A Clinically Relevant Method of Quantifying the Mechanical Properties of RockTape® Kinesiology Tape at Different Elongation Lengths

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Context: Kinesiology tape (KT) is a therapeutic intervention used to treat different musculoskeletal conditions and to enhance sports performance. The evidence is inconclusive, with researchers attributing the variable outcomes to different manufactured KT used in the research. Researchers have begun to measure and document the mechanical properties of different brands, using machines versus professionals. This prevents a clear translation to clinical practice, as it may be difficult to reproduce outcomes. There is a need to measure the mechanical properties of KT using more clinically relevant methodology. **Objective:** The purpose was to document a clinically relevant method of measuring the mechanical properties of 2 different types of precut RockTape® tape at common elongation lengths and to establish the methodology for future validation research on this testing method. **Design:** Controlled laboratory study. **Setting:** University laboratory. **Participants:** One researcher conducted all measurements. **Procedures:** Each tape was measured at 3 elongation lengths with a force gauge. **Main Outcome Measures:** Force, stress, and Young modulus. **Results:** The RockTape® 2 and RockTape® 3 elongation force were 25% = 2.27 (0.21) and 2.12 (0.26) N, 50% = 6.51 (0.27) and 5.93 (0.20) N, and 75% = 30.13 (0.63) and 21.23 (0.41) N. The stress values for the RockTape® 2 and RockTape® 3 were 25% = 0.88 (0.05) and 0.82 (0.03) kPa, 50% = 2.52 (0.03) and 2.29 (0.01) kPa, and 75% = 11.67 (0.04) and 8.23 (0.02) kPa. The Young modulus values for the RockTape® 2 and RockTape® 3 were 25% = 3.51 (0.00) and 3.29 (0.00) kPa, 50% = 5.04 (0.00) and 4.60 (0.00) kPa, and 75% = 15.57 (0.00) and 10.96 (0.00) kPa. **Conclusion:** This investigation documented a novel method of measuring the mechanical properties of 2 types of RockTape® KT. Future research should attempt to validate these testing methods.

Keywords: muscle, myofascia, recovery, soreness, wraps

Kinesiology tape (KT) is a therapeutic intervention used to treat different musculoskeletal conditions and enhance sports performance.^{1,2} Despite the popularity, the research regarding the therapeutic benefits is inconclusive, with many studies reporting variable outcomes.¹ Several researchers attribute the variability to different study methods and the use of different tape brands. A common hypothesized cause of the variability is that the various tape brands have different mechanical properties due to different manufacturing processes.³⁻⁵ This has prompted researchers to measure the mechanical properties of different KT brands.

Three recent studies (2016–2019) have measured the material and mechanical properties of 23 different KT tape brands at different elongation lengths (25%–400% of resting length).³⁻⁵ These studies used mechanical devices to test the tape and found a large variability among tape brands for grammage (weight), stress (tension), load, deformation, tenacity, and stiffness (Young modulus). However, these studies used different mechanical devices, calibrations, and tape lengths, which are limitations and prevent a direct comparison among studies.³⁻⁵ Furthermore, the reported values in these studies may not be reproducible or clinically relevant because a professional did not administer the KT intervention using a standard tape and elongation length tension.

Clinicians commonly use the 5.08-cm (2 in) width KT tape, with an elongation length range between 25% and 75% of the

resting length.^{1,2,6} For example, a 25% to 50% elongation range has been recommended for the treatment of fascia and circulatory conditions, stimulating muscle activity, and inhibiting muscle activity.³ An elongation range of 75% to 100% has been recommended for treatment of tendons and ligaments, but the 75% elongation appears to be more common because the mechanical properties (eg, stress/strain) of KT significantly change between 75% and 100%.³ A general KT elongation range from 25% to 75% may provide optimal therapeutic effects for treatment of musculoskeletal conditions and sports performance.

The previous research³⁻⁵ provides good evidence that the different tape brands are manufactured differently. However, the use of machines and different study methods prevents a clear translation to clinical practice because the testing was not administered by a professional using a standard tape-and-application technique. Therefore, it is valuable to determine changes in the mechanical properties of the KT brands administered by a professional to gain a clearer understanding of what might occur in clinical practice. The purpose of this study was to document a clinically relevant method of measuring the mechanical properties of 2 different types of precut RockTape tape (Implus, LLC, Durham, NC) at common elongation lengths and to establish the methodology for future validation research on this testing method.⁶

Methods

This controlled study was conducted in a kinesiology laboratory. The study was approved by the institutional review board at California State University Dominguez Hills. The black precut

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Figure 1 — T-square, digital force gauge, and tape sample.

RockTape® 2 (RT-2; standard) and RockTape® 3 (RT-3; extra sticky) tape were used for this investigation.⁷ Each precut strip was made of 97% cotton and 3% nylon and had the following dimensions: 206.62 g/m² grammage (density),⁵ 5.08 cm (2 in) in width, and 25 cm (10 in) in resting length. The manufacturer reports that the RT-3 tape has a stronger adhesive than the standard tape, which is the only difference between tape types.⁷ For measuring stretch force, the Wagner (Midvale, UT) Force Ten™ FDX Digital force gauge was used. The manufacturer reports an accuracy error of $\leq \pm 0.3\%$ for this technology.⁸ A custom flat metal plate was attached to the tip of the force gauge to provide an even attachment surface for the tape and to prevent the bands from rolling or bunching up during elongation (Figure 1).

Pilot Study

Prior to the data collection, a 2-session pilot training was conducted to establish intrarater reliability for the procedures outlined in the following section. The primary investigator is a licensed physical therapist with over 13 years of experience, board certified in orthopedics, and certified in several KT techniques. The primary investigator completed 5 measurements for each of the 3 tape lengths (ie, 25%, 50%, 75%) over 2 testing sessions; a total of 30 measurements were completed. The 2 separate sessions were conducted on consecutive days, and intrarater reliability was calculated using an intraclass correlation coefficient model 3, 5. The primary investigator was found to have good intrarater reliability for measuring all 3 lengths (intraclass correlation coefficient = .95; 95% confidence interval, .81–.99).

Procedures

A 25-cm precut sample of each of tape was fixated to a T-square ruler by 1 clamp. The other end was mounted to the metal plate of the force gauge (Figure 1). The initial resting length of the tape was 24 cm (minus both ends fixated), and the maximum stretched length tested was 42 cm. The T-square ruler was premarked at 3 elongation points, representing a percentage of the maximum length of the tape: 25% (30 cm), 50% (36 cm), and 75% (42 cm). The T-square ruler was securely fastened during testing to prevent any aberrant movement. The temperature in the room was 22°C to 23°C, and humidity was 37%.⁸

Testing of the 2 types of KT was conducted over 2 sessions. The primary investigator used 15 precut samples of each KT and performed measures at the 3 elongation lengths (45 total

measurements), and a second investigator documented each measurement. Each precut strip was measured once at the 3 lengths to avoid viscoelastic changes in the tape due to repeated use. The primary investigator elongated the band at a rate of 2.54 cm (1 in) per second to the desired length using a digital metronome to standardize the rate of tape lengthening. When the desired length was reached, the second investigator documented the measurement.⁸ The force gauge was calibrated before each trial. The testing procedure was designed to replicate a common clinical KT application technique.⁴

Statistical Analysis

Statistical analysis was performed using SPSS (version 25.0; IBM SPSS, Armonk, NY). The descriptive data were calculated and reported as the mean (SD) for the elongation length force, stress ($\sigma = F/A$), and Young modulus ($Y = [F L]/[A \Delta L]$) (A = cross-sectional surface area perpendicular to the applied force). The elongation length force was reported in newtons and in pounds. The values in pounds were rounded to the nearest 0.5 lb for ease of practical interpretation.⁸ The stress values and Young modulus were reported in kilopascals. The independent *t* test was used to compare the elongation length force and stress between the 2 types of KT. All statistical assumptions were met for *t*-test statistics. Statistical significance was considered $P < .05$ using a conservative 2-tailed test.

Results

The elongation length force values for both types of KT demonstrated a linear increase in force, stress, and Young modulus as the tape elongated from 25% to 75% (Table 1).

For elongation force, RT-2 increased from 2.27 (0.21) N to 30.13 (0.63) N, and the RT-3 force increased from 2.12 (0.26) N to 21.23 (0.41) N (Table 1). A comparison between the 2 KT types revealed a statistically significant force difference at 25%, $t(28) = 1.78$, $P = .09$; 50%, $t(28) = 6.68$, $P < .001$; and at 75% length, $t(28) = 45.86$, $P < .001$.

The stress values for RT-2 increased from 0.88 (0.05) to 11.67 (0.04) kPa, and RT-3 increased from 0.82 (0.03) to 8.23 (0.02) kPa (Figure 2). A comparison of the stress values revealed a statistically significant difference between both KT types at 25%, $t(28) = 3.98$, $P < .001$; 50%, $t(28) = 28.17$, $P < .001$; and at 75% length, $t(28) = 297.91$, $P < .001$. The Young modulus values for RT-2 increased from 3.51 (0.00) to 15.57 (0.00) kPa, and the RT-3 increased from 3.29 (0.00) to 10.96 (0.00) kPa.

Discussion

This investigation documented a clinically relevant method of measuring the mechanical properties of 2 different types of precut RockTape® KT at common elongation lengths. Prior studies measuring the mechanical effects of KT used different mechanical devices, calibrations, and tape lengths, making it difficult for professionals or researchers to directly compare studies.^{3–5} The translation of those results to clinical practice is further challenged because a professional did not administer the KT using a clinically relevant technique, which reduces the external validity. This investigation attempted to bridge that gap by introducing a novel method of measuring KT mechanical properties using a common clinical application technique (eg, predetermined elongation length and rate).

Table 1 RockTape® Mechanical Properties at Different Elongation Lengths

	25% (30 cm)		50% (36 cm)		75% (42 cm)	
	RT-2	RT-3	RT-2	RT-3	RT-2	RT-3
Elongation force, lb/N	0.50 lb (2.27 [0.21] N)	0.50 lb (2.12 [0.26] N)	1.50 lb (6.51 [0.27] N)	1.25 lb (5.93 [0.20] N)	6.75 lb (30.13 [0.63] N)	4.75 lb (21.23 [0.41] N)
Stress, kPa	0.88 (0.05)	0.82 (0.03)	2.52 (0.03)	2.29 (0.01)	11.67 (0.04)	8.23 (0.02)
Young modules, kPa	3.51 (0.00)	3.29 (0.00)	5.04 (0.00)	4.60 (0.00)	15.57 (0.00)	10.96 (0.00)

Abbreviations: RT-2, RockTape® 2 (standard); RT-3, RockTape® 3 (extra sticky). Note: Data are presented as mean (SD).

Figure 2 — Linear increase in RockTape® stress (tension).

Clinical Implications and Future Research

When comparing the 2 types of KT, the elongation force, stress, and Young modulus demonstrated a linear increase as they lengthened, with the highest values occurring at 75% tape elongation. The 25% to 50% elongation range has been recommended for the treatment of fascia and circulatory conditions, stimulating muscle activity, and inhibiting muscle activity.³ An elongation range of 75% to 100% has been recommended for the treatment of tendons and ligaments.³ It is important to note that the stress and stiffness values for both types of KT significantly increased as the tape elongated from 50% to 75%, with the RT-2 producing higher values than the RT-3. This may be due to the unique manufacturing of each precut tape strip versus a large roll. Also, the type of adhesive used (eg, type and amount) may not have had an influence on the mechanical properties of this KT brand. Further research is needed to investigate the influence tape adhesive has on KT mechanical properties.

Interestingly, the mechanical values reported in this investigation were different from prior machine studies, but demonstrated a similar linear increase in mechanical properties as the tape elongated.^{3–5} The identification of differences between the study methodologies is valuable for understanding the differences that may occur in clinical practice when KT is applied by a clinician. Clinicians, however, should consider the unique properties of precut KT from different manufacturers before applying the findings in this study to their use of different KTs in their clinical practice.

Future research should build upon these findings by examining the mechanical and neurophysiological effects of KT at different elongation lengths. Only one study has measured the effects of different tape elongation lengths (50%, 75%, and 100%) on quadriceps isometric strength and lower extremity function (hop test for distance). The researchers found that the different lengths did not produce significant differences and concluded that KT applied at different lengths did not produce any significant effects on lower

extremity strength and function.⁶ Perhaps researchers should continue to measure and document the neurophysiological effects of various KT brands at different elongation lengths. The current thought is that the continued KT stress (tension) affects the nervous system via stimulation of local mechanoreceptors, afferent ascending, and efferent descending pathways.⁶ Future validation studies are needed that compare this testing technique with mechanical testing methods to directly compare the results between clinician and machine application.

Limitations

Although clinical applicability may have been increased with this novel testing technique, there are several limitations that warrant discussion. First, only 2 types of manufactured KT from one brand were tested. KT from other manufacturers may produce different mechanical values at different elongation lengths. Second, a predetermined testing protocol was used, which included elongation range (25%–75%), rate of elongation, and number of samples tested. Different testing protocols may have produced different results. Third, testing was performed by 1 investigator using a force gauge versus a mechanical device. These procedures were designed to replicate a common KT application technique with the greatest similarity to a clinical application. Furthermore, the primary investigator was an experienced professional with KT training, who completed pilot testing and achieved an acceptable level of reliability prior to data collection, which strengthens the internal validity of the study.

Conclusion

This investigation documented a clinically relevant method of measuring the mechanical properties of 2 types of tape from a KT brand at common elongation lengths. Future validation research should be conducted by directly comparing these methods and machine-generated tests for different KT brands. This will help to educate professionals regarding the mechanical properties of different brands of KT to maximize consistency in application and assess the effectiveness of the intervention.^{1,2}

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