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[Original Article]

EFFECTS OF LONG-TERM CORSET WEARING ON CHRONIC LOW BACK PAIN

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Abstract : There are few studies of the therapeutic effects of long-term corset wearing in patients with chronic low back pain. The aim of this study was to evaluate the effects of long-term corset wearing on chronic low back pain and to examine the myoelectrical activities of the paravertebral muscles.

Forty subjects with chronic low back pain were enrolled and randomly divided into two groups : a group wearing corsets for 6 months (CW) group and a group not wearing corsets (NW). The treatment effects were measured using the Japanese Orthopaedic Association (JOA) score. Muscle endurance was evaluated during the Biering-Sorensen test (S-test), and the degree of muscle fatigue was evaluated by the change in percent mean power frequency (%MPF) of the paravertebral muscles.

Corset treatment for chronic low back pain improved low back pain and increased muscle endurance for a short period of time. Paravertebral muscle fatigue was not increased by long-term corset wearing for chronic low back pain, and weakening of the paravertebral muscles was not observed up to 6 months after the start of corset wearing.

Key words : Corset, Chronic low back pain, Muscle fatigue, Surface electromyography, Paravertebral muscles

INTRODUCTION

Lumbar supports are often used for the conservative treatment of low back pain. Lumbar supports include commercial lumbar belts and ready-to use lumbar canvas corsets (hereafter referred to as corsets). A lumbar support is restricted for use only for low back pain in the acute stage to reduce pain[1]. In the clinical situation, brace treatment is also performed for acute exacerbations of chronic low back pain or in the remission stage after an acute exacerbation in elderly patients over a long period of time.

Biomechanical studies have revealed that lumbar supports have the following effects : (1) they support the back so that it cannot be bent too much when lifting a large object[2] ; (2) they restrict flexion-extension and side flexion of the trunk, but not rotation[3] ; (3) they reduce intra-discal pressure of the lumber vertebrae[4] ; and (4) they increase erector spinae muscle pressure, but not intra-abdominal pressure[5]. On the other hand, it has been reported that lumbar supports have no effect on decreasing myoelectrical activities in the erector spinae muscle[3].

In general, wearing a lumbar support for a long period of time only promotes disuse atrophy of the trunk muscles and is, therefore, not preferable[1].

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However, there are few studies of the advantages of long-term corset wearing in patients with chronic low back pain[6-10]. The aims of this study were to evaluate the effects of long-term corset wearing on chronic low back pain and to examine the myoelectrical activities for measuring muscle fatigue of the paravertebral muscles.

METHODS

Subjects

The subjects were patients with chronic low back pain (LBP) who were examined at our university hospital. Chronic LBP was defined as LBP persisting for 3 months or more. The localization of LBP was defined as the area surrounded by the right and left 12th ribs cranially and the right and left iliac crests caudally. Subjects having low back pain induced by infection, osteoporosis, or osseous metastasis of a malignant tumor, and those having lower extremity symptoms or found to have a neurologic deficit were excluded. Subjects having a psychogenic factor were excluded using the Zung Self-Rating Depression Scale[11]. The objectives of this study were explained, and only the subjects who gave their informed consent were enrolled.

The subjects were randomly classified into two groups : a corset-wearing (CW) group and a group not wearing corsets (NW). Randomization was performed using a random number table. For the subjects in the CW group, a lumbar canvas corset was made, and instructions were given to wear it for 6 months, except when bathing and sleeping. Only non-steroidal anti-inflammatory drugs (NSAIDs) were given as additional therapy. In the NW group, the subjects were given medication (NSAIDs) but did not wear a corset.

Determination of LBP severity

The score rating system of the Japanese Orthopaedic Association (JOA score) was used (Table 1)[12]. The results of treatment for lumbar disorder were scored on a 29-point scale of nine points for "subjective symptoms", six points for "objective observations", 14 points for "activities of daily living (ADL)", and minus six points for "bladder function" ; higher point scores indicate improved symptoms. In this study, the subjective symptoms (0-9 points) and ADL (0-14 points) of the JOA score (23-point scale) were used to compare the treatment effects between the CW and NW groups at baseline (before starting treatment) and 1, 3, and 6 months after starting treatment. These scores reflect the severity of symptoms and disability in ADL.

Electrophysiological measurements

The myoelectrical activities of the paravertebral muscles were measured using Holter-type surface electromyography (ME3000P ; MP Japan, Tokyo, Japan). Measurements were taken at two points on the skin overlaying the paravertebral muscles, approximately 2 cm from the midline at the upper part of the second lumbar vertebra (L2) and at the upper part of the fifth lumbar vertebra (L5). Muscle endurance and the degree of muscle fatigue were examined during the Biering-Sorensen test (S-test) (Fig. 1)[13]. The S-test, which was used as an indicator of muscle endurance, was performed as follows. The subjects were asked to lie face down on a bed, with the lower half of the body fixed to the bed and the upper half protruding from it. At the start of measurement, the subjects were asked to clasp their hands behind their head and to hold the upper half of their body parallel to the floor until that position could not be held any longer. The subjects of both groups performed the S-test without wearing a corset.

Measurement of muscle endurance

The subjects' trunk-holding times were measured at the start of the investigation and 1, 3, and 6 months thereafter. The difference in the S-test trunk-holding time between the CW and the NW groups was analyzed.

Measurements of degree of muscle fatigue

The myoelectrical activities were simultaneously recorded with the trunk-holding time during the S-test at the L2 and L5 levels. The change in percent mean power frequency (%MPF) is the rate of change per minute of the average power spectrum frequency obtained by fast Fourier transformation of an electromyography wave. There appears to be a correlation between %MPF and muscle fatigue : a larger rate of decrease in %MPF represents greater muscle fatigue[14]. The difference in the time course of the degree of muscle fatigue between the CW and the NW groups was analyzed.

Statistical analysis

Repeated measures ANOVA and the unpaired t-test were used to test the differences between the CW and the NW groups. The paired *t*-test was used to test the time course of each measurement item. Each result was determined to have a signifi-

Table 1. Score rating systen of the Japanese Orthopaedic association (JOA score)

I.	subjective Symptom	(9 points)
	A. Low back pain	
	a. None	3
	b. Occasional mild pain	2
	c. Frequent mild or occasional severe pain	1
	d. Frequent or continuous severe symptom	0
	B. Leg pain and /or tingling	
	a. None	3
	b. Occasional slight symptom	2
	c. Frequent slight or occasional severe symptom	1
	d. Frequent or continuous severe symptom	0
	C. Gait	
	a. Normal	3
	b. Able to walk father than 500 m although resulting in pain, tingling, and/or muscle weakness	2
	c. Unable to walk father than 500 m owing to leg pain, tingling, and /or muscle weakness	1
	d. Unable to walk father than 100 m because of leg pain, tingling, and /or muscle weakness	0
II.	Objective observations	(6 points)
	A. SLR	2
	a. Normal	1
	b. 30° –70°	0
	c. <30°	
	B. Sensory	
	a. Normal	2
	b. mild sensory deficit	1
	c. severe sensory deficit	0
	C. Muscle power	
	a. Normal	2
	b. Mild weakness	1
	c. severe weakness	0

III. Restriction of Activities of Daily Living (ADL)	(14 points)		
ADL	Severe Restriction	Moderate Restriction	No Restriction
a. Truning over while lying	0	1	2
b. Standing	0	1	2
c. Washing	0	1	2
d. Leaning forward	0	1	2
e. Sitting (about 1 hour)	0	1	2
f. Lifting or holding heavy objects	0	1	2
g. Walking	0	1	2

IV.	Urinary bladder function	(−6 points)
	a. Normal	0
	b. Mild dysuria	−3
	c. Severe dysuria (incontinence, urinary retention)	−6

cant difference if the probability value (p) was less than the significance level of 5%.

RESULTS

Of the 50 subjects who were enrolled, 40 completed all examinations over 6 months, for a follow-up rate of 80%. There were 20 men and 20 women, ranging in age from 30–78 years. There were no

Fig. 1. The Biering-Sorensen test (S-test)
The subjects keep this position for this test.

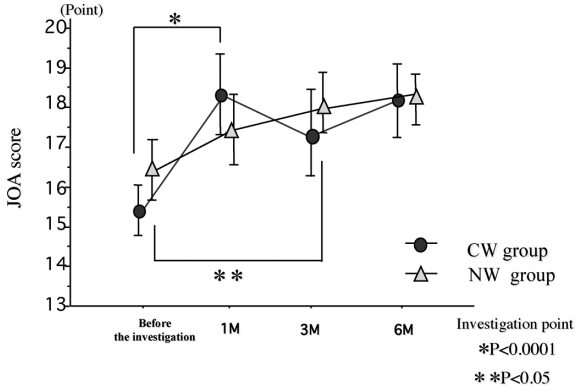

Fig. 2. Comparison of JOA scores between the two groups
The JOA scores of the CW group improve significantly 1 month after wearing a corset compared with those before wearing a corset ($p<0.05$). The significant improvement continued after 3 and 6 months of corset wearing.

significant differences in the sex and age distributions between the two groups. This study was approved by the ethics committees of the participating research institutions. All patients gave their written, informed consent.

Comparison of JOA scores between the two groups (Fig. 2)

The JOA scores of the CW group improved significantly 1 month after wearing a corset compared with before wearing a corset ($p<0.05$). The significant improvement continued after 3 and 6 months of corset wearing. On the other hand, the JOA scores of the NW group improved significantly 3 months after the start of the investigation as compared with before the investigation ($p<0.05$), and the effect continued up to 6 months after the start of the investigation. There was a significant difference in the JOA score between the two groups at one month ($p<0.01$), while there were no significant differences in the JOA score improvement rates between the two groups at other time points.

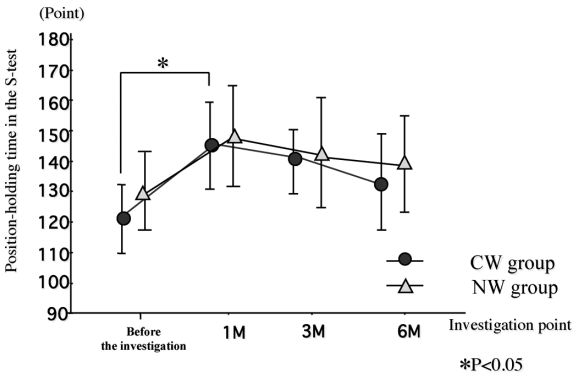

Fig. 3. Time course of the holding time
The position-holding time of the CW group is significantly prolonged at 1 month compared with baseline ($p<0.05$) and remains similar at 3 and 6 months. In the NW group, no significant change is observed in the position-holding time over the 6 months.

Muscle endurance : trunk-holding time in the S-test (Fig. 3)

The holding times for the CW group were significantly prolonged at one month compared with baseline ($p<0.05$). They were maintained at that level at 3 and 6 months. There was no significant change over the 6-month period in the NW group. These results suggest that, although the muscle endurance was improved one month after wearing a corset, no further increase in muscle endurance was observed when the corset was worn for a longer period of time.

Muscle fatigue

The time course of %MPF at the level of L2 is shown in figure 4. The averages of %MPF at L2 were not significantly different in both the CW and NW groups over the 6 months. The average %MPFs at L5 (Fig. 5) were not significantly different over the 6 months in both the CW and NW groups. These results suggest that no change to indicate an increase in muscle fatigue could be observed at the levels of both L2 and L5 regardless of whether a corset was worn. That is, even if a corset was worn for a long period of time, the degree of paravertebral muscle fatigue did not worsen, and the paravertebral muscles did not necessarily show easier fatigability in the CW group than in the NW group.

DISCUSSION

In the present study, improvement of low back pain (JOA score) and increase in paravertebral mus-

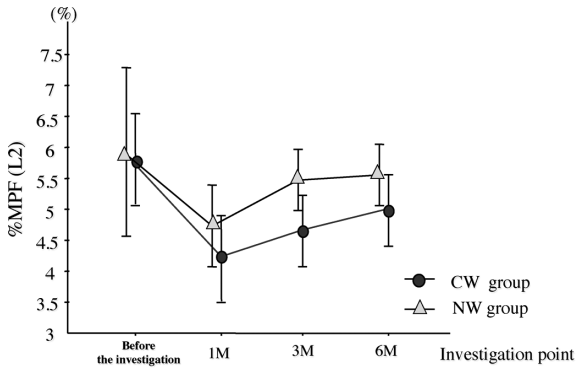

Fig. 4. Time course of %MPF at L2
The averages of %MPF at L2 are not different significantly over the 6 months in both the CW and NW groups.

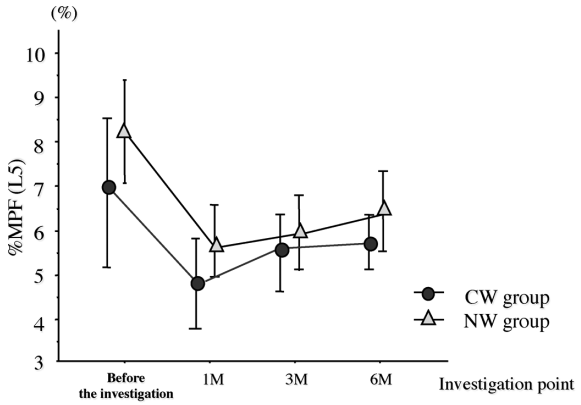

Fig. 5. Time course of %MPF at L5.
The averages of %MPF at L5 are not different significantly over the 6 months in both the CW and NW groups.

cle endurance according to the average trunk-holding time in the S-test were observed in the CW group at one month. However, there were no significant differences in the JOA score and the average trunk-holding time in both groups at 3 and 6 months. The results of this study show that corset treatment for chronic low back pain improved low back pain and increased muscle endurance for a short period of time, and treatment effects could be obtained. Wearing a corset might be useful in the early stages of treatment for low back pain. However, during long-term corset treatment for chronic low back pain, neither further improvement of low back pain nor increase in muscle endurance was obtained. The JOA score shows not only the degree of pain but also the disturbance in ADL. The JOA score in the corset-wearing group improved one month earlier than that in the medication only (non-corset-wearing) group. Given the results of this study, wearing a lumbar support is one of the means to improve the functional disturbance of the paravertebral muscle tissue in chronic low back pain.

There is concern that, if lumbar movement is controlled by wearing a lumbar support, long-term corset wearing will lead to disuse atrophy of the paraspinal muscles and restriction of the range of lumbar movement, which can cause the loss of myodynamia of the trunk muscles. Regarding the effects of long-term wearing of a lumbar support on the myodynamia of the trunk muscles in healthy people, one report has indicated that weakening of the paravertebral muscles, which is generally considered to occur, was not observed[12]. In the present study, based on the %MPF, which was used as an indicator of muscle fatigue, muscle fatigue did not increase even after wearing a corset for 6 months. That is, weakening of the paravertebral muscles was not caused by long-term corset wearing in subjects with chronic low back pain. This study verified the previous reported relationships between myoelectrical activities of the paravertebral muscles and chronic low back pain. One report indicated that, in patients with chronic low back pain and whose trunk muscles other than paravertebral muscles are working while the paravertebral muscles are loosened, continuous muscle discharge is observed in the paravertebral muscles[7]. Furthermore, in patients with intermittent claudication induced by low back pain, which is one symptom of chronic low back pain, the activity of the paravertebral muscles is increased irrespective of posture, and continuous muscle discharge is observed in the paravertebral muscles when walking[15]. These results show that the myoelectrical activity of the paravertebral muscles is significantly greater in patients with chronic low back pain than in healthy subjects in daily life. It is considered that, in patients with chronic low back pain, muscle fatigue is induced by chronic hyperactivity of the paravertebral muscles, and the chronic ischemic status of the muscular tissue is simultaneously caused by a continuous increase in the pressure in the paravertebral muscles, further worsening low back pain due to the functional disturbance of the muscular tissue.

Even though weakening of the paravertebral muscles was not observed up to 6 months after the start of wearing a corset, the JOA score in the corset-wearing group improved at one month. Based on these findings, muscle fatigue is not the only cause of low back pain. One of the limitations of this study was that the natural course of chronic low back pain was not investigated. Other limitations were that there was no group in which a corset was worn but additional therapy was not given, and the

placebo effects of corset wearing or medication were not considered. A further limitation was that the data regarding the additional therapy of NSAIDs in both the corset wearing group and the non-corset wearing group that was given only medication were limited. However, it has been reported that wearing a lumbar belt decreases the pain score and pharmacological consumption in patients with subacute low back pain[16]. Wearing a corset might be useful for elderly patients with complications as an alternative or supplementary treatment to medication. Further examinations of the effects of longer-term corset wearing on muscle atrophy and QOL are required.

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