third measurement in both the taped and un-taped conditions were identical to two decimal places.

DISCUSSION

The purpose of this study was to investigate the physiological effects of the Kinesio® Taping Space Correction Method using diagnostic ultrasound, specifically focusing on three different measurements unique to patellofemoral structures. In light of the observed results, the application of tape for space correction purposes significantly increased the distance between the underside of the patella and the medial femoral condyle (patellofemoral joint) in

healthy individuals. The tape application, however, did not increase distance in either of the other two measurements. This result is not unexpected given that tape was applied with tension only over the patella as the targeted treatment area and not over the patellar tendon at the inferior end of the tape.

While this is a statistically significant difference demonstrated in subjects with healthy tissue, whether this is a clinically significant difference remains unestablished. Unfortunately, no normative data exist regarding what constitutes an appropriate measurement difference in a healthy individual, and the more relevant question is whether the increase in joint space due to tape application can be replicated in a study of actual patients with unhealthy tissue. Previous studies of patients with unhealthy tissue have employed multiple variables such as tape and physical therapy,

so that it is unclear if their reported changes are the result of tape application, therapy, or the combination of both.¹ An individual with patellofemoral pain may experience improvement in subjectively reported symptoms due to an increase in patellofemoral joint space.³⁹ Therefore, the results are potentially beneficial to clinicians in order to reduce pain in conditions such as chondromalacia and other conditions involving narrowing of the joint space. The present study is a first step to determining whether Kinesio® Tape is able to affect the underlying physiological structures in the knee. Replication in unhealthy tissue, coupled with the collection of a subjective measurement of pain, would help establish the minimal clinically relevant difference.

A paucity of evidence exists related to the use of space correction taping methods as a means to address patient complaints of pain. In a study conducted by Gonzalez-Iglesias et al,² researchers investigate the Kinesio® Taping Space Correction Method to improve the range of motion and pain experienced by patients who suffered from whiplash-associated disorders (WAD). While the anatomical regions differ between the present study and Gonzalez-Iglesias et al,² statistically significant results of the Kinesio® Tape application when compared to a placebo application are suggestive that the space correction application may prove useful as a conservative care strategy for pain management. The introduction of unhealthy tissue as a variable in musculoskeletal disorders, along with the facilitation of specific muscle groups, make comparisons tenuous between the present and aforementioned study. Nevertheless, the inclusion of the Kinesio® Taping Space Correction Method is suggestive that additional research using these specific taping methods in relation to the physiological changes brought about by its application may prove useful to developing evidence-based treatment strategies.

Limitations

While the results obtained in this study are promising as a potential means of increasing interstitial joint space, the findings are limited insofar as they are contained to healthy individuals. Further investigation involving pathomechanics and this same tape application is important to continuing to study the effectiveness of the Kinesio® Taping Space Cor-

rection Method in unhealthy tissue. Moreover, the employed ten-minute wait period to effect significant change in the joint space may not be indicative of results with tape in place for a greater length of time. Likewise, the static nature of the application and the non-weight-bearing position during the wait period equally limits the extent to which these findings can be generalized to an active population. The authors recognize these potential limitations as being inherent to the study design and the aim of understanding underlying physiological effects of the tape without introducing additional variables which could be confounding (e.g., variation in stress on the joint in a weight-bearing position or varying pathomechanics in unhealthy tissue). A possible additional consideration is measurement reliability, which is addressed in two ways. First, the data collection includes a saved image of each measurement, which allows for reproducibility and a high degree of accuracy, and second, musculoskeletal ultrasonography has demonstrated strong inter-rater reliability in previous studies.^{32,34} The study design provides a useful baseline by demonstrating an increase in patellofemoral joint space from the underside of the patella to the medial femoral condyle with the application of Kinesio® Tape.

Generalizability

In light of the study limitations, the study is best generalized to the study population, namely adults with bilaterally healthy knees. Additional investigation which compares healthy and unhealthy tissue may help to explore this method as a potential conservative intervention for patients with patellofemoral syndromes. Moreover, the study's results should be interpreted with the understanding that the brand of tape employed in this study may have an impact on the effectiveness of this tape application to increase patellofemoral joint space and whether the difference is clinically relevant. This caveat is particularly important given the proliferation of commercially-available brands of kinesiology tape.

CONCLUSION

In sum, the results of the current study present findings that suggest that the Kinesio® Taping Space Correction Method, when applied over the patella, increases space in the patellofemoral joint in healthy

adults. However, the results did not demonstrate that the space between the superficial patella and the skin or the skin and the patellar tendon increased as the result of tape application. Additional inquiry is needed to investigate the physiological changes that may occur with similar applications in subjects who are not healthy, for example in alleviating pain in patients presenting with symptoms of chondromalacia or those with patellofemoral pain syndrome.

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