



Original Article

## Effects of magnetic field therapy after taping application on pain and function of patients with knee osteoarthritis

SANG-HYUCK PARK<sup>1)</sup>, YOUNG-HAN PARK<sup>1)</sup>, JUNG-HO LEE<sup>2)\*</sup>

<sup>1)</sup> Department of Physical Therapy, Korea National University of Transportation, Republic of Korea

<sup>2)</sup> Department of Physical Therapy, Kyungdong University: Bongpo-ri, Toseong-myeon, Goseong-gun, Gangwon-do, Republic of Korea

**Abstract.** [Purpose] The purpose of study was to investigate the effect of taping applied before magnetic field therapy. [Subjects and Methods] Thirty patients who diagnosed with knee arthritis by a specialist in the rehabilitation department were divided into three groups using the random allocation method. The control group received 15 min general physiotherapy. For the experimental group 1, non-elastic taping was applied to the medial side of the knee after general physiotherapy, followed by a 15 min magnetic field therapy. For the experimental group 2, elastic taping was applied to the medial side of the knee after general physiotherapy, followed by a 15 min magnetic field therapy. This study used visual analog scale to evaluate pain. This study used Western Ontario and McMaster Universities to evaluate the knee function. [Results] Experimental group 1 and experimental group 2 showed a significant difference visual analog scale and Western Ontario and McMaster Universities from the control group. However, no significant difference was observed between experimental group 1 and experimental group 2. [Conclusion] Choosing the applicable taping method according to the condition of the patients and applying it to therapy is necessary to reduce pain and improve the function of the patients with knee osteoarthritis.

**Key words:** Magnetic field therapy, Taping, Pain

(This article was submitted Apr. 24, 2017, and was accepted Jun. 5, 2017)

### INTRODUCTION

Osteoarthritis is a disease in which the joint facet is irregularly changed because of repeated use and damage to the cartilage, which protects the part between joints<sup>1)</sup>. Consequently, daily activities seem unnatural and the resultant friction on the joint facet changes the joint facet and damages the bone, ligament, tendon, and surrounding tissue, thus further causing inflammation or pain around the joint. The current therapy strategy is aimed at reducing joint pain, ameliorating physical impairment, and restricting the progress of joint damage<sup>2)</sup>.

Patients with knee osteoarthritis experience frequent pain, and their physical function and independence in daily life decrease because of pain and stiffness. Moreover, those with knee osteoarthritis have a short stance phase and exhibit a painful walking pattern<sup>3)</sup>.

Therapy schemes for patients with knee osteoarthritis include non-invasive therapy (e.g., taping application, exercise therapy, and electronic therapy), medicine therapy (e.g., painkiller and Nonsteroidal Anti-Inflammatory Drugs), and surgical method (e.g., Total Knee Replacement<sup>2)</sup>). A study that examined the application of magnetic field therapy to patients with knee osteoarthritis reported increased visual analogue scale (VAS) and Western Ontario and McMaster Universities (WOMAC) scores<sup>4)</sup>.

Taping therapy schemes for patients with knee arthritis are divided into non-elastic taping and Kinesio taping. Non-elastic

\*Corresponding author. Jung-Ho Lee (E-mail: ljhcivapt@naver.com)

©2017 The Society of Physical Therapy Science. Published by IPEC Inc.



This is an open-access article distributed under the terms of the Creative Commons Attribution Non-Commercial No Derivatives (by-nc-nd) License. (CC-BY-NC-ND 4.0: <https://creativecommons.org/licenses/by-nc-nd/4.0/>)

taping is mainly used to support the appropriate functional use of the body and increase dynamic stability<sup>5</sup>). Kinesio taping uses the principle of increasing proprioceptive sense, and it is widely used in orthopedics, sports medicine, and nerve root rehabilitation. A previous study that applied Kinesio taping to patients with knee osteoarthritis based on the concept of stimulation of the mechanical receptor of the skin reported increased balance and motor control and decreased VAS<sup>6</sup>). Another study reported that non-elastic taping increases the activity of the vastus medialis muscle at the time of standing after sitting among patients with patellofemoral pain syndrome<sup>7</sup>).

As shown in previous studies, taping is a direct stimulation on the muscles and is used as an intervention method that activates the muscles and increases joint stability. Most of the recent studies examining patients with knee arthritis compared the effects of each of non-elastic taping and elastic taping. Studies examining the effects of applying each taping after magnetic field therapy are scarce. This study attempts to examine not only the overlap effects of a magnetic field according to the joint fixing non-elastic taping and the proprioceptor stimulation elastic taping but also the effects of each taping application method on pain and function of patients with knee osteoarthritis.

## SUBJECTS AND METHODS

Thirty patients who visited the hospital after being diagnosed with knee arthritis by a specialist in the rehabilitation department were divided into three groups using the random allocation method: 10 in the control group, 10 in the experimental group 1, and 10 in the experimental group 2. The control group received 15 min general physiotherapy using a hot pack and a 20 min Interferential Current Therapy on the medial side of the knee. For the experimental group 1, non-elastic taping was applied to the medial side of the knee after general physiotherapy, followed by a 15 min magnetic field therapy. For the experimental group 2, elastic taping was applied to the medial side of the knee after general physiotherapy, followed by a 15 min magnetic field therapy. Intervention was implemented three times a week for six weeks for 18 sessions in total.

The inclusion criteria in this study were as follows: patients who can follow the intervention method according to the researcher's instruction, patients who feel pain around the knee joint, patients who are capable of walking without an assistive device, patients without neurological damage, and patients whose Kellgren-Lawrence grade of the knee joint is greater than level two on the radiograph. The exclusion criteria were as follows: patients older than 80, those who received total knee arthroplasty or joint endoscope in the past one year, those who performed knee joint strengthening exercise before the implementation of the intervention, those who had damage or surgery in the lower limb or lower back in the past one year, those who were diagnosed with rheumatic arthritis, those who had mental disease or were taking psychotropic medicine, and those who had skin allergic reaction to taping. We sufficiently explained the purpose and method of this study to all the research subjects before the experiment. The experiment was implemented after receiving the voluntary consent of the patients. The participants were provided a written informed consent form in accordance with the ethical standards of the Declaration of Helsinki.

This study used VAS to evaluate pain. We scored pain so that it ranges between the maximum value of 100 and the minimum value of 0 by using VAS, through which the participants in the experiment directly marked their subjective level of pain. As for the measurement method, the subjects marked the level of pain that they felt at that time on a straight line and divided the number by 100 to obtain the pain score. Pain evaluation was conducted before the magnetic field application and after the six-week magnetic field application.

This study used WOMAC to evaluate the knee function. WOMAC is a questionnaire that measures extraordinary diseases, self-control, and physical conditions. It is a clinically important tool for functional evaluation used for assessing pain, ankylosis, and physical function of patients with hip arthritis and knee osteoarthritis.

In this study, non-elastic taping was applied while the subjects were slightly bending their knee joint. We used the taping application method devised by McConnell. A horizontal tape on top was attached from the lateral patella toward the medial semitendinosus in the back by stretching the tape. A V-shaped tape on the bottom was applied from the tibial tuberosity to the gap between the lateral and medial knee joints. Before applying the non-elastic taping, we attached protection tape to the knee joint in the same way as the non-elastic tape to prevent the subjects from contracting skin allergy. The non-elastic tape was detached right after the magnetic field application.

In this study, a 5 cm-width Kinesio tape was used as the elastic tape, one side of which was divided into two from the tibial tuberosity point below the knee joint. The uncut side was attached to the inferior anterior iliac spine, and the other side was slightly attached above the patella for temporary use. Then, the subjects performed hip joint extension and maximum knee joint flexion. The side that was divided into two was attached to the tibial tuberosity along the boundary of the patella. The tape was stretched for 25% tension. The elastic tape was considered properly attached when the patella was embraced by the two divided tapes in a straight knee position. I-shape taping was applied to the patella by stretching for 75% tension.

Magnetic field therapy was applied to the medial side of the knee. Magnetic field was applied at a 5–10 Hz frequency at an intensity of 80 for 30 min while the subjects were lying on one side with a 90° flexion of the hip joint and 90° flexion of the knee joint.

For the data treatment, this study used the Shapiro-Wilk test for the normality test and the paired-t test for the within-group significance of pain and function. One-way ANOVA was implemented to examine the between-group difference of therapy effects, and Least Significant Difference (LSD) was used as the post-hoc test. The PASW/WIN 18.0 program was used for

**Table 1.** Comparison of VAS between groups

	Control (n=10)	Experimental group 1 (n=10)	Experimental group 2 (n=10)
Pre-test	7.15 ± 1.98	7.27 ± 1.76	6.86 ± 1.57
Post-test <sup>#</sup>	5.534 ± 0.96*	4.16 ± 0.87*	3.94 ± 0.83*

p<0.05, \*within group, <sup>#</sup>between group

**Table 2.** Comparison of WOMAC between groups

	Control (n=10)	Experimental group 1 (n=10)	Experimental group 2 (n=10)
Pre-test	69.85 ± 10.84	73.56 ± 12.51	74.15 ± 11.37
Post-test <sup>#</sup>	52.28 ± 9.56*	36.15 ± 10.62*	34.57 ± 9.36*

p<0.05, \*within group, <sup>#</sup>between group

statistical treatment, and the statistically significant level was set to  $\alpha < 0.05$ .

## RESULTS

All groups showed a statistically significant within-group change in VAS ( $p < 0.05$ ). A significant between-group difference ( $p < 0.05$ ) was found. In the post-hoc test through LSD, experimental group 1 and experimental group 2 showed a significant difference from the control group ( $p < 0.05$ ). However, no significant difference was observed between experimental group 1 and experimental group 2 ( $p > 0.05$ ) (Table 1). All groups showed a statistically significant within-group change in WOMAC ( $p < 0.05$ ). A significant between-group difference ( $p < 0.05$ ) was found. In the post-hoc test through LSD, experimental group 1 and experimental group 2 showed a significant difference from the control group ( $p < 0.05$ ). However, no significant difference was observed between experimental group 1 and experimental group 2 ( $p > 0.05$ ) (Table 2).

## DISCUSSION

Knee osteoarthritis is a chronic disease that progresses in the long term, and its representative symptoms are pain and functional disorder. Therefore, knee osteoarthritis therapy should stress on reducing pain and improving function rather than on the process of arthritis progress. How pain and functional disorder is caused by knee osteoarthritis is a complicated process<sup>8</sup>). The pain mechanism due to knee osteoarthritis has been theoretically suggested by some researchers from the biomechanical aspect. Osteoarthritis usually develops in the joint that mainly receives a weight load, and the knee and hip joints have the highest frequency of occurrence<sup>9</sup>).

Osteoarthritis causes pain and decreases muscle strength, range of motion of joint, joint stability, and physical function. It diminishes physical function in daily activities and quality of life. Moreover, patients with knee osteoarthritis develop painful walking with decreased duration of the mid-stance phase. Therefore, balance of the body trunk collapses during walking, thus causing secondary damage. As time passes, abnormal walking puts excessive stress on the knee. If this accumulates over a long period, arthritis symptoms in the knee can worsen<sup>10</sup>).

Pulsatory magnetic field is a safe and non-invasive method that can be applied for joint therapy. This method is segregated into two frequency bands: the wireless frequency band, which acts in the MHz domain that uses a capacitive or inductive combination of energy, and the low-frequency magnetic field, which acts in the range of 1 Hz–10 kHz<sup>11</sup>). The capacitive combination requires the allocation of a counter electrode that directly touches the skin surface surrounding the relevant tissue. Conversely, the electrode does not directly touch the skin in the case of inductive combination. The application of a magnetic field increases the ion penetrability of the protein channel and causes the initiation of the secondary transfer factor, which induces biological effects. Therefore, magnetic field therapy accelerates cartilage protection, anti-inflammatory effects, and bone reformation in degenerative connective tissue diseases<sup>12</sup>).

The mechanism that takes place in the body when elastic taping is applied is summarized as follows. First, muscle hypertension decreases, muscle strength increases, and pain decreases by stimulating the muscle spindles and the golgi tendon organ. Second, weak and delicate physiological contraction can be induced by the gamma motor reaction due to taping on skin, following the fusimotor reflex. In a previous study, taping on skin increased muscle activity and increased joint stability, thus protecting the joint by reducing pressure on it. Third, taping on skin right on the muscle restricts muscle hypertension by stimulating the agonist muscles and decreases local pain through neurological and dynamic stimulation<sup>13</sup>).

This study examined the effects of magnetic field therapy after taping therapy on pain and function of patients with knee osteoarthritis according to the type of taping. According to the study results, groups that applied non-elastic or elastic taping showed a statistically significant difference in pain reduction and functional improvement compared with the group that applied general physiotherapy. However, no difference in therapy effects was observed according to taping type. Choosing the applicable taping method according to the condition of the patients and applying it to therapy is necessary to reduce pain

and improve the function of the patients with knee osteoarthritis.

This study has several limitations. First, the number of subjects was small and the application duration of the therapy was short, thus generalizing the results of our study is difficult. Second, we did not examine the continued effects of the therapy. As we focused only on the effects on knee osteoarthritis, we also did not explore arthritis in other parts or other muscular diseases. We expect future studies to investigate the effects of applying taping on diverse parts of a larger number of research subjects and the overlap effects of magnetic field over a long period.

## REFERENCES

- 1) McAlindon TE, Bannuru RR, Sullivan MC, et al.: OARSI guidelines for the non-surgical management of knee osteoarthritis. *Osteoarthritis Cartilage*, 2014, 22: 363–388. [[Medline](#)] [[CrossRef](#)]
- 2) Lee AS, Ellman MB, Yan D, et al.: A current review of molecular mechanisms regarding osteoarthritis and pain. *Gene*, 2013, 527: 440–447. [[Medline](#)] [[CrossRef](#)]
- 3) Erhart-Hledik JC, Favre J, Andriacchi TP: New insight in the relationship between regional patterns of knee cartilage thickness, osteoarthritis disease severity, and gait mechanics. *J Biomech*, 2015, 48: 3868–3875. [[Medline](#)] [[CrossRef](#)]
- 4) Iannitti T, Fistetto G, Esposito A, et al.: Pulsed electromagnetic field therapy for management of osteoarthritis-related pain, stiffness and physical function: clinical experience in the elderly. *Clin Interv Aging*, 2013, 8: 1289–1293. [[Medline](#)] [[CrossRef](#)]
- 5) Nam CW, Lee JH, Cho SH: The effect of non-elastic taping on balance and gait function in patients with stroke. *J Phys Ther Sci*, 2015, 27: 2857–2860. [[Medline](#)] [[CrossRef](#)]
- 6) Oliveira AK, Borges DT, Lins CA, et al.: Immediate effects of Kinesio Taping® on neuromuscular performance of quadriceps and balance in individuals submitted to anterior cruciate ligament reconstruction: a randomized clinical trial. *J Sci Med Sport*, 2016, 19: 2–6. [[Medline](#)] [[CrossRef](#)]
- 7) Freedman SR, Brody LT, Rosenthal M, et al.: Short-term effects of patellar kinesio taping on pain and hop function in patients with patellofemoral pain syndrome. *Sports Health*, 2014, 6: 294–300. [[Medline](#)] [[CrossRef](#)]
- 8) Wideman TH, Finan PH, Edwards RR, et al.: Increased sensitivity to physical activity among individuals with knee osteoarthritis: relation to pain outcomes, psychological factors, and responses to quantitative sensory testing. *Pain*, 2014, 155: 703–711. [[Medline](#)] [[CrossRef](#)]
- 9) Arendt-Nielsen L, Egsgaard LL, Petersen KK, et al.: A mechanism-based pain sensitivity index to characterize knee osteoarthritis patients with different disease stages and pain levels. *Eur J Pain*, 2015, 19: 1406–1417. [[Medline](#)] [[CrossRef](#)]
- 10) Patterson MR, Delahunt E, Caulfield B: Peak knee adduction moment during gait in anterior cruciate ligament reconstructed females. *Clin Biomech (Bristol, Avon)*, 2014, 29: 138–142. [[Medline](#)] [[CrossRef](#)]
- 11) Gajewski M, Rzodkiewicz P, Maśliński S, et al.: The role of physiological elements in future therapies of rheumatoid arthritis. III. The role of the electromagnetic field in regulation of redox potential and life cycle of inflammatory cells. *Reumatologia*, 2015, 53: 219–224. [[Medline](#)] [[CrossRef](#)]
- 12) Lefaucheur JP, André-Obadia N, Antal A, et al.: Evidence-based guidelines on the therapeutic use of repetitive transcranial magnetic stimulation (rTMS). *Clin Neurophysiol*, 2014, 125: 2150–2206. [[Medline](#)] [[CrossRef](#)]
- 13) Cha HG, Kim MK, Shin YJ: Immediate effects of forearm elastic and nonelastic taping on wrist flexor muscle and grip strength of normal adults. *J Phys Ther Sci*, 2016, 28: 2769–2771. [[Medline](#)] [[CrossRef](#)]