

The Effects of Kinesio Tape on Isokinetic Muscular Function of Horse Racing Jockeys

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Abstract. [Purpose] The purpose of this study was to conduct a scientific analysis of the effectiveness of Kinesio taping at preventing injury and improving horse racing jockey' performance, by studying the effects on isokinetic muscular function of Kinesio taping applied to the knee joint muscle. [Subjects] Eight horse racing jockeys were selected for this study. [Methods] Measurement of isokinetic muscular function of both flexor and extensor muscles was performed at the angular velocities of 60°/sec and 180°/sec using a Biodex system 3, before and after application of Kinesio taping to the rectus femoris, vastus medialis, vastus lateralis, and hamstring. [Result] At the angular velocities of 60°/sec and 180°/sec, significant differences were observed in both flexor and extensor peak torque, average power, and total work of the knee joint after application of Kinesio taping. [Conclusion] The application of Kinesio taping has a positive effect on the function of both knee flexors and extensors, and also kinetic ability. Therefore, its use would lead to a significant increase in the muscle function of horse racing jockeys.

Key words: Horse racing jockeys, Isokinetic, Kinesio taping

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INTRODUCTION

In modern society, horse racing is a spectator sport which involves entertainment and speculation, and is developing into a popular leisure sport, which can provide relief to spectator from stress and frustration. Competitive sporting activities, including horse racing, may cause damage and injury due to overload of the body, resulting in shortening of a jockey's lives¹⁾. Horse racing is performed by jockeys and horses in harmony with one another, and involves a relatively high risk of various injuries associated with falls from a horse. Therefore, in order to achieve the best athletic performance, strict self-control, including weight control, and high physical strength for control of extreme tension and speed, is essential for jockeys^{2, 3)}. Injury of jockeys due to diverse internal/external causes is a frequent occurrence in many sporting activities. In sporting events where jockeys have physical contact with their opponents, most injuries occur in the early part of games^{4, 5)}.

Falls from a horse may result in death, cerebral concussion, physical handicaps, major organ ruptures, fractures due to damage to the musculoskeletal system, bruises, laceration, desmorrhexis, dislocation, cutting, and damage to the vertebrae and diverse body regions, and, in particular, frequent occurrence of injury in the lumbar region, cervicospinal area, head, face, and knee joints has been reported³⁾. Horse racing jockeys sit or adopt an upright, straight-legged posture⁶⁾ which serves important roles in maintaining

the stability of the spine and fixing the riding postures to prevent falls from a horse. Therefore, knee joint muscle strength, which bears weight loads and serves important roles in maintaining stability, preventing damage, and performing normal functions⁷⁾, is essential. In jockeys' training for improvement of their athletic performance, isotonic exercise, isometric exercise, and isokinetic exercise methods are used. In particular, isokinetic exercise is very effective at reinforcing muscle strength and presents objective and reliable data in the process of rehabilitation when the musculoskeletal system has been damaged⁸⁾. Wi Seung-Du and Seo Yeong-Hwan⁹⁾ reported that the application of femoral taping had a positive effect on isokinetic muscle function and muscle fatigue. In addition many previous studies have reported diverse results from the application of Kinesio taping. However, study of the prevention of injury or improvement of athletic performance conducted with horse racing jockeys, who are subject to risk of various kinds of injury or damage related to falls from a horse, are insufficient.

The current study examined changes in isokinetic knee joint muscle strength of horse racing jockeys after application of Kinesio taping to the knee joint region, for prevention of injury and for improvement of their athletic performance.

SUBJECTS AND METHODS

The subjects of this study were eight male horse racing jockeys, who were selected from among those who did not have paresthesia, motor abnormality, history of nervous/muscular/skeletal system disease, or contraindications against the tape. The subjects understood the intent of the

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study and agreed to participate after listening to explanations regarding experiment and procedures prior to the conduct of the experiment. The subjects' mean age was 29 ± 3.964 yrs, and they had a mean height of 155.38 ± 2.659 cm, and a mean weight of 49.75 ± 2.659 kg.

The present study was approved by Sahmyook University Institutional Review Board, and written consent was received from the subjects. The following experimental tools were used: 5 and 7.5-cm-wide Kinesio elastic tapes (NIPPON Sigmax Co., Japan), and a BIODEX System3 (Biodex Medical System Inc.).

A preliminary experiment, which included 10 horse racing jockeys, was performed to test for allergic reaction to the tape, and for testing of isokinetic knee joint muscle strength (lower extremity muscle strength and muscle evaluation). Eight subjects were finally selected. When the subjects arrived at the laboratory, they took a rest, then briefly performed warm-up exercises. A Biodex instrument was used to measure of isokinetic muscle strength at angular velocities of $60^\circ/\text{sec}$ and $180^\circ/\text{sec}$ ¹⁰ before application of Kinesio tape. Measurement load speeds were set based on measurement load speeds effective for muscle function evaluation reported by a previous study which considered protocols suitable for the purpose of the test¹¹.

After the measurements, the subjects rested before Kinesio tapes were applied to four muscle regions.

Rectus femoris taping was applied with subjects in a supine position. One end of a Kinesio tape was attached to the origin of the rectus femoris muscle, and the tape was attached along the rectus femoris muscle up to the knee region. Then, the knee was bent and a Y shape tape was attached to the patella region as if wrapping the knee.

Vastus medialis taping was applied with subjects in a supine position. Kinesio tape was attached to the medial origin of the vastus medialis. Then, the end of the foot was turned laterally, the leg was spread laterally, and the insertion of the vastus medialis was wrapped by the tape. Next the knee was bent and the tape was attached to the bottom of the patella.

Vastus lateralis taping was applied with subjects in a supine position. One end of a Kinesio tape was attached to the origin of the vastus lateralis, and the tape was attached to the vastus lateralis toward the insertion of the vastus lateralis. Then, the knee was bent and the tape was attached to the bottom of the patella.

Hamstring taping was applied with subjects in a supine position. One end of a Kinesio tape was attached to the origin of the hamstring, the leg to which the tape was attached was taken down from the bed and one end of the Y shaped tape was attached to the insertion of the biceps femoris muscle. Then, the tape was attached to the leg toward the insertions of the semitendinosus and the semimembranosus in a Y shape.

In the current experiment, 7.5-cm-wide Kinesio elastic tape (NIPPON Sigmax Co. Japan) was applied without being stretched to two muscle regions the rectus femoris muscle, and the hamstring. Five-centimeter Kinesio elastic tape (NIPPON Sigmax Co. Japan) was applied without being stretched to two muscle regions the vastus medialis muscle, and the vastus lateralis muscle, with the knee in maximal

extension. Measurement of muscle strength was repeated at the angular velocities of $60^\circ/\text{sec}$ and $180^\circ/\text{sec}$.

RESULTS

Table 1 shows descriptive statistics and t-test results for the peak torque at knee joint angular speeds of $60^\circ/\text{sec}$ and $180^\circ/\text{sec}$, before and after the application of Kinesio tape. At $60^\circ/\text{sec}$, peak torque of the right extensor was 131.50 ± 18.18 before, and 137.50 ± 17.40 after the application of Kinesio tape, a statistically significant difference ($p=0.004$), and that of the right flexor was 67.38 ± 9.26 before, and 75.38 ± 11.88 after the application of Kinesio tape, a statistically significant difference ($p=0.012$). At $60^\circ/\text{sec}$, peak torque of the left extensor was 122.50 ± 9.07 before, and 132.50 ± 12.88 after the application of Kinesio tape, a statistically significant difference ($p=0.004$), and that of the left flexor was 59.88 ± 13.10 before and 74.13 ± 10.70 after the application of Kinesio tape, a statistically significant difference ($p=0.043$). At $180^\circ/\text{sec}$, peak torque of the right extensor was 86.00 ± 11.48 before, and 90.13 ± 12.65 after the application of Kinesio tape, a statistically significant difference ($p=0.033$), and that of the right flexor was 50.75 ± 6.52 before, and 56.63 ± 9.67 after application of Kinesio tape, a statistically significant difference ($p=0.024$). At $180^\circ/\text{sec}$, peak torque of the left extensor was 82.38 ± 10.32 before, and 88.63 ± 11.71 after the application of Kinesio tape, a statistically significant difference ($p=0.002$), and that of the left flexor was 45.88 ± 7.376 before, and 56.00 ± 8.49 after the application of Kinesio tape, a statistically significant difference ($p=0.002$).

Table 2 shows descriptive statistics and t-test results for the average torque during knee joint movements at angular speeds of $60^\circ/\text{sec}$ and $180^\circ/\text{sec}$, before and after the application of Kinesio tape. The average torque at $60^\circ/\text{sec}$ of the right extensor was 82.38 ± 10.93 before, and 90.75 ± 13.12 after the application of Kinesio tape, a statistically significant difference ($p=0.005$), and that of the right flexor was 50.38 ± 3.50 before, and 56.50 ± 5.07 after the application of Kinesio tape, a statistically significant difference ($p=0.003$). At $60^\circ/\text{sec}$, average torque of the left extensor was 76.75 ± 13.87 before, and 86.00 ± 11.01 after the application of Kinesio tape and statistically significant difference ($p=0.006$), and that of the left flexor was 47.75 ± 9.362 before, and 54.63 ± 8.02 after the application of Kinesio tape, a statistically significant difference ($p=0.005$). At $180^\circ/\text{sec}$, average torque of the right extensor was 130.13 ± 22.01 before, and 139.63 ± 22.56 after the application of Kinesio tape, a statistically significant difference ($p=0.001$), and that of the right flexor was 77.75 ± 12.15 before, and 90.88 ± 13.64 after the application of Kinesio tape, a statistically significant difference ($p=0.008$). At $180^\circ/\text{sec}$, average torque of the left extensor was 122.50 ± 28.83 before, and 136.13 ± 23.56 after the application of Kinesio tape, a statistically significant difference ($p=0.014$), and that of the left flexor was 70.63 ± 14.85 before, and 87.63 ± 13.13 after the application of Kinesio tape, a statistically significant difference ($p=0.004$).

Table 3 shows descriptive statistics and t-test results for the total work done during performance of isokinetic knee joint movements at knee joint angular speeds of $60^\circ/\text{sec}$ and

Table 1. Comparison of peak torque during isokinetic knee joint movements at 60°/sec and 180°/sec, between before and after the application of Kinesio taping (Unit: Nm)

	60°/sec extensor (R)	60°/sec flexor (R)	60°/sec extensor (L)	60°/sec flexor (L)	180°/sec extensor (R)	180°/sec flexor (R)	180°/sec extensor (L)	180°/sec flexor (L)
Before the experiment	131.50 ± 18.18	67.38 ± 9.26	122.50 ± 9.07	59.88 ± 13.10	86.00 ± 11.48	50.75 ± 6.52	82.38 ± 10.32	45.88 ± 7.376
After the experiment	137.50 ± 17.40	75.38 ± 11.88	132.50 ± 12.88	74.13 ± 10.70	90.13 ± 12.65	56.63 ± 9.67	88.63 ± 11.71	56.00 ± 8.49
Δ%	4.56	11.88	8.16	23.8	4.80	11.59	7.59	22.06
t value	-4.243	-3.336	-4.145	-2.470	-2.658	-2.869	-4.597	-4.944
p value	0.004*	0.012*	0.004*	0.043*	0.033*	0.024*	0.002*	0.002*

Δ%:[(After the experiment–Before the experiment)÷Before the experiment]×100

*p<0.05,

R: Right, L: Left

Table 2. Comparison of average torque during isokinetic knee joint movements at 60°/sec and 180°/sec, between before and after the application of Kinesio taping (Unit: Watt)

	60°/sec extensor (R)	60°/sec flexor (R)	60°/sec extensor (L)	60°/sec flexor (L)	180°/sec extensor (R)	180°/sec flexor (R)	180°/sec extensor (L)	180°/sec flexor (L)
Before the experiment	82.38 ± 10.93	50.38 ± 3.50	76.75 ± 13.87	47.75 ± 9.362	130.13 ± 22.01	77.75 ± 12.15	122.50 ± 28.83	70.63 ± 14.85
After the experiment	90.75 ± 13.12	56.50 ± 5.07	86.00 ± 11.01	54.63 ± 8.02	139.63 ± 22.56	90.88 ± 13.64	136.13 ± 23.56	87.63 ± 13.13
Δ%	10.16	12.15	12.05	14.41	7.3	16.89	11.13	24.07
t value	-4.098	-4.519	-3.922	-4.108	-5.485	-3.715	-3.228	-4.250
p value	0.005*	0.003*	0.006*	0.005*	0.001*	0.008*	0.014*	0.004*

Δ%:[(After the experiment–Before the experiment)÷Before the experiment]×100

*p<0.05,

R: Right, L: Left

Table3. Comparison of total work during isokinetic knee joint movements at 60°/sec and 180°/sec, between before and after the application of Kinesio taping (unit: Joule)

	60°/sec extensor (R)	60°/sec flexor (R)	60°/sec extensor (L)	60°/sec flexor (L)	180°/sec extensor (R)	180°/sec flexor (R)	180°/sec extensor (L)	180°/sec flexor (L)
Before the experiment	496.75 ± 82.51	305.88 ± 42.58	458.38 ± 84.23	288.63 ± 47.52	1574.50 ± 277.37	1029.63 ± 100.27	1522.63 ± 313.76	900.75 ± 200.63
After the experiment	552.50 ± 88.09	327.75 ± 44.13	516.75 ± 56.99	308.00 ± 52.04	1666.25 ± 239.94	1146.13 ± 118.14	1634.88 ± 254.45	1122.38 ± 140.67
Δ%	5.19	12.73	7.15	6.71	5.83	7.37	11.32	24.61
t value	-4.333	-3.560	-2.666	-3.111	-3.396	-2.397	-3.112	-3.105
p value	0.008*	0.008*	0.002*	0.017*	0.001*	0.048*	0.017*	0.017*

Δ%:[(After the experiment–Before the experiment)÷Before the experiment]×100

*p<0.05,

R: Right, L: Left

180°/sec, before and after the application of Kinesio tape. The total work at 60°/sec of the right extensor was 496.75 ± 82.51 before, and 552.50 ± 88.09 after the application of Kinesio tape, a statistically significant difference ($p=0.008$), and that of the right flexor was 305.88 ± 42.58 before, and 327.75 ± 44.13 after the application of Kinesio tape, a significant difference ($p=0.008$).

At 60°/sec, total work of the left extensor was 458.38 ± 84.23 before, and 516.75 ± 56.99 after the application of Kinesio tape, a statistically significant difference ($p=0.002$), and that of the left flexor was 288.63 ± 47.52 before, and 308.00 ± 52.04 after the application of Kinesio tape, a statistically significant difference ($p=0.017$). At 180°/sec, total work of the right extensor was 1574.50 ± 277.37 before, and 1666.25 ± 239.94 after the application of Kinesio tape, a statistically significant difference ($p=0.001$), and that of the right flexor was 1029.63 ± 100.27 before, and 1146.13 ± 118.14 after the application of Kinesio tape, a statistically significant difference ($p=0.048$). At 180°/sec, total work of the left extensor was 1522.63 ± 313.76 before, and 1634.88 ± 254.45 after the application of Kinesio tape, a statistically significant difference ($p=0.017$), and that of the left flexor was 900.75 ± 200.63 before, and 1122.38 ± 140.67 after the application of Kinesio tape, a statistically significant difference ($p=0.017$).

DISCUSSION

For jockeys, the physical conditions required for achievement of good performance in horse racing include light weight, small frame, a sense of balance, excellent reflexes, and agility. These are important factors that affect the results of races and determine the period of activity as a jockey. Therefore, jockeys need to maintain strict control of their weight, balance, and physical strength at normal times, and, in particular, improvement of lower extremity muscle function is very important.

Diverse tools and methods for improvement of muscle function have been studied and developed by many previous researchers; however, recently, the application of Kinesio tape, an adhesive elastic tape that is not chemically treated, in order to normalize reduced muscle strength and cramp, and to improve the circulation of blood, tissue fluids, and lymph fluids, through the principle of muscle homeostasis, to achieve muscle balance and relieve symptoms, has been widely used in diverse fields¹².

In the present study, Kinesio tape was applied to four muscles of the knee joints of horse racing jockeys, and a Biodex instrument was used to evaluate the isokinetic muscle strength of their knee joints at angular velocities of 60°/sec and 180°/sec.

The results of the present study indicate that peak torque, average torque, and total work, showed significant increases after application of Kinesio tape to the knee joint region, compared to before the application at knee joint angular speeds of 60°/sec and 180°/sec. These results can be interpreted as indicating that application of Kinesio tape has a positive effect on isokinetic knee joint extensor strength and flexor strength of horse racing jockeys. These results

are consistent with the results of other studies, including the study reported by Kowall MG, Kolk G, Nuber GW, Cassisi JE, Stern SH¹³.

Wi Seung-Du et al.⁹ reported improvement of isokinetic muscle strength after application of taping to the quadriceps femoris muscle, and Fratocchi G, Di Mattia F, and Rossi R et al.¹⁴ reported that application of taping over the biceps brachii resulted in significantly increased concentric elbow peak torque in a population of healthy participants.

In the present study when taping was applied, isokinetic knee joint extensor and flexor strength showed significant increases, and this can be interpreted as increase in muscle strength arising from improvement in the ratio of antagonists and synergists. That is, application of taping to the knee joint region acts primarily to fix the joints, and, secondarily to improve harmony and balance between antagonists and synergists around the joint, thereby helping cooperative actions and muscle strength improvement¹⁵.

The physiological mechanism of muscle strength improvement through Kinesio taping can be explained by the cutaneous fusimotor reflex theory, which states that when the skin is stimulated by various forms of stimuli, such as contact and vibrations, muscles below the stimulated skin region are induced to contract through gamma motor reflexes¹⁶. Therefore, taping stimulates an increase in muscle activity of the skin, improving muscle strength^{12, 15}. The mechanism of muscle strength improvement through Kinesio taping can also be explained by the irradiation phenomenon, in which increases in intensity and frequency of stimuli lead to an increase in the diffusion of the intensity of reactions. That is, muscular contractility can be increased by increasing the intensity of stimulation of muscles through taping. We conclude that muscle strength was improved by the combined effects of these factors.

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