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Effect of Korean Medicine Combined with Electric Moxibustion in Patients with Traffic Accident-Induced Lumbago

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ABSTRACT

Background: The purpose of this study was to investigate electric moxibustion on patients with back pain caused by road traffic accidents.
Methods: This was a retrospective study (n = 112) comparing treatment with Korean medicine combined with electric moxibustion (n = 56), and Korean medicine alone (n = 56). Patient gender, age, Numeric Rating Scale (NRS), Oswestry Disability Index (ODI) and EuroQol-5 Dimension (EQ-5D) was recorded for each group at the time of hospital admission. Mean NRS measured weekly, mean ODI and EQ-5D scores were measured 2 weeks post-treatment, and evaluated by paired sample t test. using the Statistical Program for Social Science v. 25.0 for Windows. An independent, two-sample t test was used to test for a significant difference in the decrement of NRS, ODI and increment EQ-5D scores between groups.
Results: NRS scores decreased in both groups after 1 week of treatment (electric moxibustion, from 5.13 ± 0.79 to 3.86 ± 0.67; Korean medicine alone, from 5.18 ± 0.92 to 4.30 ± 0.94; both $p < 0.001$). There was a significantly greater reduction in NRS score in the electric moxibustion group (1.27 ± 0.59) than in the Korean medicine alone group (0.88 ± 0.61; $p = 0.001$). After 2 weeks of treatment, EQ-5D scores increased significantly in the moxibustion group (0.19 ± 0.12) compared with the Korean medicine alone group (0.13 ± 0.20; $p = 0.043$). After 2 weeks of treatment, NRS and ODI scores decreased in both groups. EQ-5D increased in both groups.
Conclusion: We suggest that electric moxibustion treatment may be effective for reducing early-stage back pain in patients with road traffic accident injuries.

Introduction

Road traffic accidents (RTAs) are defined as personal injury caused by traffic on the road, as stated in Article 2 of the Road Traffic Act. Since 2014, the number of deaths due to RTAs in Korea has decreased to less than 5,000, and the number of injured people has decreased to less than 350,000. However, the national economic loss caused by personal and material damage associated with RTAs, which still occurs frequently, remains a serious social problem [1].

According to the Ministry of Land, Transport, and Maritime Affairs, the number of domestic driving license holders reached 31,190,000 in 2017, with 21,803,000 cars registered. The total number of RTAs was 216,335, of which 4,185 people were killed and 322,829 were injured [2]. Although the number of RTAs is decreasing annually, this is still a large number. In recent years, the RTA trend in Korea shows that the proportion of injured is higher than the number of deaths, and the management of RTAs has become more important [3].

The most common RTA injury is back and neck pain, which accounts for more than half of traffic related injuries. This is presumably due to the collision pattern resulting in sudden overall tension of the cervical vertebrae occurring in the posterior collision, while the combined damage caused by the flexion and

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the pelvic correction of the seatbelt appears to cause lumbar pain [4].

According to Park et al [5], amongst patients treated with Korean medicine for RTAs, 49% complained of back pain, even after receiving treatment at other hospitals, whilst 53% of the patients chose Korean medicine treatment due to persistent pain. The popularity of Korean medicine treatment for RTAs is increasing. From a Korean medicine perspective, pain caused by RTAs is classified as Qi stagnation and blood stasis. This includes falls, blood stasis, bruise, bone fracture, and blood amassment, and it is treated with the concept of improving the circulation of the blood and eliminating blood stasis [6]. Moxibustion therapy stimulates the meridian in the human body, and controls the imbalance of the yin-yang and Qi-blood. It is used for the prevention and treatment of disease by communicating meridians [7]. Chae et al [8] reported that there was no significant difference in body surface temperature change between moxibustion and electric moxibustion treatment using DITI. In a study by Joe [9], moxibustion and electric moxibustion treatment were reported to have a similar treatment effect on lumbar stenosis.

To increase knowledge of the effectiveness of Korean medicine in the treatment of the after-effects of RTAs, the pharmacopuncture and electro-acupuncture treatment of back pain caused by RTAs has been studied by Kim et al [10] and Kim et al [11]. However, to the best of our knowledge, no study has investigated the application of electric moxibustion in the treatment of RTA injuries. Therefore, the present study investigated the effect of Korean medicine combined with electric moxibustion as a treatment approach for RTA-induced back pain. Patients who visited Haeundae Jaseng Hospital due to RTAs from June 1, 2016 to April 1, 2017 were screened for inclusion and exclusion criteria of the study. A retrospective chart review based on medical records was performed where patients treated with Korean medicine combined with electric moxibustion treatment were compared with those that received Korean medicine treatment alone.

Materials and Methods

Patients

Between June 1, 2016 and April 1, 2017, a total of 168 patients radiologically diagnosed with simple sprains due to RTAs were enrolled as patients who were hospitalized at the Haeundae Jaseng Hospital. Patients that fulfilled the inclusion criteria were followed-up (Fig. 1). Inclusion criteria comprised of back pain complaints without pre-existing physical disorder of the associated vertebra; agreement to the possibility of simple radiography, hospitalization for more than 2 weeks and continual treatment with acupuncture, herbal medicine, or herbal medicine treatment; ability to express personal opinion; and aged between 20 and 70 years. Exclusion criteria comprised of suspected neurological deficit due to neurological examination; history of lumbar surgery before RTA; lumbar disc herniation and spinal stenosis diagnosed by magnetic resonance imaging post-accident; diagnosis of certain serious diseases that may cause pain such as malignancies, vertebral fractures, spinal infections, inflammatory spondylitis, and mami-syndrome; and treatment at other hospitals during the period of hospitalization.

Study groups

The medical records of 112 patients who received inpatient treatment at Haeundae Jaseng Hospital were evaluated. The study groups comprised of 56 patients (Group A) who were treated with combined Korean medicine and electric moxibustion and 56 patients (Group B) who received Korean medicine treatment alone.

Treatment

All patients received 2 weeks of treatment. Group A was treated with electric moxibustion therapy, twice daily for 14 minutes in addition to the common Korean medicine treatment outlined below. Group B only received the common Korean medicine treatment. Patients received sufficient explanation of the treatment and proceeded after giving consent.

Electric moxibustion treatment

The electric moxibustion treatment device used in the treatment was e-Tteum (Hansangmedix, Goyang, Korea). its cylindrical in shape 103 mm diameter (D), 87 mm height (H) and weighs 265 g (Fig. 2). A built-in lithium-ion battery (DC 7.4V, 1100 mAh) powers the device to dissipate heat by using the lower ceramic heat sink. Moxibustion treatment is program controlled for temperature and duration of treatment within the device. The state of rising, holding, and falling is displayed in the form of a bar on the upper LCD panel display.

During the hospitalization period, patients received electric moxibustion treatment twice daily. This was applied at Gwanwon (CV4) and Sinsu (BL23) for 14 minutes each time. During a visit, 2 sessions of a 3-minute increase, a 3-minute hold, and a 1-minute

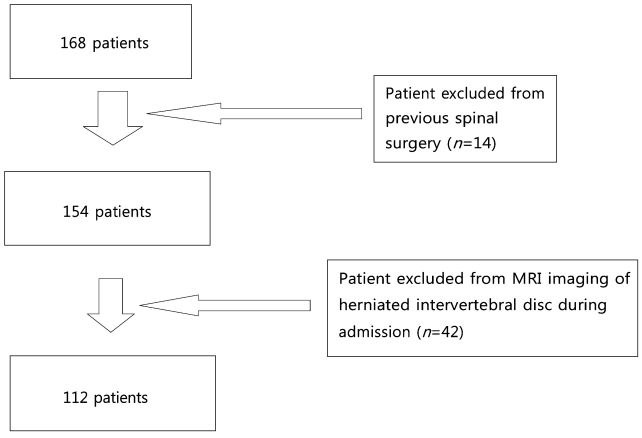

Fig. 1. Flowchart for patient enrollment in the study.

Fig. 2. Electric moxibustion used for treatment.

decrease were performed, and the maximum temperature was set at 47℃. The same procedure was performed for each patient by 2 Korean medical doctors who had more than 3 years of clinical experience.

Common treatment

Acupuncture

Each patient received acupuncture twice daily using disposable stainless-steel needles 0.20×30 mm and 0.25×30 mm (Dongbang,Inc.,Ltd., Boryeong, Korea) at Yoyanggwan (GV3), Myeongmun (GV4), Sinsu (BL23), Gihaesu (BL24), Daejangsu (BL25), and Gwanwonsu (BL26). The depth was approximately 10 mm to 20 mm and the duration was 15 minutes. Electrical stimulation was performed at 1 Hz to 30 Hz using a low-frequency treatment device STN-330 (Stratek, Anyang, Korea) at 2 acupuncture points. Electrical stimulation was used to generate a sufficient intensity of muscle contraction without the patient feeling pain. It was performed twice daily during the treatment period.

Pharmacopuncture

Pharmacopuncture (Table 1) was performed at Jaseng Wonoe Tangjunwon, Namyangju, Korea before acupuncture treatment. Using a disposable insulin syringe (0.5 mL, 30G×8 mm, Sungshim Medical, Bucheon, Korea), 0.25 mL – 0.5 mL of Shinbaro was injected at L4, L5, S1 spinous process, and at both sides of PSIS. This was performed once daily before the first week of hospitalization, and once every 2 days thereafter.

Herbal medicine treatment

Patients were classified according to their symptoms. Danggwisu-Powder (Table 2) was administered at Haeundae Jaseng Tangjunwon twice daily in the morning and evening, and this was effective at reducing pain caused by bruising [12]. In the case of combined neck pain, Kamiseokyong-decoction (Table 3) was administered.

Evaluation index

Numeric rating scale

The numeric rating scale (NRS) NRS-11, uses numbers from 0 to 10 as a method for quantifying the degree of subjective pain felt by the patient [13]. NRS values were collected at the initial visit, and at 1- and 2-weeks post-treatment.

Oswestry disability index

The oswestry disability index (ODI) is a 10-item multiple-choice questionnaire completed by the patient, and used to evaluate the functional status associated with back pain by describing the disability of daily life in 6 steps from 0 to 5 points [14]. ODI values were collected at the initial visit and 2 weeks post-treatment.

EuroQol-5 dimensions

The EuroQol-5 dimensions (EQ-5D) is a measure of health-related quality of life developed by the EuroQol group to measure overall health status [15]. It was designed to be used for a wide range of health conditions, and it is one of the most widely used tools to measure the quality of life. EQ-5D values were collected at the initial visit and 2 weeks post-treatment.

Statistical analyses

Statistical analyses were performed using the Statistical Program for Social Science v. 25.0 for Windows program

Table 1. Composition of Shinbaro Pharmacopuncture.

Pharmacognostic name	Quantity (g)
Paeoniae Radix	0.027
Osterici Radix	0.0014
Araliae Continentalis Radix	0.0014
Eucommiae Cortex	0.0014
Achyranthis Radix	0.0014
Cibotii Rhizoma	0.0014
Saposhnikoviae Radix	0.0014
Acanthopanax Root Bark	0.0014

Table 2. Composition of Danggwisu-powder.

Pharmacognostic name	Quantity (g)
Angelicae Gigantis Radix	5.625
Paeoniae Radix Rubra	3.750
Linderae Radix	3.750
Caesalpiniae Lignum	3.750
Cyperi Rhizoma	3.750
Carthami Flos	3.000
Persicae Semen	2.625
Cinnamomi Cortex Spissus	2.250
Glycyrrhizae Radix et Rhizoma	1.875

Table 3. Composition of Kamiseokyong-decoction.

Pharmacognostic name	Quantity (g)
Curcumae Longae Rhizoma	7.500
Angelicae Gigantis Radix	3.750
Cinnamomi Cortex Spissus	3.750
Pinelliae Tuber	3.750
Atractylodis Rhizoma Alba	3.750
Linderae Radix	3.750
Coicis Semen	3.750
Paeoniae Radix Rubra	3.750
Kalopanacis Cortex	3.750
Glycyrrhizae Radix et Rhizoma	1.875
Osterici Radix	1.875

(IBM Corp., Armonk, USA). Measurements were expressed as mean ± SD. A paired sample *t* test was used to compare the improvement in each group before and after treatment. Independent two-sample *t* tests were performed to compare the significance of differences in NRS, ODI decrements and EQ-5D increments between groups. Values of $p < 0.05$ were considered to be statistically significant.

Patient protection policy on patient information use

This study was approved by the Jaseng Hospital Clinical Review Committee (Institutional Review Board) for the protection of the patient's personal information by retrospective statistical analysis that did not record the patient's personal identification information (Approval no.: JASENG2018-06-014).

Results

General patient characteristics

Of the 56 patients in Group A, 22 were men and 34 were women; of the 56 patients in Group B, 26 were men and 30 were women. The mean age was 40.77 ± 12.96 years in Group A and 42.84 ± 14.10 years in Group B. The mean pretreatment NRS, ODI and EQ-5D scores were 5.13 ± 0.79, 45.06 ± 13.17 and 0.67 ± 0.13 in Group A, and 5.18 ± 0.92, 43.17 ± 14.92 and 0.62 ± 0.17 in Group B, respectively. There was no statistically significant difference in age, pretreatment NRS, ODI and EQ-5D between groups (Table 4).

Comparison of improvement rate according to treatment period

The mean NRS score in Group A was 5.13 ± 0.79 at pretreatment, 3.86 ± 0.67 1-week post-treatment, and 3.32 ± 0.90 2 weeks post-treatment. There was a significant decrease in values between timepoints ($p < 0.001$). ODI score significantly decreased from 45.06 ± 13.17 at pretreatment to 25.60 ± 13.02 at 2 weeks post treatment ($p < 0.001$). EQ-5D score also significantly increased from 0.67 ± 0.13 at pretreatment, to 0.87 ± 0.08 2 weeks post-treatment ($p < 0.001$; Table 5).

The mean NRS score in Group B was 5.18 ± 0.92 at pretreatment, 4.30 ± 0.94 at 1-week post-treatment, and 3.46 ± 0.74 at 2 weeks post-treatment, with a significant decrease in values between timepoints ($p < 0.001$). ODI score significantly decreased from 43.17 ± 14.92 at pretreatment to 27.45 ± 13.93 2 weeks post-treatment ($p < 0.001$). EQ-5D scores also significantly increased from 0.62 ± 0.17 at pretreatment to 0.75 ± 0.19 2 weeks post-treatment ($p < 0.001$; Table 6).

Comparison of treatment outcomes before and after treatment

After 1 week of treatment, NRS score decreased by 1.27 ± 0.59 in Group A and 0.88 ± 0.61 in Group B (Table 7). There was a statistically significant difference between NRS decrement and values between groups ($p < 0.05$; Fig. 3). After 2 weeks of treatment, NRS score decreased by 1.80 ± 0.77 in Group A and 1.71 ± 0.68 in Group B, but there was no statistically significant difference between groups ($p > 0.05$).

The change in ODI score before and after treatment was 19.46 ± 11.96 in Group A and 15.72 ± 14.38 in Group B ($p > 0.05$; Table 7), but there was no significant difference between the groups.

Table 4. The General Characteristics of the Study PSatients.

Characteristics	Group A* ($n = 56$)	Group B† ($n = 56$)	*p*
Gender (M/F)	22/34	26/30	
Age (y)	40.77 ± 12.96	42.84 ± 14.10	0.420
NRS	5.13 ± 0.79	5.18 ± 0.92	0.741
ODI	45.06 ± 13.17	43.17 ± 14.92	0.480
EQ-5D	0.67 ± 0.13	0.62 ± 0.17	0.072

Data are presented as means ± SD.
Statistics significance was evaluated by independent two samples *t*-test.
EQ-5D, EuroQol-5Dimension; NRS, numerical rating scale; ODI, Oswestry disability index
*In Group A, Patients were treated by Korean medical treatments with Electric moxibustion
†In Group B, Patients were treated by Korean medical treatments without Electric moxibustion.

Table 5. Lower Back Pain in Group A During the Period of Treatment.

	Follow-up Point			*p*
	Pre-treatment	After 1-week treatment	After 2-week treatment	
NRS	5.13 ± 0.79	3.86 ± 0.67	3.32 ± 0.90	< 0.001* < 0.001† < 0.001‡
ODI	45.06 ± 13.17		25.60 ± 13.02	< 0.001
EQ-5D	0.67 ± 0.13		0.87 ± 0.08	< 0.001

Data are presented as means ± SD.
Statistics significance was evaluated by paired samples *t*-test.
EQ-5D, EuroQol-5Dimension; NRS, numerical rating scale; ODI, Oswestry disability index.
*p between pre-treatment and after 1-week treatment's NRS.
†p between 1-week treatment NRS and after 2-week treatment's NRS.
‡p between pre-treatment NRS and after 2-week treatment's NRS.

Table 6. Lower Back Pain in Group B During the Period of Treatment.

	Follow-up Point			*p*
	pre-treatment	After 1-week treatment	After 2-week treatment	
NRS	5.18 ± 0.92	4.30 ± 0.94	3.46 ± 0.74	< 0.001* < 0.001† < 0.001‡
ODI	43.17 ± 14.92		27.45 ± 13.93	< 0.001
EQ-5D	0.62 ± 0.17		0.75 ± 0.19	< 0.001

Data are presented as means ± SD.
Statistics significance was evaluated by paired samples *t*-test.
EQ-5D, EuroQol-5Dimension; NRS, numerical rating scale; ODI, Oswestry disability index.
*p between pre-treatment and after 1-week treatment's NRS.
†p between 1-week treatment NRS and after 2-week treatment's NRS.
‡p between pre-treatment NRS and after 2-week treatment's NRS.

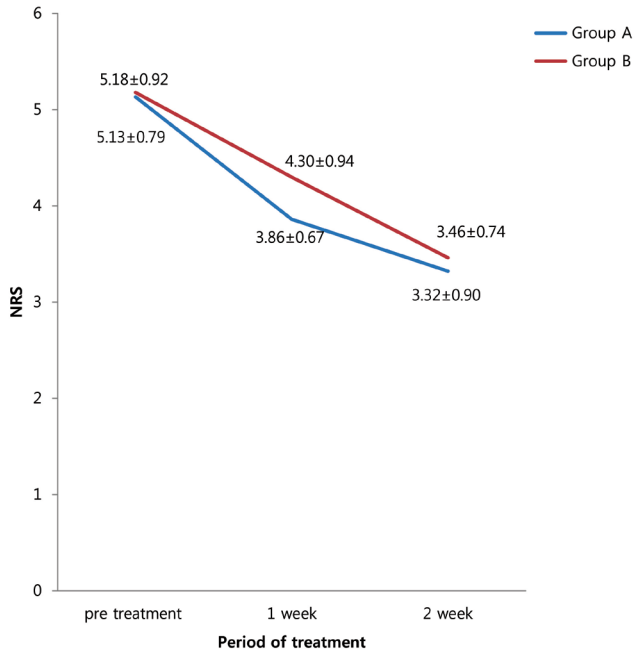

Fig. 3. NRS in period of treatment.
NRS, numerical rating scale.

Table 7. Comparison of Lower Back Pain Decrement Between Group A and Group B.

		Group A*	Group B†	*p*
NRS Decrement	Pre to 1-wk treatment‡	1.27 ± 0.59	0.88 ± 0.61	0.001
	Pre to 2-wk treatment§	1.80 ± 0.77	1.71 ± 0.68	0.518
ODI Decrement	Pre to 2-wk treatment§	19.46 ± 11.96	15.72 ± 14.38	0.138
EQ-5D Increment	Pre to 2-wk treatment§	0.19 ± 0.12	0.13 ± 0.20	0.043

Data are presented as means ± SD.
Statistical significance was evaluated by independent two samples *t*-test.
EQ-5D, EuroQol-5Dimension; NRS, numerical rating scale; ODI, Oswestry disability index.
*Group A, Patients treated by Korean medical treatments with electric moxibustion.
†Group B, Patients treated by Korean medical treatments without electric moxibustion.
‡Pre-treatment to 1-week treatment.
§Pre-treatment to 2-week treatment.

After 2 weeks of treatment, EQ-5D score increased by 0.19 ± 0.12 in Group A and 0.13 ± 0.20 in Group B (Table 7). There was a statistically significant difference between EQ-5D increment and values between groups ($p < 0.05$).

Adverse reactions to treatment

During the 2 weeks of treatment, there were no reported cases of adverse reactions such as skin infection, fever, blisters, bleeding, pruritus, sweating, nausea, dizziness, or headache.

Discussion

Lower back pain refers to pain predominately in the sacral and spinal areas. Lumbar vertebrae experience greater tension, pressure, and range of motion to support weight than other vertebrae, therefore, more than 80% of humans experience lower back pain [16]. Skeletal injuries, soft tissue injuries, bruises, and systemic symptoms caused by RTAs are referred to as RTA injury syndrome, the clinical symptoms of these injuries can persist and are collectively referred to as the after-effect of an RTA [17]. In the case of pain due to simple spasms in the lower back caused by an RTA, there is no special abnormality upon examination, but the patient often complains of pain [18].

Moxibustion is a method of treating diseases using thermal or chemical stimulation through burning moxa [19]. It treats the disease through chemical stimuli to burn the skin, and thermal stimulation performed by cauterizing the site corresponding to the pathology [20]. Zhao et al [21] reported that moxibustion therapy can be effectively used for acute and subacute back pain.

The most commonly used acupuncture location point for back pain is the back line of the bladder meridian (BL), including Sinsu (BL23), Gihaesu (BL24), and Daejangsu (BL25) [22-24]. Kim [25] showed that moxibustion treatment of Sinsu (BL23) also had a beneficial effect on back pain. Kou et al [26] reported that moxibustion therapy promotes heat metabolism in the lower back, and improves symptoms of pain, clinical signs of lower back pain, and daily activities of patients with disc herniation. Kou et al [26] also showed significant improvement in the amplitude of the standing waves of the tibialis or anterior tibial muscle and amplitude of the common peroneal nerve and tibial nerve, as well as reduce the accumulation of intramuscular lactate in lower skeletal muscles.

Reported side effects of conventional moxibustion therapy have been allergies and nausea [27]. In addition, skin scars caused by burns, secondary infections, scarring of muscles, and inhibition of motility of muscle fiber can all occur. In addition, smoke output from the moxibustion may contain benzopyran carcinogens, which can lead to lung cancer and respiratory diseases [28]. In a questionnaire conducted by Han et al [29] and Lee et al [30], the most common reported shortcoming of moxibustion therapy was its unpleasant smell and smokiness. Due to these undesirable effects and usually a lack of ventilation, it is not practical to perform conventional moxibustion therapy in clinical practice in a hospital environment.

Electric moxibustion has the advantage of eliciting a similar therapeutic effect by inducing the same change in body temperature as traditional moxibustion. It transfers heat to deep parts of the body but with minimal moxa discomfort and irritation caused by patient anxiety or odors, with a minimal risk of fire [31]. There have been studies comparing the temperature changes of Gu-gwan moxibustion, Ae-gwon moxibustion, and deep heat stimulation system showing that the deep heat stimulation system was similar to moxibustion and reduced the side effects of conventional moxibustion [32]. Studies have shown that the surface temperature of the skin remains the same when electric moxibustion was used compared with traditional moxibustion, and the temperature of the deep part of the skin is maintained at a higher level. In this study the deep heat stimulation system and thermal stimulation protocol was also found to be useful. In the study by Yoon et al [33], there was a comparison between the effects of no stimulation, indirect moxibustion, moxa-extract stimulation, and PTC ceramic heating stimulation and Moxa-Extract Moxibustion. When a 43°C heat stimulus was applied, an elevated body temperature was maintained for up to 2 hours,

although it was less than the effect of a body temperature rise, 4 hours after Indirect moxibustion. The effects of body temperature elevation due to menstruation using the PTC heating element was confirmed.

Heat therapy has the effects of pain relief and body relaxation. Hemodynamic effects increase blood circulation and reduce chronic inflammation. It increases the velocity of conduction through the nerve and reduces the rigidity of the joints, thereby relieving muscle shortening and constriction. Therefore, we believe that heat therapy using electric moxibustion may be effective at increasing resilience and reducing lower back pain caused by RTAs. The purpose of this study was to investigate the clinical efficacy of electric moxibustion therapy. There was no difference in the general characteristics of the patients who received electric moxibustion treatment and those that received Korean medicine alone. In both treatment groups, NRS, ODI and EQ-5D scores were significantly improved before and after treatment. NRS decrement 1-week post-treatment in the electric moxibustion group was significantly higher than in the Korean medicine alone group. NRS and ODI decrement after 2 weeks of treatment was not statistically significant between groups. However, EQ-5D increment 2-week post-treatment in the electric moxibustion group was significantly higher than in the Korean medicine alone group. These results demonstrate that combined moxibustion and general Korean medicine treatment can significantly improve pain and daily disability of patients caused by simple back pain resulting from RTAs. However, electric moxibustion treatment was confirmed to be more helpful for initial pain reduction and health-related quality of life in patients with lower back pain caused by RTAs. For the clinical application of traditional moxibustion treatment, the side effects such as unpleasant smell, respiratory effects caused by inhalation of harmful gases, allergy, and burnt skin, can be reduced.

This study had several limitations. It was difficult to represent all types of RTAs because the study number (n = 112) was not large enough. Furthermore, 2 weeks of treatment was insufficient for determining the final degree of improvement. In addition to electric moxibustion treatment, combined acupuncture treatment, electroacupuncture, pharmacopuncture, and herbal medicine were applied to each patient therefore, the effects of moxibustion treatment alone could not be tested. Moreover, it was not possible to reflect the variables introduced between practitioners. The lack of blinding in the study among patients, practitioners, and evaluators, could also be highlighted as a limitation in this study but this was a retrospective study rather than a prospective study. Studies in the future should try to reduce confounding variables through randomization and double blinding. A single practitioner should be employed for the study and other treatments should be restricted. The treatment period and follow-up should be further extended too.

Conclusion

Between June 1, 2016 and April 1, 2017, the clinical records of patients with simple back pain caused by traffic accidents at Haeundae Jaseng Hospital were analyzed. A comparison was made between those who were treated with combined Korean medicine and electric moxibustion and those that received Korean medicine only. The following results were obtained.

1. NRS and ODI scores significantly decreased, whilst EQ-5D score significantly increased in both groups after treatment for 2 weeks compared with values at the initial visit.

2. When a pain reduction effect was observed according to the treatment period, after 1 week of treatment, NRS decrement was significantly greater in the combined Korean medicine and electric moxibustion group, than in the Korean medicine alone group.

3. After 2 weeks of treatment, EQ-5D increment was significantly higher in the combined Korean medicine and electric moxibustion group than in the Korean medicine alone group.

4. After 2 weeks of treatment, there was no significant difference in pain improvement or daily disability between the 2 groups.

Conflicts of Interest

The authors have no conflicts of interest to declare

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