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Original Article

Elastic therapeutic tape: do they have the same material properties?

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Abstract. [Purpose] Elastic therapeutic tape has been widely used for rehabilitation and treatment of sports injuries. Tapes with different elastic properties serve different treatment purposes with inappropriate tension reducing tape effectiveness. Many tapes are available in the market, but studies on tape properties are limited. The aim of this study was to examine the material properties of elastic therapeutic tape. [Subjects and Methods] Brands of elastic therapeutic tape included KinesioTex®, ATex, Mueller, 3M, and ThaiTape. The Material Testing System Insight® 1 Electromechanical Testing Systems was used to apply a tensile force on elastic therapeutic tape. Ten specimens of each brand were tested. Stress, load, and Young's modulus at 25%, 50%, 75%, 100%, and maximum point were collected. One-way analysis of variance with post hoc testing was used to analyze tape parameters. [Results] Maximum elongation and Young's modulus at all percentages were significantly different between brands. There were no differences in maximum load and maximum stress. [Conclusion] Mechanical properties are different for commercial elastic therapeutic tapes. Physiotherapists and other clinicians should be aware of mechanical tape properties to correctly apply kinesio tape.

Key words: Elastic therapeutic tape, Material properties, Tension test

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INTRODUCTION

Elastic therapeutic tape (ET), also known as kinesio tape, is widely used for various clinical treatments including the provision of structural support, reduction of swelling and inflammation, stimulation and inhibition of muscle activity, and improving blood and lymph flow[1–8)]. ET is typically manufactured with a 10% pre-stretched material applied to the backing paper (paper-off tension) and can be stretched longitudinally around 120–140% from its original length[9–11)]. Proper tape tension is required for different treatment purposes. For example, light tape tension (0–15%) is recommended for lymphatic correction, whereas moderate to high tape tension (50–100%) is recommended for ligament/tendon treatment[10)].

ET has gained popularity in clinical practice and sports settings. As a result, several commercial tape brands are available on the market. As far as we know, only Jodar et al. studied the material properties of different types of tapes (i.e. inelastic tape, elastic tape, and elastic therapeutic tape). Additionally, three different colors of elastic therapeutic tapes of the same brand were compared. Although the manufacturer claims there is no difference in properties of tapes with different colors, there was some discrepancy in maximum elongation and maximum stress. Since elastic therapeutic tapes utilize an elastic property, clinicians should understand the material properties of elastic therapeutic tapes so that they can correctly apply appropriate tension for effective treatment. Therefore, the aim of the present study was to investigate the material properties of commercially available elastic therapeutic tapes.

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SUBJECTS AND METHODS

Five commercial elastic therapeutic tapes, i.e. KinesioTex® (Japan), ATex (Korea), Mueller (USA), 3 M (USA), and ThaiTape (Thailand) were examined. The MTS Insight® 1 Electromechanical Testing System (1kN standard length, USA) was used to apply a tensile force to these tapes. Each tape was cut in an I-shape (5 mm × 50 mm × 0.5 mm)

A tape specimen was mounted to a fixture secured to the base of the electromechanical materials testing systems (MTS Insight® 1, Eden Prairie, Minnesota, USA) Each specimen started with no load and gradually pulled to failure at a speed of 10 mm/min. The testing system recorded both the load and elongation of the therapeutic tapes. Ten samples of each brand were tested. The data were then averaged and analyzed. A one-way analysis of variance (ANOVA) was used to compare stress, load, and Young's modulus of the five different elastic therapeutic tapes brands. Bonferroni multiple comparison tests were used for the post hoc analysis. The significance level was set at $p < 0.05$.

RESULTS

Material properties are provided in Table 1. Differences were observed for all parameters except maximum load and maximum stress (Table 1). Mueller had the greatest maximum elongation (148.86 ± 2.27%) whereas ThaiTape had the lowest maximum elongation (72.51 ± 1.76%).

For the Young's modulus, ThaiTape showed the greatest maximum Young's modulus whereas the Mueller tape showed the lowest modulus. At 25% and 50% of elongation, most brands displayed a similar modulus (except ThaiTape). However, beyond 50% of elongation, the Young's modulus was quite different. The 3 M brand exhibited the greatest modulus compared to the other brands. The stress-strain curves of the five ET tapes, with ATex and Muller tapes having similar stress-strain curves.

DISCUSSION

The purpose of this study was to investigate the material properties of different commercial brands of elastic therapeutic tapes. Since the application and effectiveness of these tapes are based on their elastic properties, an understanding of the properties is essential to maximize the benefits of these tapes. We observed substantial differences in material properties among these selected elastic therapeutic tapes.

Jodar et al. compared not only three different types of tapes (i.e. inelastic tape, elastic tape, and ET tape), but also three different colors (i.e. red, black, and blue) of tapes (KinesioTex®). Interestingly, although the company claims that there are no differences in the properties of tapes with different colors, this study found some variations in the properties. Maximum elongation had a wide range, which was between 72.03% for the black-colored tape and 108% for the red-colored tape. The 100% Young's modulus values ranged between 2.47 MPa and 7.18 MPa[12]. The maximum elongation and 100% Young's modulus in the present study were 113.55% and 0.12 MPa, respectively. The discrepancy between the two studies may be due to different testing equipment. Jodar et al. used weight plates and a tape measurement, which is prone to large measurement error. In the present study, a more common, reliable, and accurate standard instrument was available to test materials in the industry.

For maximum load, there was no difference among the ET tapes indicating similar ability to resist a load tension. However, there was a difference in the maximum Young's modulus among these tapes. Our results suggest that the ThaiTape had the highest stiffness and the lowest compliance; it completely ruptured around 75% of elongation. In contrast, Mueller and ATex tapes showed high compliance, which can be observed from the stress-strain curves. Interestingly, the Young's modulus of the four ET tapes except that of the ThaiTape was similar up to 50% of elongation. However, after 75% of elongation, significant differences in the stress-strain curves emerged (Fig. 1). A comparison of the 3 M and KinesioTex® showed that 3 M has lower compliance and higher stiffness than KinesioTex®.

For clinical treatment, physical therapists and other clinicians usually estimate tape tension from the length of the tape being pulled. For example, a 10-inch ET tape with maximum tension can be stretched to 14 inches. When therapist want to apply 25% tension, the tape needs to be pulled to 11 inches[10]. This 25% tension is usually recommended for the treatment of the fascia, circulatory, stimulating, and inhibiting muscle activities. Based on the results of the present study, most ET brands except ThaiTape can be used for this length tension technique. In contrast, for ligament and tendon application, 75–100% of tension is recommended. However, when using the tape length technique to estimate 75% of tension, the therapists must perform with caution as each commercial tape displayed significant differences in stress at 75 and 100% elongation. For example, at 75% elongation, the 3 M tape has greater stress (5.5 MPa) than Muller (1.7 MPa), which means that the tape tension is different. Our findings could be useful for physical therapists to adjust tape tension to tapes' properties and use it for an appropriate purpose. However, future studies should examine the effectiveness of the tape in treatment and rehabilitation when it is applied to the skin since the present study only examined the mechanical properties of isolated tape specimens.

Five elastic therapeutic tapes exhibited different material properties in stress, extensity, and Young's modulus. Therefore, physical therapists and athletic trainers should be fully aware of tape properties to maximize treatment.

Table 1. Material properties of five different elastic therapeutic tapes

Variables	Elastic therapeutic tapes				
	3M	ATex	KinesioTex®	Mueller	Local brand
Maximum elongation (%)	100.21 ± 1.77 **,***,****,*****	135.09 ± 2.05 *,***,****	113.55 ± 1.97 *,**,****,*****	148.86 ± 2.27 *,**,***,*****	72.51 ± 1.76 *,**,***,****
Maximum load (n)	63.87 ± 4.09	77.59 ± 4.97	68.36 ± 4.56	67.23 ± 6.12	70.06 ± 4.53
Maximum stress (MPa)	24.75 ± 1.58	30.07 ± 1.93	26.49 ± 1.77	26.05 ± 2.37	27.76 ± 0.62
Maximum young's modulus (MPa)	0.25 ± 0.02****,*****	0.22 ± 0.01*****	0.23 ± 0.01*****	0.17 ± 0.02*,*****	0.37 ± 0.02*,**,***,****
Stress at 25% elongation (MPa)	0.51 ± 0.02****,*****	0.44 ± 0.02*****	0.53 ± 0.01****,*****	0.40 ± 0.01*,***,*****	0.93 ± 0.04*,**,***,****
Stress at 50% elongation (MPa)	1.43 ± 0.07	1.03 ± 0.03	1.33 ± 0.02	0.90 ± 0.03	5.84 ± 0.84 *,**,***,****
Stress at 75% elongation (MPa)	5.50 ± 0.64 **,****,****,*****	2.23 ± 0.09*,*****	3.15 ± 0.08 *,****,*****	1.71 ± 0.07 *,***,*****	27.76 ± 0.62 *,**,***,****
Stress at 100% elongation (MPa)	23.28 ± 1.52 **,***,****,*****	4.80 ± 0.23*,***	11.97 ± 0.92*,**,*****	3.75 ± 0.31*,***	-
Young's modulus at 25% elongation (MPa)	0.02 ± 0.00****,*****	0.02 ± 0.00*****	0.02 ± 0.00****,*****	0.01 ± 0.00 *,***,*****	0.04 ± 0.00 *,**,***,****
Young's modulus at 50% elongation (MPa)	0.03 ± 0.00*****	0.02 ± 0.00*****	0.03 ± 0.00*****	0.02 ± 0.00*****	0.12 ± 0.02 *,**,***,****
Young's modulus at 75% elongation (MPa)	0.07 ± 0.01 **,***,****,*****	0.03 ± 0.00*,*****	0.04 ± 0.00 *,****,*****	0.02 ± 0.00 *,***,*****	0.37 ± 0.00*,**,***,****
Young's modulus at 100% elongation (MPa)	0.23 ± 0.01 **,***,****	0.05 ± 0.00 *,***	0.12 ± 0.00 *,**,****	0.04 ± 0.00 *,***	-

Data are presented as mean and standard error of mean (SEM)
*different from 3M, $p < 0.05$, **different from ATex®, $p < 0.05$, ***different from KinesioTex®, $p < 0.05$, ****different from Mueller, $p < 0.05$, ***** different from Local brand, $p < 0.001$
Data are presented as mean ± SEM.

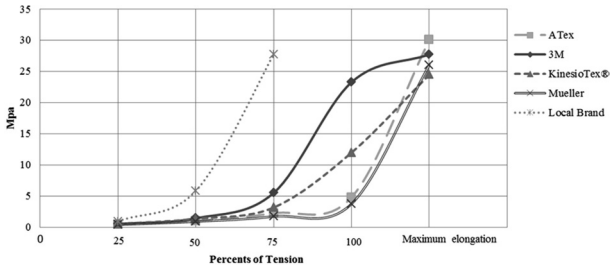

Fig. 1. Stress-Strain curves of 5 elastic therapeutic tape brands

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