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# EFFECTS OF KINESIO-TAPING ON PERFORMANCE WITH RESPECT TO FATIGUE IN RUGBY PLAYERS: A PILOT STUDY

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Kinesio-taping has become popular in athletes aiming to improve their performance, as it might influence muscle strength and blood circulation. Due to these aspects kinesio-taping could also affect muscle fatigue and relative power production. Therefore, the aim of this pilot study was to identify the effect of kinesio-taping on performance outcome and relative power contribution of the hip, knee and ankle joint in rested and fatigued situation. 4 university rugby players performed 20m-sprints and vertical jumping tasks (CMJ, DJ) in kinesio taped and untaped condition before and after a rugby specific fatigue protocol. Kinesio-tape improved performance for the 20m-sprint in rested situation. It seemed to change the relative hip, knee and ankle joint power contribution pattern in rested (DJ) and fatigued (CMJ, DJ) situation, which could influence injury risks.

**KEY WORDS:** rugby, kinesio-taping, fatigue, vertical jump, stretch shortening cycle

**INTRODUCTION:** Kinesio tape (KT) is primarily used in treating joint sprains and instability, pain, muscle weakness and tissue inflammation, but its practice has recently become more widespread in a healthy population, as it is also used by athletes, aiming to improve their performance (De Hoyo, Alvarez-Mesa, Sanudo, Carrasco, & Dominguez, 2012). KT takes action by e.g. 1) lifting the skin, 2) increasing mechanoreceptor stimulation, 3) providing positional stimulus to the skin and 4) increasing lymph flow and blood circulation (Kase, Wallis, & Kase, 2003; Kataoka & Ichimaru, 2005). This could impact muscle strength, explosive muscular power and movement control, and could be of beneficial effect in sports such as e.g. rugby, requiring jumping, kicking and sprinting tasks. If KT influences the taped muscle, changes in relative joint power-production could appear, even if performance outcome would not change. Vertical jump tasks are commonly used to diagnose muscle strength and leg power, as well as the ability to effectively transfer the energy from the stretch-shortening-cycles (SSC) into jump height. Despite the widespread popularity of KT, little scientific evidence exists. These studies are mainly focused on muscle strength and show controversial results to support the use of KT for performance enhancement in healthy athletes. While some studies report no change in muscle strength in this population due to KT (Chang, Chou, Lin, Lin, & Wang, 2010; De Hoyo et al., 2012; Fu, Wong, Pei, Wu, Chou, & Lin, 2008; Wong, Cheung, & Li, 2012) other studies report an increase in explosive power of the gluteus muscle (Mostert-Wentzel, Swart, Masenyetse, Sihlali, Cilliers, Clarke et al., 2012), hand grip strength (Lee, Yoo, & Lee, 2010), eccentric isokinetic quadriceps force (Vithoulka, Beneka, Malliou, Aggelousis, Karatsolis, & Diamantopoulos, 2010), isokinetic quadriceps peak torque (Slupik, Dwornik, Bialoszewski, & Zych, 2007) and m. gastrocnemius medialis activity (Huang, Hsieh, Lu, & Su, 2011). Additionally, Huang et al. (2011) showed that even though vertical jump height did not increase due to KT, changes appeared in the vertical force. These results were achieved in rested situation and a healthy rested muscle might not refer to the stimuli of the KT. As it is postulated that KT increases blood circulation and lymph flow (Kase et al., 2003), fatiguing effects of the muscle could be influenced by the application of KT, but this has scarcely been investigated. Only two study-reports in English were found indicating an increased blood circulation after 20 min of cycling (Kataoka & Ichimaru, 2005) and a lesser decrease of muscle strength during a tennis fatiguing protocol (Schneider, Rhea, & Bay, 2010) due to KT used on healthy participants. Additionally, the scientific body is lacking on information if possible changes in strength alter e.g. joint power production, leg stiffness and reactivity strength index (RSI) as possible indicators for performance. Therefore, the aim of this study was to investigate the effect of KT on sprint and vertical jump performance in healthy participants in rested situation and fatigued situation. Due to the increasing popularity of gluteal KT in rugby, this study further wants to investigate these effects in an applied setting of rugby players.

**METHODS:** 4 university level rugby-players (height: 183±7.0 cm, mass: 89.5±5.3 kg) participated in this study and signed a written consent form. The KT was applied by a trained physiotherapist prior to warm up. For KT condition kinesio-tape was applied bilaterally from origin to insertion on the gluteus maximus and medius using the KT muscle technique, where the athlete fully flexes the hip, the tissue is pre-stretched and the tape is applied under very light tension, hence when the hip returns to its neutral position, the myofascial system is pre-loaded due to the elastic recoil of the tape (Figure 1.a). Each participant underwent a testing session in untaped condition (NT) and in KT condition (KT). All sessions were performed in randomized order, with a minimum of 1 week between each session. A testing session consisted of subject preparation (marker placement, taping if necessary), a 20 min rugby specific warm-up (5 min jog, 5 min sprints and squat jumps, 5 min active stretching, and 5 min jog), a pre-test, an adapted rugby specific fatigue protocol (Figure 2) and a post-test. At pre- and post-test the sprint time of two 20 m sprints as well as kinematic and kinetic data of 3 CMJs, 3 DJs each at height 30 cm, 40 cm and 50 cm were collected. Sprint time was measured using a timing gate system (SMARTSPEED™, Fusion Sport Inc, Australia, 1000 Hz). Kinematic and kinetic data were collected simultaneously by a 9 camera three-dimensional motion analysis system (VICON, MX camera system, Oxford Metrics Ltd, UK; 100 Hz) and a force plate (Kistler, 5233A, Winterthur Switzerland, 1000 Hz). Reflective markers were placed according to the Cleveland Clinic lower body markerset (Motion Analysis Corp, Santa Rosa, USA).

Figure 1: KT applied on gluteus maximus and medius

| | |
|---|---|
| 1 | 20 m sprint |
| 30 s | Weighted sled push at 70% of bw |
| 30 s | Shuttle runs |
| 30 s | Vertical jumps on crash mat |
| 30 s | Weighted lunges at 20% of bw |
| 30 s | Isometric squat |
| 30 s | Maximum cycling at self selected resistance |
| 60 s | Rest |

5 repetitions

Figure 2: Rugby specific fatigue protocol

The key variables analysed included the 20m sprint time ($st_{20;}$), jump height ($h_{max}$; via center of mass displacement), maximal vertical force ($Fz_{max}$), maximal rate of force development ($RFD_{max;}$ at CMJ), reactive strength index (RSI; jump height/ground contact time), as well as the relative contribution of peak hip, knee and ankle joint power ($P\_Hip_{rel}$,$P\_Knee_{rel}$,$P\_Ankle_{rel}$; percentage of the sum of peak ankle, knee and hip joint power). The kinetic data was normalized to bodyweight. The mean of the two sprints and the mean of the 3 performed jumps of each task will be presented. In order to detect significant differences ($p \leq 0.05$) with a test-power of 0.8 a medium effect size (Cohen's d between 0.4 and 0.79) would require a sample size between 16-50 participants, and a high effect size (Cohen's d≥0.8) ≤15 participants. As this is a pilot study, only the effect sizes will be discussed omitting further statistical analysis.
Initial observations of 4 subjects is presented and discussed within this abstract, but we hope to be able to present data up to12 subjects for ISBS 2013.

**RESULTS:** After the fatigue protocol participants showed slower sprint times (~0.10 s for NT and KT), a decrease in CMJ-height (~4 cm NT, ~5 cm KT), and a smaller decrease in DJ height (~3 cm NT, 2 cm KT). Contact times, RSI and $RFD_{max}$ did not change neither due to fatigue nor to taping condition. Parameters showing effect sizes by Cohen's d ≥ 0.8 between taping conditions in pre- and post-test are presented in Table 1. Sprint time was faster in the KT-condition and reached a Cohen's d≥0.80 in the pre-test. The KT did not affect CMJ-height, but participants showed higher maximal vertical force (d≥0.80) during the CMJ before and after fatigue when being taped. The relative power contribution changed after fatigue, revealing a higher (d≥0.80) contribution of the hip power and a lower contribution of the knee power in the KT-condition. The effect of KT in DJ performance is ambiguous showing decreased jump heights before and after fatigue in KT-condition for the DJ of the 50 cm box (d≥0.80). Similar to the CMJ, maximal vertical force is increased in KT-condition with a medium effect at least, reaching d≥0.8 for the 30 cm and 50 cm drop only before fatiguing. The relative power contribution seems to show a tendency to reduce hip and knee joint power at the cost of increasing ankle joint power after fatigue, but results are not consistent over the drop jumps of the three heights.

**Table 1**

**Mean (sd) values and Cohen's d of 20m sprint, CMJ and drop jump performance before and after a fatiguing protocol**

| Paramter | NT-Pre mean (sd) | KT-Pre mean (sd) | NT-Post mean (sd) | KT-Post mean (sd) | NT-KT pre Cohen's d | NT-KT post Cohen's d |
|---|---|---|---|---|---|---|
| *20 m Sprint* | | | | | | |
| st20m [s] | 3.14 (0.12) | 3.07 (0.05) | 3.24 (0.22) | 3.17 (0.16) | **0.85** | 0.37 |
| *CMJ* | | | | | | |
| CMJ_h [m] | 0.43 (0.03) | 0.47 (0.08) | 0.44 (0.07) | 0.41 (0.06) | 0.68 | 0.45 |
| CMJ_Fz_Max [N/BW] | 1.15 (0.06) | 1.27 (0.07) | 1.11 (0.06) | 1.22 (0.14) | **1.78** | **1.11** |
| CMJ_P_Hip_rel [%] | 28 (7) | 27 (1) | 27 (8) | 34 (4) | 0.19 | **1.19** |
| CMJ_P_Knee_rel [%] | 27 (7) | 27 (6) | 28 (6) | 19 (8) | 0.03 | **1.20** |
| *DJ* | | | | | | |
| DJ30_h [m] | 0.39 (0.08) | 0.38 (0.04) | 0.34 (0.06) | 0.33 (0.03) | 0.08 | 0.25 |
| DJ40_h [m] | 0.42 (0.02) | 0.41 (0.03) | 0.40 (0.01) | 0.40 (0.02) | 0.51 | 0.30 |
| DJ50_h [m] | 0.51 (0.02) | 0.49 (0.01) | 0.50 (0.01) | 0.49 (0.02) | **1.24** | **0.84** |
| DJ30_Fz_Max [N/BW] | 2.96 (0.32) | 3.42 (0.51) | 2.78 (0.32) | 3.00 (0.49) | **1.07** | 0.52 |
| DJ40_Fz_Max [N/BW] | 3.28 (0.59) | 3.64 (0.55) | 3.03 (0.37) | 3.23 (0.39) | 0.62 | 0.52 |
| DJ50_Fz_Max [N/BW] | 3.51 (0.33) | 3.80 (0.21) | 3.43 (0.30) | 3.73 (0.53) | **1.06** | 0.69 |
| DJ30_P_Hip_rel [%] | 11 (8) | 10 (2) | 11 (8) | 11 (4) | 0.26 | 0.05 |
| DJ40_P_Hip_rel [%] | 11 (5) | 11 (6) | 17 (11) | 12 (4) | 0.06 | 0.64 |
| DJ50_P_Hip_rel [%] | 14 (5) | 11 (3) | 19 (11) | 13 (6) | **0.87** | 0.71 |
| DJ30_P_Knee_rel [%] | 45 (7) | 36 (5) | 44 (6) | 38 (6) | **1.54** | **1.10** |
| DJ40_P_Knee_rel [%] | 43 (7) | 38 (8) | 42 (6) | 36 (7) | 0.68 | **0.92** |
| DJ50_P_Knee_rel [%] | 43 (6) | 40 (4) | 42 (8) | 37 (4) | 0.64 | 0.74 |
| DJ30_P_Ankle_rel [%] | 43 (8) | 54 (5) | 45 (10) | 51 (6) | **1.63** | **0.80** |
| DJ40_P_Ankle_rel [%] | 46 (10) | 51 (3) | 42 (10) | 52 (4) | 0.75 | **1.41** |
| DJ50_P_Ankle_rel [%] | 42 (8) | 50 (4) | 39 (6) | 50 (4) | **1.10** | **2.14** |

**DISCUSSION:** The aim of this study was to investigate the effect of KT on sprint and vertical jump performance in healthy participants in rested and fatigued situation. KT only shows a performance enhancement for the 20 m-sprint time in rested situation. The M. gluteus maximus is considered a prime contributor to reach high levels of speed in sprinting (Delecluse, 1997), and the actions of KT on the gluteal muscles could provide enhanced support for power production. It seems that KT shows different effects for movements containing a slow and a fast SSC. At the CMJ (slow SSC) the relative hip power contribution increases and the relative knee power contribution decreases after fatigue, implying that the actions of the tape influenced the gluteal muscles. At the drop jump (fast SSC) relative hip and knee power contribution is smaller or the same to the untaped situation at the cost of an increase of relative ankle power contribution before and after fatigue. Concurrently maximal vertical forces increases, which is in accordance with Huang et al. (2011). The increase in relative joint power contribution at the ankle might impose the ankle at higher risks of injury for movements requiring a fast SSC. This might be due to possible alterations in joint stiffness, but this needs further investigation.

**CONCLUSION:** Kinesio-taping the gluteal muscles could influence performance outcome in tasks requiring high gluteal muscle activities. Even if performance outcome is not affected by the KT, relative hip, knee and ankle joint power production patterns can already change in rested situation but show higher effects after fatigue. The change in power production pattern might be beneficial for the knee in slow SSC, but could impose a higher injury risk for the ankle in tasks requiring fast SSC due to higher relative power contribution.

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