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Original Article

The effects of extracorporeal shock wave therapy on the pain and function of patients with degenerative knee arthritis

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Abstract. [Purpose] The purpose of this study was to identify the effects of extracorporeal shock wave therapy on the pain and function of patients with degenerative knee arthritis. [Subjects and Methods] Twenty patients with degenerative knee arthritis were divided into a conservative physical therapy group (n=10) and an extracorporeal shock wave therapy group (n=10). Both groups received general conservative physical therapy, and the extracorporeal shock wave therapy was additionally treated with extracorporeal shock wave therapy after receiving conservative physical therapy. Both groups were treated three times a week over a four-week period. The visual analogue scale was used to evaluate pain in the knee joints of the subjects, and the Korean Western Ontario and McMaster Universities Osteoarthritis Index was used to evaluate the function of the subjects. [Results] The comparison of the visual analogue scale and Korean Western Ontario and McMaster Universities Osteoarthritis Index scores within each group before and after the treatment showed statistically significant declines in scores in both the conservative physical therapy group and extracorporeal shock wave therapy group. A group comparison after the treatment showed statistically significant differences in these scores in the extracorporeal shock wave therapy group and the conservative physical therapy group. [Conclusion] extracorporeal shock wave therapy may be a useful nonsurgical intervention for reducing the pain of patients with degenerative knee arthritis and improving these patients' function.
Key words: Extracorporeal shock wave therapy, Pain, Degenerative knee arthritis

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INTRODUCTION

In recent years, improvements in the social and economic environment have led to increases in the average life expectancy, and the resulting increases in the elderly population have resulted in an aging society[1)]. While most elderly people are suffering from one or more chronic disease, such as diabetes, high blood pressure, and arthritis, chronic degenerative arthritis is a disease with a high incidence compared to other musculoskeletal diseases. Around 80% of individuals aged 55 or older develop this disease[2)], and it affects women more frequently than men[2)]. In addition, the disease frequently intrudes into the knee joints, which bear a lot of weight[2)]. Degenerative arthritis is characterized by pain and functional disorders, and it limits movements commonly used in daily life, such as standing up from a chair, standing comfortably, walking, and descending stairs[3)].

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Treatments for degenerative arthritis include medication, exercise therapy, physical therapy, and surgery. Among the treatments that focus on reducing pain and improving function, extracorporeal shock wave therapy (ESWT) has recently drawn great attention[4]. ESWT has been performed in Germany as a treatment for musculoskeletal diseases in various fields since the early 1990s after it was used to decompose kidney and bile duct stones in 1976[5]. The therapeutic principles of ESWT are based on the micro-trauma theory and the cognitive decline theory. The former holds that healing lesion tissues is facilitated by repeatedly stimulating lesion areas with ESWT, thereby creating temporary micro-traumas around lesion areas that induce the creation of new blood vessels, which increases blood supply. Extracorporeal shock waves can spread into tissues around painful regions, thereby increasing mitochondrial oxidation and the photochemistry effect that facilitates adenosine triphosphate (ATP) production, resulting in expansion of blood vessels and lymphatic vessels. This will reduce pain due to the rapid removal of exudate and re-absorption of the unnecessary liquids that are accumulated in the human body by facilitating blood circulation and increases in metabolism[6].

ESWT improves their function by stimulating or reactivating the healing process of connective tissues, including tendons and bones[7]. Since Heller & Niethard[8] first presented a study on ESWT on lateral epicondylitis, Rompe et al.[9] reported success rates that varied from 58 to 85%. Thus, ESWT has been suggested as a safe and effective method for treating patients with lateral epicondylitis. Only a limited number of studies have attempted to examine its effects on degenerative arthritis. Therefore, the purpose of this study was to identify the effects of ESWT on the pain and function of patients with degenerative knee arthritis.

SUBJECTS AND METHODS

The subjects were 20 patients aged 55–70 who had been diagnosed with degenerative knee arthritis based on clinical findings and the Kellgren & Lawrence Grade 2 level results of examinations using medical equipment, such as X-ray machines, among outpatients who had visited S Orthopedic Hospital in Daegu.

The exclusion criteria were those with cardiovascular or neurological diseases, those with other diseases that disturb activities, those with rheumatic diseases, and those who had received knee surgery. The subjects in the ESWT group (ESWTG, n=10) were 64.2 ± 4.1 years old, 157.2 ± 7.4 cm in height, and weighed 57.2 ± 11.3 kg, and the subjects in the conservative physical therapy group (CPTG, n=10) were 67.2 ± 5.9 years old, 158.4 ± 8.0 cm in height, and weighed 62.7 ± 7.3 kg. Ethical approval for the study was granted by U1 University's institutional review board. All subjects read and signed consent forms in accordance with the ethical standards of the Declaration of Helsinki.

Both groups received general conservative physical therapy consisting of the application of a heat pack (20 min), interference current therapy (15 min), and ultrasound (5 min). The ESWTG was also treated using a magnetic-based ESWT device (HNT MED, Korea) after receiving conservative physical therapy. Shock waves with a frequency of 4 Hz were applied to the medial and lateral condyles 1,000 times using a focus-type head. The shock wave probe was held stationary on a trigger point around the knee or at the patellofemoral and tibiofemoral borders of the target knee, while avoiding direct placement on the peroneal nerve or vessel[10]. The target region for the therapy was determined using a physical examination so that the intensity of energy would be controlled according to the level of pain that the patients could bear so that the energy of the shock waves would be precisely delivered to the target region.

The visual analogue scale (VAS) was used to evaluate pain in the knee joints of the subjects, and the Korean Western Ontario and McMaster Universities Osteoarthritis Index (K-WOMAC) was used to evaluate the function of the knee joints. For both groups, the VAS and K-WOMAC scores were measured using the same method both before and after four weeks of the experiment. In terms of statistical analysis, a paired t-test was performed to examine the changes within each group, and an independent t-test was performed to compare the variables between the two groups. SPSS/PC Ver. 13.0 was used for statistical processing, and the statistical significance level was set at α=0.05.

RESULTS

The comparison of the VAS and K-WOMAC scores within each group before and after the treatment showed statistically significant declines in both groups following treatment. The group comparison after the treatment showed significant differences in the ESWTG and the CPTG ($p<0.05$) (Table 1).

DISCUSSION

ESWT is widely applied to patients with various musculoskeletal diseases[11], and Lee and Han[12] reported that it is an effective treatment for reducing patients' pain and improving their function. Wang et al.[13] reported extracorporeal shock waves were effective in preventing and treating knee arthritis in rats with knee arthritis. Chen et al.[14] conducted a comparative study in which ESWT and ultrasound therapy were applied to patients with knee arthritis for eight weeks, and they reported that the group in which ESWT was applied showed reduction in pain, Lequesne index scores and increasing in the range of motion. The present study also showed statistically significant declines in the VAS and K-WOMAC scores of the ESWTG. This result may be because shock waves are a sort of sound waves that can be transmitted through soft tissues without loss of energy,

Table 1. Comparison of the VAS and K-WOMAC scores between the two groups

	Group	Pre	Post
VAS (point)	CPTG**	6.8 ± 2.0	5.5 ± 1.72
	ESWTG**	7.9 ± 1.5	2.9 ± 0.7††
K-WOMAC (point)	CPTG**	30.9 ± 11.8	25.4 ± 9.1
	ESWTG**	37.4 ± 8.5	9.3 ± 3.0††

VAS: visual analog scale; K-WOMAC: Korean Western Ontario and McMaster Universities Osteoarthritis Index; CPTG: conservative physical therapy group; ESWTG: extracorporeal shock wave therapy group, *paired t-test, †independent sample t-tests, **, ††$p<0.01$

and their fine and repetitive stimulations are effective for reducing pain[15]. In addition, stimulations caused by shock waves form new muscular fibers by facilitating the secretion of substances that generate blood vessels around an affected region. These new muscular fibers increase blood flow around a lesion and induce the reformation of blood vessels, which eventually stimulates and reactivates the healing process of the tendons and the tissues around them, thereby stabilizing the tissues[16]. The secretion of substances induces lymphangiogenesis through upregulation of expression of vascular endothelial growth factor and basic fibroblast growth factor[17].

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