SHORT-TERM EFFECTS OF ELASTIC TAPING ON GYMNAST'S JUMPING PERFORMANCE

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Original article

Abstract

It was explored whether three different applications of elastic tape on the lower limbs of active, healthy gymnasts influence their vertical jumping performance. 16 gymnasts randomly performed drop jumps, squat jumps, and counter movement jumps on a force platform in four experimental conditions: 1. no tape application, 2. rectus femoris tape application, 3. triceps surae tape application, and 4. sham tape application. Five task-relevant parameters were calculated in order to represent vertical jumping performance in the three vertical jumping tasks: 1) contact time during take-off phase, 2) peak vertical force during take-off phase, 3) flight duration, 4) peak vertical impact force during landing phase, and 5) time to peak vertical impact force during landing phase. A decrease in flight duration during drop jumping, and counter movement jumping appeared when elastic tape was applied. During drop jumping gymnasts' flight duration decreased when elastic tape was applied to the triceps surae muscle. During counter movement jumping gymnasts' flight duration decreased when elastic tape was applied on the rectus femoris muscles. It is concluded that there is no apparent beneficial need for active, healthy gymnasts to apply elastic tape in order to enhance vertical jumping performance.

Keywords: *Vertical Jumping, Force Platform, Athletic Performance.*

INTRODUCTION

The implementation of elastic tape straps in the applied sport became quite apparent in the last few years. The primary aim in using these tape straps is to support muscle functioning, when athletes are suffering from an injury, or in case of restricted muscle functioning due to overuse and/or harm. However, elastic tape straps may also be used in terms of prevention, or even performance enhancement when muscle functioning is not restricted (Kumbrink, 2012). Therefore, the aim of this study was to explore whether the application of elastic tape on the lower limb may influence vertical jumping performance. To approach this, three different applications of elastic tape at the lower limb were examined to influence vertical jumping performance in three different jumping tasks.

There are several conceptualizations for the cotton elastic tape straps in sport science and related fields. These conceptualizations are *kinesio tape* (O'Sullivan & Bird, 2011; Williams, Whatman, Hume, & Sheerin, 2012), *kinaesthetic tape* (Bassett, Lingman,

& Ellis, 2010), and *elastic tape* (Huang, Hsieh, Lu, & Su, 2011). There are also specific brand names, such as Kinesio® Tape, K-Tape®, Kintex™, or alike. In this manuscript the term *elastic tape* is used, referring to tape straps that can be stretched longitudinally up to 120-140% of their original length, and shorten after they were attached to the skin (Halseth, McChesney, DeBelsio, Vaughn, & Lien, 2004).

Elastic taping is hypothesized in sport prevention and sport rehabilitation to improve body functioning when for instance dealing with pain, blood and lymph flow, sensory perception, as well as joint, muscle, and fascia functioning (Kase, Wallis, & Kase, 2003). However, a systematic review conducted on the use and treatment efficacy of elastic taping highlights, that the reviewed articles neither indicated a clinical significance of elastic taping on pain reduction (shoulder and neck), scapular kinematics, muscle strength, electromyographic activity, nor on cervical range of motion. It is argued that the discussed studies failed to report significant effects mainly due to insufficient methodological quality (Bassett et al., 2010). Nevertheless, a meta-analysis concerning the use of elastic taping in treatment and prevention of sport injuries indicated that elastic taping could have a small, yet beneficial effect on muscle strength but fails for instance to affect proprioception at the ankle (Williams et al., 2012).

Empirical results of elastic, lower leg taping on active, healthy subject's performance are also conflicting. Positive effects of elastic taping occurred for instance when measuring relative peak torque changes of the vastus medialis muscle via surface electromyography (Slupik, Dwornik, Bialoszewski, & Zych, 2007), vertical ground reaction force (Huang et al., 2011), and height of flight (Mostert-Wentzel et al., 2012) when performing a vertical jump. Furthermore, no or even contradictory effects of elastic tape occurred when measuring isokinetic muscle strength of the anterior and posterior thigh (Fu et al., 2008), isokinetic quadriceps femoris muscle strength, lower limb performance and subjective perception of strength (Vercelli et al., 2012), tensiomyographic response of vastus lateralis and medialis muscles, maximum power output, performance of counter movement jump and 10-m-sprint (De Hoyo, Álvarez-Mesa, Sañudo, Carrasco, & Domínguez, 2013) as well as during measurements of vertical and horizontal jumping performance and dynamic balance (Nunes, de Noronha, Cunha, Ruschel, & Borges 2013).

Inconclusive evidence concerning performance related effects of elastic taping might in part be explained by methodological differences between the studies just mentioned, like for instance differences in tape application procedures, participant characteristics, measurement procedures, or empirical tasks. Given that elastic taping is likely to influence vertical jumping performance (Huang et al., 2011; Mostert-Wentzel et al., 2012) this may be of special, practical interest when the experimental tasks implemented cover the requirements of the sporting event. Compared to other sport disciplines like team sports, combat sports, swimming and track and field, the jumping performance in artistic gymnastics training and competition is quite manifold and requires two-legged reactive take-offs, decelerated landings as well as generating momentum with and without a counter movement (Arkaev & Suchilin, 2004). The standardized experimental vertical jumping tasks implemented in this study cover the characteristics of gymnasts' vertical jumping during training and competition. For instance, reactive take-offs occur in floor and vaulting events and represent the drop jump. Generating momentum with and without a counter movement occurs in mounts to beam, pommel horse and parallel bars as well as in artistic floor and beam leaps, thus representing the squat jump, and the counter movement jump. Additionally, it is of special interest to explore possible performance related effects of elastic taping in gymnastics because the use of tapes, bandages and/or orthoses in gymnastic competitions is restricted unless they are skin-coloured (FIG, 2013).

Given that for instance elastic taping is likely to influence gymnasts' vertical jumping performance (Huang et al., 2011; Mostert-Wentzel, 2012) at least two questions arise: First, does the hypothesized effect of elastic taping depend on the kind of the vertical jumping task (e.g., drop jump vs. squat jump vs. counter movement jump)? Second, does the hypothesized effect of elastic taping depend on the tape application area and/or procedure (e.g., rectus femoris muscle and/or triceps surae muscle)? Exploring these questions may reveal if different elastic tape applications may influence different requirements of vertical jumping.

In order to address these questions, it was explored whether three different applications of elastic tape on the lower limbs of active and healthy gymnasts influence their corresponding jumping performance in three different vertical jumping tasks. It was hypothesized that elastic tape applications on gymnasts' rectus femoris and triceps surae muscles influences vertical jumping performance. Rectus femoris and triceps surae muscles primarily affect vertical jumping performance (Finni, Komi, & Lepola, 2000; Viitasalo, Salo, & Lahtinen, 1998). Therefore, if any effects occur, tape applications on these muscles most likely should influence gymnast's vertical jumping performance. Additionally it was hypothesized that this effect may or may not depend on the vertical jumping tasks, namely the drop jump, the squat jump, and the counter movement jump. A sham tape application was hypothesized to have no influence on vertical jumping performance but should function as a control condition (Williams et al., 2012).

METHODS

Experimental Tasks. Gymnasts were instructed to perform drop jumps, squat jumps, and counter movement jumps on a force platform with a sampling rate of 1000 Hz (TrueImpulse™, Northern Digital Inc., Canada). It was decided to use the aforementioned standardized vertical jumping tasks, since they also occur in general artistic gymnastic situations.

During all jumps, the arms were held at the hip, whereas take-off and landing of each jump occurred on the force platform. When performing a drop jump, the gymnast dropped from a gymnastic block onto the force platform and performed a reactive maximum vertical jump. The height between the surface of the block and the surface of the force platform was 35 cm. Bobbert and colleagues (1986) suggest dropping heights between 20 and 40 cm regarding joint reaction forces, mechanical output and quality of jumping performance (Bobbert, Mackay, Schinkelshoek, Huijing & van Ingen Schenau, 1986). Additionally, the dropping height of the gymnastic block fits the requirements of gymnastics training and conditioning (Arkaev & Suchilin, 2004). When performing a squat jump, the gymnast got into a squatted resting position with an individually preferred knee-angle between 70 and 90° (Baechle & Earle, 2008; Bobbert, Gerritsen, Litjens, & Van Soest, 1996). From this resting position, the gymnast performs a maximum vertical jump. When performing a counter movement jump, the gymnast performed a maximum vertical jump starting from an upright standing position followed by a downward movement to an individually preferred knee-angle between 70-90° (Baechle & Earle, 2008; Bobbert et al., 1996; Bobbert et al., 1986). Knee-angles were controlled first, via visual observation. Second, each trial was videotaped with a digital high-speed video camera (Casio Exilim ZR-400) operating at 120 Hz and with a spatial resolution of 640 x 480 pixels. The camera was placed orthogonal to the performing gymnast's sagittal axis and 5 m away from the centre of the force platform. A movement analysis with the software utilius easyINSPECT (CCC-Software, 2008) revealed no deviations of knee-angles above 90° or below 70°. Prior to each jump, the gymnast was instructed to jump as high as possible. Additionally in all tape application conditions, the gymnast was instructed in such a way that all tape applications support vertical jumping performance. The instruction was: “This tape applications is positively influencing your general vertical jumping performance, and we want to explore in which jumping task which tape application may best support your vertical jumping performance.”

Task Analysis. Vertical ground reaction force measurements and time-discrete task parameters of all vertical jumping performances were analysed using a force platform operating with a sampling rate of 1000 Hz. Following the argumentation of previous studies (Enoka, 2002; Marina, Jemni & Rodríguez, 2013; Mkauer, Jemni, Amara, Chaabèn & Tabka, 2012) and with the help of a professional sport biomechanist, five task parameters occurring in each jumping task were calculated in order to represent vertical jumping performance during take-off-, flight- and landing phase in the three vertical jumping tasks. The parameters were: 1) contact time during take-off phase ($t_0 – t_1$), 2) peak vertical force during take-off phase (F_1), 3) flight duration ($t_1 – t_2$), 4) peak vertical impact force during landing phase (F_2), and 5) time to peak vertical impact force during landing phase ($t_2 – t_3$). 1), 3) and 5) indicate the durations between starting and end point of each phase in Milliseconds. t_0 was defined as the first deviation of vertical ground reaction force from the resting position’s vertical ground reaction force (zero in the drop jump and approx. body weight in the squat and countermovement jump). t_1 was defined as the last deviation from zero before the final take-off. t_2 was defined as the first deviation from zero following the initial landing contact. t_3 was defined depending on the time of the peak vertical impact force during the landing phase (F_2). F_1 and F_2 indicate the maximum vertical peak force of the take-off (F_1) and landing (F_2) phase in Newton.

The task parameters just mentioned on the one appear in each of the three vertical jumping tasks and thus make the tasks comparable. On the other hand these parameters can modulate force diagrams and rely to further parameters, which cannot be assessed directly like for instance internal load etc. Furthermore the five parameters calculated are sensitive to interventions of the vertical jumping tasks (Bobbert et al., 1986; Finni et al., 2000).

Tape Application Procedures. The elastic tape applied in this study was a black, 5 cm wide, elastic tape (K-Tape®, biviax GmbH, Germany). It was decided to use black tape throughout the whole study to avoid colour preferences. Nevertheless, one may argue in line with the philosophy of elastic taping that black elastic tape should enhance and empower muscle functioning (Kase et al., 2003; Kumbrink, 2012). In one tape application condition (RFTA), the left and right rectus femoris muscle was taped from origin to insertion (proximal to distal) using a Y-shaped elastic tape strap (Vercelli et al., 2012). In another tape application condition (TSTA), the left and right triceps surae muscle was taped from origin to insertion (proximal to distal) using a Y-shaped elastic tape strap (Nunes et al., 2013). It was decided to apply the elastic tape from origin to insertion and with 50-75% of stretch, because this direction and amount of stretch is thought to facilitate and activate the taped muscle (Kase et al., 2003; Kumbrink, 2012). In an additional tape application condition, a sham tape (Vercelli et al., 2012) was applied on the left and right muscle belly of both, rectus femoris and triceps surae muscles perpendicular to their muscle fibre orientation. Here, two I-shaped elastic tape straps were applied without additional stretch (SHTA, c.f. Fig. 1). A professional taping expert was asked to apply all elastic tapings.

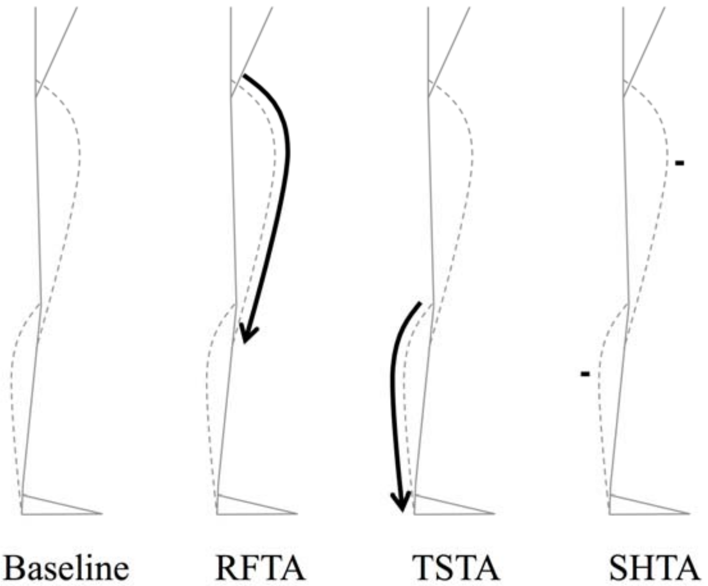

Figure 1. Schematic representation of the elastic tape applications implemented in this study. In the baseline condition no tape was applied neither on gymnast's rectus femoris nor triceps surae muscles (dotted grey lines). In the RFTA and TSTA conditions elastic tape was applied from origin to insertion on either gymnast's rectus femoris or triceps surae muscles. In the SHTA condition elastic tape was applied on the muscle belly and perpendicular to muscle fibre orientation of gymnast's rectus femoris and triceps surae muscles.

The study consisted of four phases. During the first phase the gymnast arrived at the laboratory, was instructed about the general purpose of the study, and completed an informed consent form. Gymnast's height and weight was measured and the gymnast was given an individual, self-directed ten-minute warm-up phase consisting of mobilisation drills, like heel rises, squats and lunges as well as basic gymnastic jumps and landings, like reactive jumps, tucked jumps and basic one- and two-legged jumps and landings. Afterwards a practice period of at least four practice trials of each vertical jumping task was conducted to familiarize the gymnast with each task. The second phase comprised a baseline condition without any elastic tape application in which the gymnast performed blocks of four valid drop jumps, squat jumps, and counter movement jumps for a total of twelve jumps. Jumping tasks were presented in a blockwise randomized order for each participating gymnast. When gymnasts accidently performed the wrong jumping task, did not reach the defined knee-angle, did not dropped-off and/or land on the force platform or reported/showed any movement discrepancies, like for instance an unstable landing, the trial was repeated.

The third phase consisted of a total of 36 jumps. Each gymnast was asked to perform blocks of four valid drop jumps, squat jumps, and counter movement jumps in the three tape application conditions, whereas block order (drop jump, squat jump, and counter movement jump) was randomly presented to each gymnasts in each tape application condition. Rectus femoris tape applications and triceps surae tape applications were also randomly presented to each gymnast in such a way, that one of the two tape applications was presented first and the other one afterwards. The sham tape application condition was always presented last. During each tape application condition, both legs were taped and after a ten-minute time slot to ensure full adhesive strength of the elastic tape the gymnast performed the jumping tasks (Vercelli et al., 2012). In the fourth phase the gymnast was debriefed and received a thank-you gift. During the debriefing process a manipulation check was conducted indicating that none of the participating gymnasts indicated to perceived an experimental manipulation concerning the tape application procedures, neither the experimenter's instructions nor the experimental tasks. There was no time pressure during the study and the gymnast was allowed to rest as needed.

Data Analysis. In order to get an estimation of the average performance in each individual case and in order to reduce within participant variation, means and standard errors of each gymnast's four trials in each jumping task and each tape application condition were calculated. A significant level of $\alpha = .05$ was defined for all results reported in this study. According to differences in task characteristics of the three vertical jumping tasks, separate univariate analyses of variance were calculated, taking the five task parameters 1) contact time during take-off phase, 2) peak vertical force during take-off phase, 3) flight duration, 4) peak vertical impact force during landing phase, and 5) time to peak vertical impact force during landing phase as dependent variables. Tape application condition (Baseline vs. RFTA vs. TSTA vs. SHTA) was treated as a within-subjects factor. Cohen's f was calculated for all significant results reported. Post-hoc tests (Tukey HSD) were calculated for all significant results reported. In order to get an estimation of gymnasts' jumping performance, means and standard errors were calculated for each of the five parameters.

RESULTS

It was hypothesized that the elastic tape application on gymnasts' rectus femoris and triceps surae muscles influences vertical jumping performance. Additionally it was hypothesized that this influence may or may not depend on the vertical jumping tasks, namely the drop jump, the squat jump, and the counter movement jump. A sham tape application was hypothesized to have no influence on vertical jumping performance.

Table 1 shows the aggregated data of the analysis. There was a significant main effect of tape application condition (Baseline vs. RFTA vs. TSTA vs. SHTA) for flight duration in the drop jump, $F(3, 45) = 3.229$, $p = .031$, Cohen's $f = 0.46$, and for flight duration in the counter movement jump, $F(3, 45) = 4.105$, $p = .012$, Cohen's $f = 0.52$. Figure 2 illustrates the average flight durations in the three vertical jumping tasks and the four tape application conditions. Gymnasts' average flight duration of the drop jump decreased compared to the baseline condition about 16.24 ms in the triceps surae tape application condition. During the counter movement jump the most apparent decrease of gymnasts' average flight duration compared to the baseline condition appears in the rectus femoris tape application condition. Here, the mean flight duration decreases about 12.52 ms. According to Tukey HSD post-hoc analysis, first a significant difference between the baseline tape application condition and the triceps surae tape application condition was found for the drop jump. Second, a significant difference appeared for the counter movement jump between the baseline tape application condition and the rectus femoris tape application condition. Nevertheless, none of the remaining calculated effects became significant, indicating no differences in the particular parameters between the tape application conditions.

DISCUSION

The aim of this study was to explore whether three different applications of elastic tape on the lower limbs of active and healthy gymnasts influences their vertical jumping performance in three different vertical jumping tasks. It was hypothesized that the elastic tape application on gymnasts' rectus femoris and triceps surae muscles influences vertical jumping performance. Additionally it was hypothesized that this influence may or may not depend on three different jumping tasks.

Table 1
Aggregated data of vertical jumping task performance

Jumping Task Parameter	Baseline No tape Mean ± SE	Tape Application Conditions RFTA Mean ± SE	TSTA Mean ± SE	SHTA Mean ± SE	*F*(3, 45)	*p*	Cohen's *f*
Drop Jump							
Contact time during take-off phase [ms]	207.33 ± 10.02	212.48 ± 15.39	209.00 ± 12.60	207.70 ± 14.05	0.237	.870	-
Peak force during take-off phase [N]	2296.51 ± 29.48	2290.14 ± 32.23	2300.61 ± 26.82	2282.25 ± 28.46	0.171	.915	-
Flight duration [ms]	487.44 ± 10.02	476.92 ± 9.83	471.20 ± 9.33	476.25 ± 10.37	3.229	.031	0.46
Peak impact force during landing phase [N]	2006.43 ± 56.70	2054.08 ± 51.93	1987.45 ± 53.14	2076.06 ± 55.51	1.438	.244	-
Time to peak impact force during landing phase [ms]	80.50 ± 2.42	83.21 ± 2.06	82.30 ± 1.84	82.53 ± 2.18	0.739	.534	-
Squat Jump							
Contact time during take-off phase [ms]	359.17 ± 20.50	366.07 ± 17.12	350.08 ± 12.16	368.63 ± 16.93	0.690	.563	-
Peak force during take-off phase [N]	1578.34 ± 89.41	1606.22 ± 99.30	1601.22 ± 90.66	1591.41 ± 94.37	0.783	.510	-
Flight duration [ms]	479.59 ± 11.15	475.44 ± 11.69	471.84 ± 11.31	471.45 ± 10.78	1.732	.174	-
Peak impact force during landing phase [N]	2037.38 ± 63.46	2065.24 ± 50.86	2033.04 ± 51.16	2074.78 ± 57.20	0.588	.626	-
Time to peak impact force during landing phase [ms]	82.65 ± 2.81	87.57 ± 2.81	86.30 ± 2.85	87.25 ± 3.16	2.142	.108	-
Counter Movement Jump							
Contact time during take-off phase [ms]	756.53 ± 31.23	769.80 ± 29.85	776.94 ± 30.03	772.45 ± 33.59	0.860	.469	-
Peak force during take-off phase [N]	1619.69 ± 96.38	1621.75 ± 85.04	1607.18 ± 85.26	1645.18 ± 68.93	0.243	.866	-
Flight duration [ms]	492.85 ± 11.79	480.33 ± 13.53	490.28 ± 12.88	488.81 ± 13.14	4.105	.012	0.52
Peak impact force during landing phase [N]	2022.91 ± 65.20	1987.12 ± 60.63	1980.40 ± 63.04	1997.80 ± 101.97	0.217	.884	-
Time to peak impact force during landing phase [ms]	83.32 ± 2.35	86.02 ± 3.04	86.73 ± 2.86	86.41 ± 3.70	0.950	.424	-

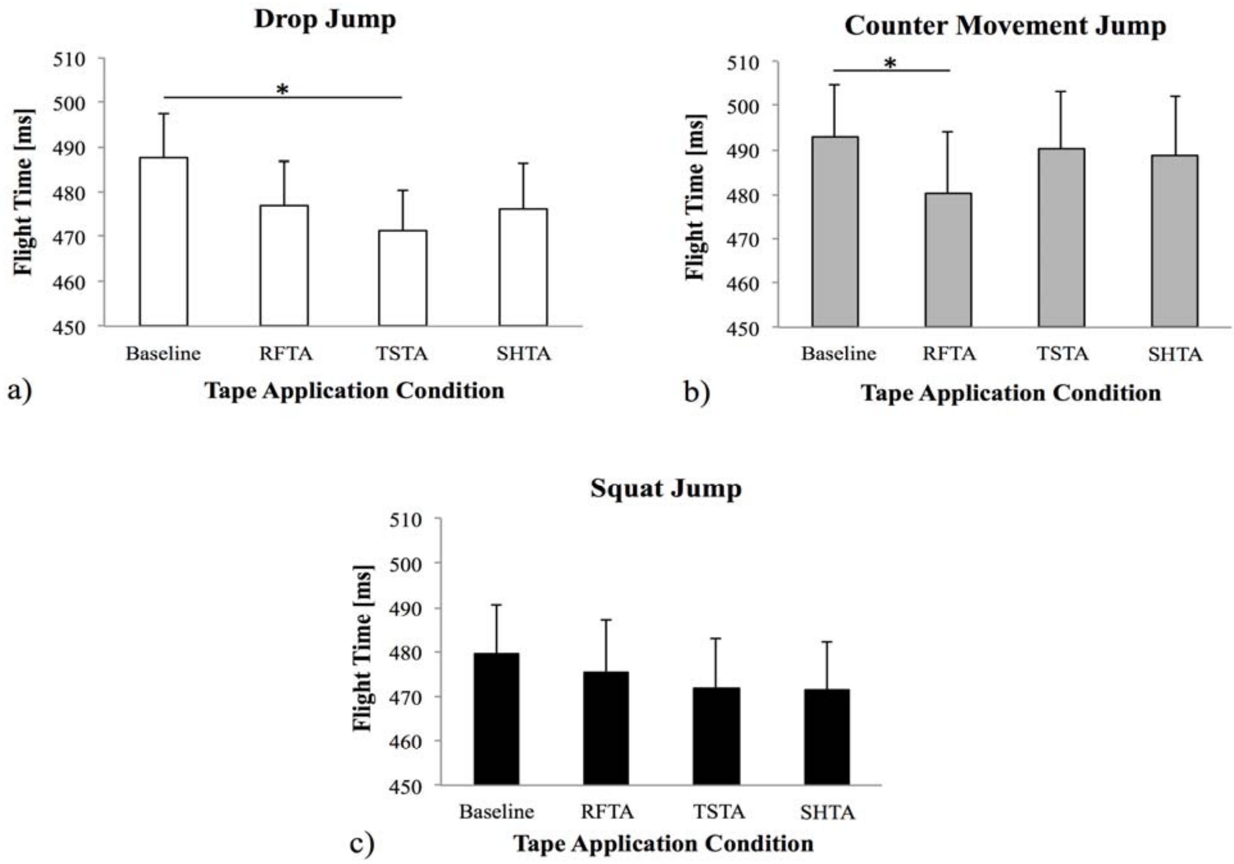

Figure 2. Means and standard errors of gymnast's flight duration in the three vertical jumping tasks a) the drop jump, b) the counter movement jump and c) the squat jump in the four study conditions (* = significant difference at $p < .05$ according to Tukey HSD post-hoc analysis).

A sham tape application was hypothesized to have no influence on vertical jumping performance but should function as a control condition. In all tape application conditions gymnasts were instructed in such a way that each tape application is due to support vertical jumping and is thought to function as a performance-enhancing tool. However, it should be explored in which parameters, which tasks and which amount these effects occur.

Most surprisingly, and in contrast to most of the results of the former studies on performance related effects of elastic tape (c.f. Huang et al., 2011; Mostert-Wentzel et al., 2012), the results of this study revealed a decrease in flight duration during drop jumping and counter movement jumping when elastic tape was applied. In the rectus femoris tape application condition gymnasts flight duration during the counter movement jump significantly decreased. This may be due to the fact that the facilitative tape application (from origin to insertion) on gymnasts' rectus femoris muscles inhibits the stretching part during the stretch-shortening cycle of the counter movement during this specific jumping task (Finni et al., 2000). The same may be true for the drop jumping task in which gymnasts' flight duration decreased in the triceps surae tape application condition compared to the baseline condition without an elastic tape application. The result that there is no significant effect on flight duration during the squat jumping task underlines the argumentation, that facilitative elastic tape application (from origin to insertion) has a performance hampering effect on vertical jumping performance in jumping tasks containing a stretch-shortening cycle, whereas no such effect could be shown for a vertical jumping task performed from a resting position without any stretch-shortening movement (squat jump).

The sham tape application was hypothesized to have no influence on jumping performance but should function as a control condition (Williams et al., 2012). In line with the results of former studies implementing an elastic tape application as a control condition (Chang, Chou, Lin, Lin, & Wang, 2010; Fratocchi et al., 2013; Mostert-Wentzel et al., 2012; Vercelli et al., 2012) the results of this study revealed no performance influencing effect of the sham tape application condition when it is applied on the muscle belly of the rectus femoris and triceps surae and perpendicular to their muscle fibre orientation. In the sham tape application it was decided to apply the elastic tape perpendicular to the muscle fibre orientation of rectus femoris and triceps surae to avoid mechanical co-interactions of neighbouring muscles (c.f. vastus intermedius, vastus lateralis, vastus medialis, tibialis anterior) which may have occurred when the sham tape application would have been applied longitudinal and next to the intended muscles. However, gymnasts in this study reported to indicate no manipulation of the tape application conditions, the sham tape application should be quite similar to the other tape application conditions. Containing for instance the same amount of elastic tape, and/or focusing on one body segment area in each tape application condition should be appropriate for future studies.

Quite confidently, the decreasing, yet performance hampering effect of the elastic tape application on the triceps surae during the drop jump and on the rectus femoris during the counter movement jump, seems to be caused mostly by mechanical properties instead of superstitious effects, like for instance increased attention, hampering tactile perception or a negative attitude. Nevertheless the elastic tape application may have a facilitating effect on factors such as inter- and intramuscular coordination or even muscular co-contraction as well as sensory input. But these effects are yet speculative and open to further investigations.

However, the flight duration in vertical jumping is highly depending on the way the gymnast performs the landing phase (e.g. bend or straight ankle, knee and hip joints; Horita, Komi, Nicol, & Kyröläinen, 2002) and 36 jumps may result in fatigue, these aspects do not seem explain the decrease in gymnasts' flight time. First, gymnasts' general execution of the vertical jumping tasks was well trained and did not vary significantly during the study progress. Additionally in a general floor, vault or beam warm-up and/or preparatory drill gymnasts are exposed to about 80 reactive take-offs and 60-80 take-offs with and without a counter-movement (e.g. basic drills, gymnastic leaps, somersaults) and the appropriate number of landings (Arkaev & Suchilin, 2004). Second, in spite of that, means and standard errors of the four jumps of each vertical jumping task in each tape application condition were calculated and utilized for further statistics.

There are several limitations of this study, and three specific aspects should be highlighted. First, it was decided to assess vertical jumping performance by means of a force platform since former studies indicated a positive effect of elastic taping on vertical jumping performance (Huang et al. 2011; Mostert-Wentzel et al., 2012). However, the same vertical jumping performance may result from different activation patterns of the leg muscles (Enoka, 2002) thus masking the isolated effect of elastic taping on one particular area. Future studies could integrate more complex measurements in their designs such as electromyographic measurements or alike. Second, it was decided to apply the elastic taping from origin to insertion, which should have a facilitating and activating effect on the taped muscle (Kase et al., 2003; Kumbrink, 2012). Surprisingly our results revealed a contrary result. Therefore, on the one hand it seems advisable for future studies to implement both tape application directions into their design

(Vercelli et al., 2012). On the other hand possible effects of tape applications implemented on (soft) tissues other than muscle, like for instance tendon, ligament, capsule, and other joint structures should be investigated (O'Sullivan & Bird, 2011). Third, one could argue that elastic taping may have different performance related effects in more coordinative task in which participants need to respond and adjust their movements according to natural or manipulated changes in the task execution, like for instance in tasks affording dynamic balance and/or dealing with perturbation. Therefore it might be beneficial to explore the effects of elastic taping on tasks with different demands in particular, or in light of the requirements of the sporting event in which athletes apply elastic taping in general.

However, two practical implications of this study can be summarized. First, there is no need for healthy, active gymnasts to apply elastic tape on rectus femoris and/or triceps surae in order to enhance vertical jumping performance. But second, depending on the vertical jumping task elastic tape applications which do not hamper performance (e.g. RFTA and SHTA in the drop jumping task, TSTA and SHTA in the counter movement jumping task, and all elastic tape applications in the squat jumping task) may function as superstitious, supporting and/or prophylactic tools when athletes believe in their postulated effects and thus may support performance although this is not measurable by the five task parameters applied in this study.

CONCLUSION

When applying elastic tape for performance enhancing purposes it should be taken into account that empirical evidence is still inconclusive. Whereas former studies failed to report conclusive performance-enhancing effects, the results of the present study revealed performance-decreasing effects of elastic taping on gymnasts' vertical jumping performance. It is concluded that there is no need for healthy, active gymnasts to apply elastic tape in order to enhance vertical jumping performance. Conflicting scientific results may thus indicate that generalized effects are controversial and positive influences in one specific characteristic can induce a decrease in another performance influencing characteristic. Although, athletes may use elastic tape for individual reasons such as comfort or even the belief in its clinical significance, it still seems to be of high interest to study potential effects of elastic taping in a standardized methodological approach and in light of the requirements of the sporting event.

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