

Effects of Extracorporeal Shockwave Therapy on Patients with Chronic Low Back Pain and Their Dynamic Balance Ability

SANGYONG LEE, PhD, PT¹⁾, DAEHEE LEE, PhD, PT¹⁾, JUNGSEO PARK, PhD, PT¹⁾*

¹⁾ Department of Physical Therapy, Youngdong University: 12 Youngdong-eup, Youngdong-gun, Chungbuk 370-701, Republic of Korea

Abstract. [Purpose] The purpose of the present study was to examine the effects of extracorporeal shockwave therapy (ESWT) for patients with chronic low back pain and their dynamic balance ability. [Subjects] Twenty-eight patients with chronic low back were divided into an extracorporeal shockwave therapy group (ESWTG: n=13) and a conservative physical therapy group (CPTG, n=15). [Methods] An exercise program that included Williams' exercises and McKenzie's exercises was performed by both groups. The program was implemented twice a week for six weeks. The visual analog scale (VAS) was used to measure the chronic low back pain of the patients. Their dynamic balance ability was measured with BioRescue. [Results] The within-group comparison of the VAS of the ESWTG and the CPTG showed significant improvements after the intervention. In the VAS comparison between the groups after the treatment, the ESWTG showed a significantly larger improvement. In the within-group comparison of dynamic balance ability, the ESWTG showed significant improvements after the intervention in SAPLS, SAPRS, SAPFS, SAPBS, and TSA, and the CPTG showed significant improvements in SAPLS and SAPBS. In the between-group comparison of the dynamic balance ability after the treatment, the ESWTG showed significantly larger improvements in their SAPLS, SAPRS, SAPFS, and TSA. [Conclusion] The exercise program combined with the ESWT relieved chronic back pain more than the exercise program combined with the CPT. The former was also more effective at improving the patients' dynamic balance ability in terms of SAPLS, SAPRS, SAPFS, and TSA.

Key words: Extracorporeal shock wave therapy, Balance ability, Conservative physical therapy

(This article was submitted May 29, 2013, and was accepted Jul. 22, 2013)

INTRODUCTION

Low back pain is the second most common ailment suffered by adults, surpassed only by the common cold. It is recognized not only as a health problem, but also as a social problem, because it is the most frequent cause of absenteeism among office workers. In modern industrial society, the number of low back pain patients has been gradually increasing due to sedentary lifestyles with little exercise.

Simple low back pain can be prevented by habitually adopting a proper posture while sitting, and avoiding sitting in one position for a long time. Chronic low back pain has many causes, which are treated with diverse methods, such as bed rest, lumbar support devices, traction, thermotherapy, electrical stimulation, and manipulation in most cases¹⁾. In addition, invasive treatment methods, such as selective nerve root block and epidural injection, may be used. Surgery may be performed if there is no response to these treatment methods or if the disease is deemed seri-

ous²⁾. New conservative treatment methods, including extracorporeal shockwave therapy (ESWT), have recently been implemented³⁾.

In ESWT, extracorporeal shockwaves are applied to lesions to help revascularization and stimulate or reactivate the process of connective tissue and bone healing, thereby relieving pain and improving functions⁴⁾. ESWT can be used for pain relief as well as improving muscle strength through appropriate motor simulation of the muscles and tendons with extracorporeal shockwaves⁵⁾. Although ESWT is currently used to treat diseases of the musculoskeletal system, few studies have examined the effect of ESWT on chronic low back pain, or pain and balance ability following treatment. Therefore, the present study investigated the effects of ESWT on patients with chronic low back pain and their dynamic balance ability following treatment.

SUBJECTS AND METHODS

The present study was conducted with 28 patients (9 males, 19 females) who visited K neurosurgical hospital located in Daegu, Korea. They were classified by neurosurgeons as having chronic low back pain because their low back pain persisted for 12 weeks or longer. The study subjects were divided into an ESWT group (ESWTG, n=13) (mean±SD age 53.92±10.38 years, height 163.15±10.61 cm,

*Corresponding author. Jungseo Park (e-mail: emotion526@nate.com)

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weight 64.54±11.98 kg) and a conservative physical therapy group (CPTG, n=15) (mean±SD age 54.33±13.16 years, height 160.27±7.41 cm, weight 60.20±6.92 kg). All the subjects read and signed consent forms in accordance with the ethical standards of the Declaration of Helsinki. Additional criteria for inclusion in the study were never having undergone surgery for the relief of low back pain, having no mental or cognitive problem that would have affected the study, and having been advised by their attending neurosurgeon that lumbar exercises were not prohibited.

A JEST-2000 (Joeun Medical, Daejeon, Korea) was used to administer the treatment for the ESWTG. with the patients in a prone position, 2,000 (7 times per sec) shockwave impulses (5 Hz) at an energy flux density of 0.10 mJ/mm² were delivered using a 17-mm head. After determining the regions of low back pain through physical examinations, a surgical lubricant was applied to the contact surface, and the shockwave energy was delivered. The chief complaint of the patients with chronic low back pain was pain in the buttock and lumbosacral region of the spine. Therefore, the treated regions were mainly the quadratus lumborum muscle, the gluteus maximus muscle, the gluteus medius muscle, the gluteus minimus muscle, and the piriform muscle. The CPTG received thermotherapy using hot packs, and ultrasound and electrotherapy using TENS. Both the ESWTG and the CPTG received treatment twice a per week for six weeks, and both groups took part in an exercise program comprised of Williams' exercises and McKenzie's exercise.

The exercise program was designed to strengthen the lumbar muscles. It was implemented in 30 minute sessions, twice a week, for six weeks. The Williams' exercise is composed of a posterior pelvic tilt (10 sec/1 set, 3 sets), followed by sit-ups (10 times/1 set, 3 sets), and a knee to chest exercise (10 sec/1 set, 3 sets). McKenzie's exercise involves bending the trunk back while supporting the trunk with both elbows in a prone position (trunk extension) (20 sec/1 set, 3 sets), followed by bending the trunk back while supporting the trunk with both hands with the elbow extended in a prone position (10 sec/1 set, 3 sets), and then bending the trunk back in a standing position (10 sec/1 set, 3 sets).

The visual analogue scale (VAS) was used to evaluate the levels of the patients' pain. To examine the subjects' dynamic balance ability, their surface area per left side (SAPLS), surface area per right side (SAPRS), surface area per forward side (SAPFS), surface area per back side (SAPBS), and total surface area (TSA) were measured using the BioRescue (RM Ingénierie, France) system. BioRescue has a baropodometric platform equipped with 1,600 pressure sensors, which can be used to evaluate weight bearing, body movements, and balance between the left and the right lower limbs using pressure sensors under the feet. The subjects adopted an upright standing position on the platform, with the feet making an angle of approximately 30° at the heels, by placing the toes further apart than the heels. The subjects moved their weight in four directions prompted by a monitor placed in front of them: forward, backward, leftward, and rightward. APLS, SAPRS, SAPFS, SAPBS, and TSA do not measure the shift in weight by moving the trunk. Rather, they measure the maximum limits of the shifts in

weight at the ankles, while maintaining stability and without losing balance. The maximum limits were analyzed by measuring the areas of sway during the weight shifts from the center point to the farthest point from the center point. The shifts were measured three times in total, and the average values of the measured values obtained through the repeated measurements were used.

In the present study, to examine differences in the pain scales and the dynamic balance ability, the paired sample t-test was conducted for comparisons within the groups, and the independent sample t-test was conducted for comparisons between the groups. The data were statistically processed using SPSS 12.0 for Windows with a significance level, α , of 0.05.

RESULTS

In the VAS comparisons within the groups of chronic low back patients, the ESWTG and the CPTG showed significant improvements after the intervention. In the VAS comparison between the groups after the treatment, the ESWTG showed a significantly larger improvement ($p<0.05$). In the dynamic balance ability comparisons within the groups, the ESWTG showed significant improvement after intervention in SAPLS, SAPRS, SAPFS, SAPBS, and TSA, and the CPTG showed significant improvements in SAPLS and SAPBS ($p<0.05$). In the dynamic balance ability comparison between the groups after the treatment, the ESWTG showed significantly larger improvements in SAPLS, SAPRS, SAPFS, and TSA ($p<0.05$) (Table 1).

DISCUSSION

The present study was conducted to examine the effects of ESWTG applied to chronic low back pain patients on their pain and dynamic postural balance.

Loew et al.⁶⁾ reported that when 20 calcific tendinitis patients were treated with shockwave therapy and followed up three months later, 75% of the patients showed pain relief and improvements on the Constant and Murley scale (CMS). Rompe et al.⁷⁾ reported that when shoulder joint calcific tendinitis patients were treated with sporadic shockwave therapy, 60% of the patients recovered normal functioning, and 72% of the patients showed only intermittent discomfort based on their CMS. Cho et al.⁸⁾ reported that when elbow joint lateral epicondylitis patients were treated with ESWT, their pain was significantly relieved, and their muscle strength significantly increased. Na²⁾ reported that pain was significantly relieved in patients with chronic low back pain who were treated with ESWT. Lee⁴⁾ reported that when ESWT was applied to patients with elbow joint lateral epicondylitis, their pain was relieved, their simple elbow test scores significantly improved, and 83% of patients showed satisfactory results. Lee suggested that ESWT may present a new effective and noninvasive conservative treatment method for elbow joint lateral epicondylitis that fails to respond to conservative treatment. According to the results of the present study, both the ESWTG and the CPTG showed significant decreases in the VAS in the within-group comparisons after the treatment,

Table 1. Comparison of the PS and DBA between each group

		Group	Pre	Post
PS (point)	VAS	ESWTG**	7.2±0.8	4.5±1.1 [†]
		CPTG**	7.6±0.5	5.5±0.5
DBA (mm ²)	SAPLS	ESWTG**	1,770.2±804.2	4,072.3±1,917.8 [†]
		CPTG*	2,036.1±1,198.4	2,636.1±1,071.5
	SAPRS	ESWTG**	2,098.7±908.7	3,652.5±1,626.4 [†]
		CPTG	2,235.7±1,422.9	2,498.1±1,025.7
	SAPFS	ESWTG**	2,094.1±1,012.8	4,429.6±2,491.6 [†]
		CPTG	2,439.8±1,934.6	2,610.4±1,229.7
	SAPBS	ESWTG**	1,851.8±910.5	3,295.2±1,322.9
		CPTG*	1,858.7±1,013.9	2,523.9±931.6
	TSA	ESWTG**	4,153.6±1,499.1	7,724.7±3,490.7 [†]
		CPTG	4,298.7±2,660.6	5,134.3±2,033.8

PS: pain scale, DBA: dynamic balance ability, VAS: visual analog scale, SAPLS: surface area per left side, SAPRS: surface area per right side, SAPFS: surface area per forward side, SAPBS: surface area per back side, TSA: total surface area, ESWTG: extracorporeal shockwave therapy group, CPTG: conservative physical therapy group, *: paired t-test, [†]: independent sample t-test, *: p<0.05, **: p<0.01

and the ESWTG showed a significantly larger decrease in the VAS than the CPTG. These results are consistent with the results of the study conducted by Rompe et al.⁷⁾, which indicated that gentle and repetitive stimuli given through shockwave therapy were effective at relieving pain. Also a report by Hammer et al.⁹⁾ indicated that ESWTG cured inflammation in the tendons and ligaments when applied to lesions. ESWT is thought to work by breaking calculi and gallstones, inducing increases in the blood flow rate and revascularization, thereby stimulating and reactivating the process of healing of the tendons, surrounding tissues, and bones. We consider the present study showed decreases in the VAS as a result of the same processes.

In the present study, to examine the relationship between pain relief and postural balance, changes in the patient's balance ability were measured using a Biorescue. Lee¹⁰⁾ reported that the sway distance and the rate of movement in standing positions was significantly decreased in patients with low back pain compared to healthy subjects, and that the proprioceptive sense inputs in the low back pain patients were altered due to pain; thus, somesthesia was damaged, and their motile responses were changed. Yun¹¹⁾ noted that athletes with pain in their arms adopted an asymmetric body posture and that this led to pain throughout their bodies and affected their balance ability. In addition, Poole et al.¹²⁾ reported that when the postural balance ability of 20 elderly subjects with cervical pain was compared with that of 20 elderly subjects without pain, those with cervical pain showed significantly poorer balance ability, indicating that the cervical pain significantly affected their balance. According to the results of the comparisons of the dynamic balance ability within the groups in the present study, the ESWTG showed significant improvements after intervention in SAPLS, SAPRS, SAPFS, SAPBS, and TSA, and the CPTG showed significant improvements in SAPLS and SAPB. In the comparison of the dynamic balance ability between the groups after the treatment, the ESWTG showed significantly larger improvements in SAPLS, SAPRS,

SAPFS, and TSA. Gill and Callaghan¹³⁾ argued that pain displaces the normal signals coming from muscles and sensory organs, thereby hindering balance ability. Magnusson et al.¹⁴⁾ argued that if active ranges of joint motion are limited due to chronic pain, then the actual ranges of joint motion also decrease. In the present study, ESWT likely reduced the low back pain, reducing its interference with the signals coming from the muscles and the sensory organs, thereby improving the active ranges of joint motion. As a result, the ranges of joint motion were improved, and the weight shift distances increased.

The limitations of the present study were as follows. First, the number of subjects with chronic low back was limited, meaning the results cannot be generalized. Second, the lumbar lesion regions were limited. Third, the subjects' daily living activities could not be completely controlled. Fourth, objective evaluations of blood tests for parameters such as lactic acid, prostaglandin E, substance P, and kinin were not undertaken, and finally the results of the evaluation of the patients' dynamic balance ability could not be compared with previous studies because data from previous studies were not available. In later studies, the blood test results of patients with chronic low back and their muscle strength following ESWT should be examined.

REFERENCES

- 1) Jung EH: The effects of traditional physical therapy on pain reduction and depression level of patients with chronic low back pain. Dankook University, Dissertation of master's degree, 2000.
- 2) Na JY: The effectiveness of Extracorporeal shock wave therapy on chronic low back pain. Chosun University, Dissertation of master's degree, 2011.
- 3) Kudo P, Dainty K, Clarfield M, et al.: Randomized, placebo-controlled, double-blind clinical trial evaluating the treatment of plantar fasciitis with an extracorporeal shockwave therapy (ESWT) device: a North American confirmatory study. *J Orthop Res*, 2006, 24: 115–123. [Medline] [Cross-Ref]
- 4) Lee SB, Kwon DJ, Song YJ et al.: Shockwave Therapy for Tennis Elbow. *The Journal of the Korea Orthopaedic Association*, 2004, 39: 142–145.
- 5) Svernlöv B, Adolfsson L: Non-operative treatment regime including eccentric training for lateral humeral epicondylalgia. *Scand J Med Sci*

- Sports, 2001, 11: 328–334. [[Medline](#)] [[CrossRef](#)]
- 6) Loew M, Daecke W, Kusnierczak D, et al.: Shock-wave therapy is effective for chronic calcifying tendinitis of the shoulder. *J Bone Joint Surg Br*, 1999, 81: 863–867. [[Medline](#)] [[CrossRef](#)]
 - 7) Rompe JD, Hopf C, Kullmer K, et al.: Analgesic effect of extracorporeal shock wave therapy on chronic tennis elbow. *J Bone and Joint Surg*, 1996, 78: 223–227.
 - 8) Cho NJ, Park JS, Cho WS: Effect of Wrist Extensor Strength and Pain on Extracorporeal Shock Wave Therapy of the Lateral epicondylitis. *Journal of the Korean Academy of Clinical Electrophysiology*, 2008, 6: 57–68.
 - 9) Hammer DS, Rupp S, Ensslin S, et al.: Extracorporeal shock wave therapy in patients with tennis elbow and painful heel. *Arch Orthop Trauma Surg*, 2000, 120: 304–307. [[Medline](#)] [[CrossRef](#)]
 - 10) Lee HS: Study of standing balance control between normal subjects and subjects with low back pain. Daegu University, Dissertation of doctor's degree, 2001.
 - 11) Yun MJ: Effects of 8 weeks pilates for the body balance, posture and pain lateral and bilateral athletes comparative analysis. Keimyung University, Dissertation of master's degree. 2011.
 - 12) Poole E, Treleaven J, Jull G: The influence of neck pain on balance and gait parameters in community-dwelling elders. *Man Ther*, 2008, 13: 317–324. [[Medline](#)] [[CrossRef](#)]
 - 13) Gill KP, Callaghan M: The measurement of lumbar proprioception in individuals with and without low back pain. *Spine*, 1998, 23: 371–377. [[Medline](#)] [[CrossRef](#)]
 - 14) Magnusson ML, Bishop JB, Hasselquist L, et al.: Range of motion patterns in patients with low back pain before and after rehabilitation. *Spine*, 1998, 23: 2631–2639. [[Medline](#)] [[CrossRef](#)]