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Trunk Muscle Strength in Patient with Low Back Pain

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Abstract

The purpose of this study was to clarify the characteristics of trunk muscle strength in patients with low back pain. The peak torques of isometric trunk flexion, extension, side bending, and rotation were compared. We found that the peak torque of rotation to the painful side was significantly lower than that to the no-pain side in patients with low back pain. No intra- or inter-group differences in peak torque were detected except for that of rotation. In the physical therapy regimens of patients with low back pain, it is best to keep these points in mind as the features of isometric muscle strength-the trunk flexors and extensors-are not always weak, and focus should be placed on strengthening the trunk rotators.

Keywords: Low back pain; Trunk muscle strength; Isometric contraction

Abbreviations: BW: Body Weight; JOABPEQ: Japanese Orthopedic Association Back Pain Evaluation Questionnaire; LBP: Low Back Pain; NLBP: Non-Low Back Pain

Introduction

The trunk muscles are considered important spinal mobilizers and stabilizers [1-3]. MacGill et al. showed that depending on the task, co-contraction with the extensors (quadratus lumborum and latissimus dorsi) and the abdominals (rectus abdominis, obliques, and transverse abdominis) ensures stability [3]. Furthermore, the trunk muscles compensate for low back pain-induced dysfunction. Therefore, it is important to measure the trunk muscle strength during evaluations and interventions in patients with low back pain. We measured the isometric trunk muscle strength of patients with low back pain.

In this study, to clarify the relationship between trunk muscle strength and low back pain, we compared the trunk muscle strength in the presence and absence of low back pain.

Materials and Methods

The subjects included 20 patients with low back pain (low back pain [LBP] group: mean age, 35.1 ± 18.5 [23-77] years; mean height, 171.6 ± 7.2 [162-184] cm; mean body weight, 66.5 ± 7.9 [59-88] kg) and 31 healthy men (non-low back pain [NLBP] group: mean age, 37.4 ± 20.3 [2279] years; mean height, 169.2 ± 6.7 [160-185] cm; mean body weight, 62.2 ± 7.4 [50-77] kg). An orthopedist at our hospital diagnosed the LBP group with LBP. The pain had continued for >3 months in the patients with LBP. Clinical diagnoses included fascial lumbago (9 patients), lumbar disc disease (7 patients), lumbar disc hernia (2 patients), and lumbar facet arthritis (2 patients). Neurological symptoms did not appear in all subjects.

We used the Japanese Orthopedic Association Back Pain Evaluation Questionnaire (JOABPEQ) to evaluate the degree of LBP. The JOABPEQ is a measure of health related quality of life in patients with LBP [4]. The assessment items include LBP, lumbar function, walking ability, social life function, and mental health. Each assessment items score of JOABPEQ consists of 0-100 points. 100 points is very good condition. The LBP group had the following mean scores: LBP, 71 points; lumbar function, 50 points; walking ability, 79 points; social life function, 51 points; and mental health, 61 points. The degree of pain was evaluated using the visual analogue scale, and the results included: LBP degree, 44 mm; buttock and lower limb pain, 52 mm; and buttock and lower limb numbness degree, 0 mm.

The LBP group (N=20) was further classified into the following 5 subgroups based on the direction in which pain was induced: flexion (N=3), extension (N=5), rotation (N=7), flexion and rotation (N=2), and extension and rotation (N=3).

We measured isometric muscle strength using Tergumed 3D (Proxomed Corporation, Germany; Figure 1). The pushing force upon the back and shoulder pad with the subject in a fixed sitting state with both legs on the device pad was measured. The order of measurement was flexion, extension, left side flexion, right side flexion, left rotation, and right rotation. The measurement protocol consisted of a 7-s isometric contraction, measurement, and a 10-s break. The procedure was repeated 3 times. Peak torque (Nm) was the adopted maximum value of the 3 measurements. We also calculated peak torque percent body weight (%BW) (Nm/kg).

Data analysis was performed using an unpaired *t*-test and a paired *t*-test. The unpaired *t*-test was used for inter-group comparisons of mean values of age, height, and weight, and for inter-group comparisons of peak torques of flexion and extension. The paired *t*-test was used

Figure 1: Measurement of the trunk muscle strength by the Tergumed 3D

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for intra-group examinations of the peak torque of side flexion and rotation. The significance level was set at <5%. All subjects provided written informed consent for study participation and the publishing of their data.

Results

No significant differences were noted between groups in terms of age, height, and weight (Table 1). No subject complained of pain during the measurement process. Peak torque %BW values are shown in Tables 2-4. No significant difference was detected in the peak torque %BW of extension between groups (Table 2). However, a significant difference was noted in the peak torque %BW of rotation between the painful and no-pain sides in the LBP group ($p<0.01$; Table 3).

Discussion

Although many studies have reported on trunk muscle strength in patients with LBP, it is not obtained the reliable opinion [5-10]. According to other research, trunk muscle strength in patients with LBP was lower than that in healthy subjects [5-8]. The transversus abdominis muscles of patients with LBP were reportedly thinner than those of healthy subjects [9,10]. Furthermore, strengthening of the transversus abdominis and internal oblique muscles reportedly improved LBP [11], and strength training of the trunk extensors was thought to be important in the treatment of LBP [12].

Given the above results, we believe that measuring the trunk muscle strength in patients with LBP is important for the evaluation of LBP and the determination of the physical therapy regimen for the treatment of LBP. Therefore, to clarify the characteristics of trunk muscle strength in patients with LBP, we studied the peak torque of isometric trunk muscle contractions. The existing studies on muscle strength in patients with LBP used various postures and contractions. In this study, we studied the isometric contraction in a sitting position with a trunk upright position, which is thought to be safe and place less mechanical stress on the joints and soft tissues. Therefore, because our subjects did not feel soreness or pain during the measurement, there were no significant differences in the peak torque between the groups except for rotation. We believe that the measurement had no effect on muscle strength, since the subjects did not report LBP during the process.

In this study, we found a significant difference in rotation torque only between the painful and no-pain sides in the LBP group: trunk rotation torque in the direction of the pain side was significant lower than that of the no-pain side. The subjects did not complain of pain during the measurement, but the rotation muscle strength to the painful side was reduced. We believe that this result was affected by disuse muscle atrophy of agonist because of the stereotyped movements of daily life that these patients used to avoid pain. Because there was also a significant reduction in the thickness of the erector spinae and multifidus muscles in patients with LBP compared to that in healthy subjects [13], it is necessary to prevent disuse atrophy in patients with LBP. Strong fixation, fixed belt location, and motionless (isometric) measurement are thought to be involved in those results that did not show significant differences.

This study found no significant differences in extension and flexion torque between the groups, and it demonstrated that sufficient muscle contractions are possible when factors such as contraction style and posture are considered. Regarding strength training in patients with LBP, both isometric training to prevent disuse atrophy and the demonstration of muscle strength in various contraction styles under pain control are needed.

	Age	Height	Weight
Low back pain group	35.1 ± 18.5	171.6 ± 7.2	66.5 ± 7.9
Non-low back pain group	37.4 ± 20.3	169.2 ± 6.7	62.2 ± 7.4

Table 1: Comparison of mean subject age, height, and weight values.

	Flexion	Extension
Low back pain group	1.83 ± 0.23	4.35 ± 0.95
Non-low back pain group	1.83 ± 0.22	4.28 ± 0.89

Table 2: Comparison of peak torque %BW of flexion and extension between groups.

	Side flexion	Rotation*
Pain side	2.11 ± 0.48	1.53 ± 0.07
No-pain side	2.33 ± 0.42	1.65 ± 0.10

*$p < 0.01$

Table 3: Comparison of peak torque %BW of side flexion and rotation in the low back pain group.

	Side flexion	Rotation
Left side	2.12 ± 0.43	1.53 ± 0.23
Right side	2.20 ± 0.53	1.61 ± 0.18

Table 4: Comparison of peak torque %BW of side flexion and rotation in non-low back pain group.

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