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Original Research Article

EFFECT OF STANDING EXERCISE USING PELVIS AND THORAX SYMMETRICAL DEVICE FOR CARE WORKERS WITH LOW BACK PAIN

Hironori Ogura, Kazuya Ito *, Kenji Hoshi, Kazuyoshi Gamada.

Graduate School of Medical Technology and Health Welfare Sciences, Hiroshima International University, Hiroshima, Japan.

ABSTRACT

Objectives: Healthcare workers have a high prevalence of low back pain (LBP). Purpose of this study was to verify the effect of exercise during work for the low back pain of care workers.

Methodology: Study design was a randomized control trial with 8-month follow-up.

Participants: Thirty-six care workers have complaining LBP were randomized two groups. Exercises were supplied to subjects in the intervention group, performed exercises ten to thirty minutes a day while 8-month. In another group was no intervention. At the beginning of the study, two weeks, four weeks, and eight weeks were recorded two outcomes—Roland-Morris Disability Questionnaire (RMDQ) and Visual Analog Scale (VAS) on four postures (trunk extension/flexion/rotation and standing posture). In both groups, only Subjects of VAS ≧40mm on the beginning of this study were extracted to compare between groups at four terms. Statistical analyses were used the Mann-Whitney U test after Bonferroni correction. Significance level before correction $\alpha = .05$.

Results: There was no difference between groups regarding all outcomes recorded at the beginning of the study. In sub-group analysis, Intervention group showed significant improvement of the pain outcomes; Trunk extension at two weeks ($p = .004$) and eight weeks ($p = .012$), Trunk rotation at eight weeks ($p = .008$). RMDQ was no difference between groups.

Conclusion: Exercise aimed at symmetrization of pelvis and thorax reduces the pain of trunk extension and rotation for healthcare workers of low back pain VAS ≧40mm.

KEY WORDS: Healthcare Workers, Low back pain, Exercise Therapy, Alignment, Devices.

Address for correspondence: Kazuya Ito, Graduate School of Medical Technology and Health Welfare Sciences, Hiroshima International University, 555-36 Kurose-Gakuendai, Higashi-Hiroshima, Hiroshima 739-2695, Japan. **E-Mail:** kazuya.ito.1987@gmail.com

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INTRODUCTION

Health care workers and nurses have high rates of musculoskeletal disorders [1]. The prevalence of low back pain (LBP) among student care workers is 51%, but increases to 63% after one year of employment [2]. Other reports describe the prevalence of LBP as 45% - 63% among care workers and 40-50% among workers in general [3-7]. Care workers routinely perform repetitive physical tasks involved in patient handling, which may be a source of physical stress leading to musculoskeletal disorders including LBP and other injuries [8-11]. In recent years, the number of workers supporting the welfare system has decreased whereas the number of patients with long-term disabilities has increased with progression of the aging population. Moreover, more than 30% of care workers leave their jobs in nursing homes annually [12]. Castel et al. [12] reported a correlation between job contents and organization of the facility, and indicated that physical disorders become one of the factors leading individuals to quit a job. However, a strategy for preventing LBP in nurses and healthcare workers has not yet been established [13]. Therefore, it is necessary to establish a method of LBP prophylaxis in the workplace.

Recently, several preservation strategies have been proposed for LBP. Despite systematic reviews related to conservative therapy for LBP, the effectiveness of therapeutic exercise, physiotherapy and additional harness therapy has not been established for either acute or chronic LBP or for any of the functional disorders caused by LBP [2,11,14-16].0Both positive and negative results have been reported for continuous application of additional devices such as a lumbar or pelvic belt [13, 17-19]. One limitation is that prolonged usage of such a belt may cause decreased muscle thickness [20]. Considering that care workers must perform the intervention during working hours, the time required for the intervention should be minimized and exercises that can be performed while standing would be preferred to those performed in a lying position. Although pelvic asymmetry and decrease in thoracic mobility have been noted as causes of LBP [21], treatments aimed at correcting pelvic or thoracic asymmetry have not been proposed [22-24].

A lumbar corset and pelvic belt are often prescribed for patients with clinically diagnosed LBP, but none of these devices are designed to restore pelvic or thoracic alignment. The pelvic belt applies compressive force on the sacroiliac (SI) joint and may work to reduce the conformity of the SI joints, but has no effect on correcting asymmetric sagittal tilts of the innominate. Moreover, none of these devices treats thoracic asymmetry. Therefore, the research question would be whether a device designed to correct asymmetric alignment of the pelvis and thorax can effectively reduce pain and improve the ability to function in care workers and nurses with low back pain. The aim of this study was to determine whether a 4-week intervention involving a 10-minute exercise program while wearing a pelvis-thorax realignment device (PTRD) can effectively reduce LBP symptoms and improve the ability of care workers to function.

Correcting pelvic or thoracic alignment may require the application of external force to restore and hold these regions in the optimal positions, which may enhance motor learning to stabilize the pelvis or thorax in the corrected alignment. Mulligan [25] considered that bony positional faults contribute substantially to painful joint restrictions. Therefore, he advocated "mobilizations with movement", which is achieved by an active exercise while the joint position is corrected. Positive effects of treatment based on Mulligan's concept have been reported in numerous studies, and his theory is now widely accepted [26,27].

Accordingly, we developed a set of PTRD currently called ReaLine CORE (GLAB Corp, Japan) to achieve more symmetrical alignment of the pelvis and symmetrical lateral expansion mobility of the lower thorax by performing standing activities while wearing the device [Figure 1]. It is a set of two identical devices, which have rigid front and back frames, two belts and 2 sets of ratchets. When it is applied to the pelvis, the pelvis becomes more symmetrical and stable with the application of focal forces on the bilateral anterior superior iliac spines and compressive forces on the SI joints while standing exercises are performed. When applied to the thoracic, the middle and lower thorax become more symmetrical and mobile with the application of force to the anterior thorax. It is speculated that pain and range of motion during forward or backward bending are improved because surfaces of the facet joints in the lumbar vertebrae have become more parallel and are under less constraint when symmetrical positions of the pelvis and thorax are maintained. Therefore, we assume that PTRD reduces the concentration of stress on the lower back, which leads to pain reduction and functional improvement in care workers with LBP.

The hypotheses of this study are that 1) significant improvement of pain and activities of daily living (ADL) can be achieved using the PTRD; and 2) individuals with a higher visual analog scale (VAS) score at baseline would exhibit significant improvement in pain and ADL. Our study could suggest a simple and effective exercise therapy for the nursing field if the exercises wearing PTRD can be implemented within about 10 minutes a day. A single-blinded randomized controlled trial was performed to test the hypotheses.

MATERIALS AND METHODS

Participants: This study was a single-blinded randomized control trial with a 4-week intervention and 4-week follow-up. Subjects were recruited from nurses and care workers at three nursing homes. Inclusion criteria were: 1) care workers complaining of LBP on a questionnaire; and 2) aged between 18 and 60 years. Exclusion criteria were: 1) history of surgery around the pelvis; 2) neurologic symptoms; 3) osteoporosis; 4) pregnant or within one year postpartum; 5) inability to understand the study protocol. Thirty-six care workers and nurses (male; 15, female; 21) complaining of LBP were randomized into intervention and control groups by a computer-generated table of random numbers. This study was conducted according to the principles expressed in the Declaration of Helsinki. All study protocols and forms were developed and utilized as instructed by the ethics committees of the nursing facilities.

Intervention and compliance: A 10-minute program involving eight standing exercises while wearing PTRD was performed by the intervention group 1-3 times/day, five days a week for 4-weeks with a four-week follow-up period thereafter. The exercise program consisted of: 1) deep breaths to enhance lateral expansion of the middle and lower thorax; 2) shoulder elevation; 3) upper thoracic rotation; 4) stepping; 5) lateral shift of the pelvis; 6) pelvic rotation with knees extended; 7) pelvic rotation with knees flexed; and 8) forward and backward bending of the trunk while standing [Figure 2]. There was no intervention performed by the control group. At work, ordinary duties were carried out by both groups. An occupational therapist instructed the intervention group on the intervention program and supervised the exercises performed by the participants.

Outcome Measures: At baseline, 2 weeks, 4 weeks, and 8 weeks, two outcome measures were recorded. As the primary measure, the progression of pain and functional decline due to LBP was evaluated by the Roland-Morris Disability Questionnaire (RMDQ). The RMDQ is frequently used as a "core" outcome measure in LBP trials [28,29], has proven reliability and validity [30,31] and known test-retest reliability in various settings [28,29,30]. The second outcome measure was pain Visual Analog Scale (VAS) during four postures (trunk extension, flexion, rotation, and standing posture). The pain VAS was measured using a horizontal scale from 0 (no pain) to 100 (maximal pain). VAS is a standardized instrument to measure pain intensity and shows a high test-retest reliability ($r > .95$) [10]. The assessor was blinded to the group assignments of the subjects during questionnaire assessments and measurements.

Statistical Analysis: The sample size was calculated using G*Power. The sample size was estimated based on the primary outcome measure (RMDQ) at 8-weeks follow-up, and assuming 80% power and 5% significance. To detect a clinically meaningful difference of 5 points between group mean changes from baseline to 8-weeks follow-up on the RMDQ, a total sample size of 36 was required. This total was based on a standard deviation of 2.3 points. Reports after the start of the trial suggested that a change score of 3 points on the RMDQ should have been used for the sample size calculations. Post-hoc power analysis was performed. On sub-group analysis, low statistical power was demonstrated by a power ($1-\beta$) of approximately 0.08.

PASW statistics18 was used for calculations. Data at baseline, 2 weeks, 4 weeks, and 8 weeks were extracted for comparison between groups Statistical analyses were performed using the Mann-Whitney U test after Bonferroni correction. The significance level before correction was $\alpha = .05$.

RESULTS

A total of thirty-six care workers participated (Mean age; 38.7 ± 9.7 year, BMI; 23.4) in this study [Table 1]. Eighteen subjects were randomized to each group, and there were no dropouts. There were no statistically significant differences between the groups at baseline. The intervention frequency in the intervention group was approximately one time/day. For hypothesis 1, there were no significant differences between groups for any of the terms on RMDQ and VAS.

However, aggravation of low back pain was not reported either.

For hypothesis 2, a VAS score ≧40mm during each movement at baseline was used to identify high VAS score groups. There were 10 participants who reported a VAS score of 40 or greater during trunk rotation and 12 such participants during maximal backward bending. The intervention group showed significant improvement of pain outcomes for trunk extension at 2 weeks (p = .004) and 8 weeks (p = .012), trunk rotation at 8 weeks (p = .008). However, there were no differences on RMDQ between the intervention and non-intervention groups.

Table 1: Characteristics of surveyed subject (mean ± SD).

Number of the subject	Intervention group			Control group			P value
	18 (M 8, F 10)			18 (M 7, F 11)			0.735
Age (year)	42.6	±	8.8	38.7	±	9.7	0.216
Height (cm)	160.5	±	8.6	162.4	±	8.5	0.518
Weight (kg)	59.6	±	14	61.7	±	16.9	0.714
Body mass index (kg/m^2)	22.8	±	4.8	22.7	±	3.4	0.958

Fig.1 RealLine® CORE a pelvis-thorax realignment devices

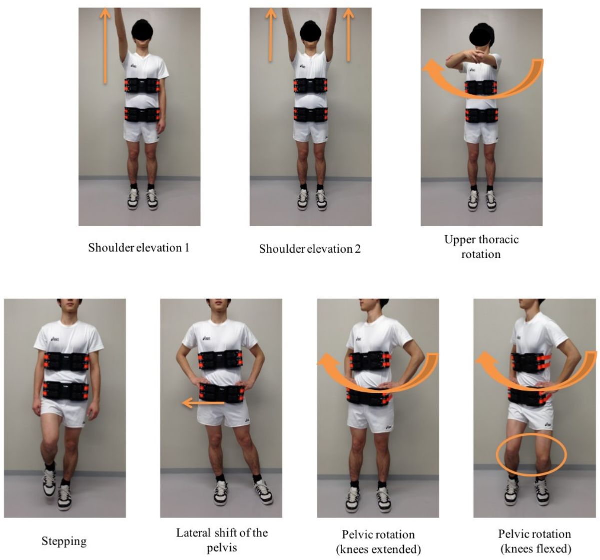

Fig. 2 The 10-minute exercise program while wearing PTRD

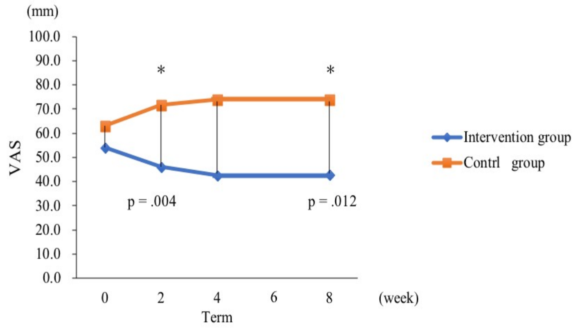

Fig. 3 VAS during trunk extension in the subgroup analysis.

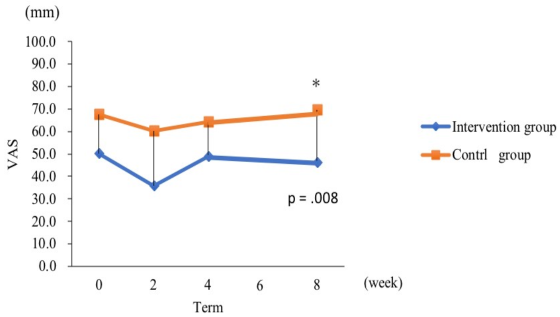

Fig. 4 VAS during trunk rotation in the subgroup analysis.

DISCUSSION

The aim of this study was to determine whether a 4-week intervention involving a 10-minute daily exercise program while wearing a PTRD would effectively reduce LBP symptoms and improve the ability of care workers to function. The results did not show significant differences between the groups on either RMDQ or VAS at any time point, which did not support hypothesis 1. In the high VAS score subgroup, pain during maximum trunk extension was significantly decreased at 2 weeks and 8 weeks, and pain during rotation at 8 weeks.

At baseline, VAS and RMDQ scores of all subjects combined averaged 25.2 and 1.8, respectively, showing an obvious floor effect. Therefore, these results were considered inconsistent with previous studies demonstrating improvements in VAS and RMDQ using a lumbopelvic belt [17,19,33]. Compliance with the intervention program was one time a day and did not satisfy the original protocol. However, considering multiple risk factors for LBP associated with care work [34-37], it is a positive finding that the LBP symptoms did not worsen. On the other hand, subjects who scored LBP higher than 40 mm on VAS at baseline reported less pain during rotation and extension after the intervention. These findings were similar to those of a previous study that compared corset and non-intervention groups [17,33]. Our intervention program requires only 10 minutes of standing exercises per session and can fit into the working environment of care facilities. Since corset therapy requires prolonged usage [17,19], the intervention program offers a great advantage in limiting the risk of decreased trunk strength or increased stiffness.

To date, there have been few devices that effectively restore pelvic symmetry and lower thoracic mobility. Pelvic asymmetry may reduce conformity of the sacroiliac joints, and reduce form closure [38,39]. The thorax is related to mobility of the spinal column, in particular lower thorax expansion is considered important in gaining thoracic mobility [9,40]. Although associations between reduced thoracic mobility and LBP have not yet been shown, it is speculated that increased mobility of the thorax may contribute to a reduction of mechanical stress on the lumbar spine. Accordingly, 10-minute standing exercises while wearing PTRD might have contributed to improved symmetry of the pelvis and thorax, improved thoracic mobility and reduced mechanical stress on the lumbar spine. Therefore, we think that pelvic and thoracic symmetry may be a contributing factor for realigning the spine and improving function.

There were no dropouts, and there were no censored data. The study was designed as a randomized control trial to remove measurement bias. However, the intervention was not fully monitored and the quality of exercises was not uniform across the subjects. Nearly 60% of the subjects were females and the mean age was approximately 40 years old, which matches the demographics of the care workers and nurses in Japan. Therefore, the results of this study can be generalized to Japanese care workers and nurses.

There are four limitations in this study. 1) We did not obtain objective outcome scores such as pain-free range of motion measurement. 2) Because we carried out unsupervised interventions, the quality of the intervention may have been uneven. 3) There is a possibility of a β error due to the limited sample size. 4) We were not able to maintain a sufficient frequency of the intervention sessions per day with the average being less than one time/day. If we could have maintained a greater intervention frequency, subjects might have shown greater improvement. Insufficient frequency of intervention sessions might have limited the degree of functional recovery and pain reduction.

Exercises while wearing the pelvic and thoracic realigning device for care workers and nurses with LBP contributed to restoring function and reducing pain in subjects with higher VAS scores. None of the subjects with higher VAS scores experienced sharp pain exacerbation during the intervention period while continuing to work. Future studies may require a supervised intervention program with a higher frequency of sessions.

Conflicts of interest: None

REFERENCES

[1]. Boden LI, Sembajwe G, Tveito TH, Hashimoto D , Hopcia K, Kenwood C, et al. Occupational injuries among nurses and aides in a hospital setting. American journal of industrial medicine. 2012;55(2):117-26.

[2]. Wang XQ, Zheng JJ, Yu ZW, Bi X, Lou SJ, Liu J, et al. A meta-analysis of core stability exercise versus general exercise for chronic low back pain. PLoS One. 2012;7(12):e52082. Epub 2013/01/04.

[3]. Leboeuf-Yde C, Klougart N, Lauritzen T. How Common Is Low Back Pain in the Nordic Population?: Data From a Recent Study on a Middle Aged General Danish Population and Four Surveys Previously Conducted in the Nordic Countries. Spine. 1996;21(13):1518-25.

[4]. Moens G, Dohogne T, Jacques P, Van Helshoecht P. Back pain and its correlates among workers in family care. Occupational Medicine. 1993;43(2):78-84.

[5]. Smedley J, Egger P, Cooper C, Coggon D. Manual handling activities and risk of low back pain in nurses. Occup Environ Med. 1995 Mar;52(3):160-3. Epub 1995/03/01.

[6]. Trinkoff AM, Lipscomb JA, Geiger-Brown J, Storr CL, Brady BA. Perceived physical demands and reported musculoskeletal problems in registered nurses. Am J Prev Med. 2003 Apr;24(3):270-5. Epub 2003/03/27.

[7]. Videman T, Ojajärvi A, Riihimäki H, Troup JD. Low back pain among nurses: a follow-up beginning at entry to the nursing school. Spine. 2005;30(20):2334-41.

[8]. Tullar JM, Brewer S, Amick BC, 3rd, Irvin E, Mahood Q, Pompeii LA, et al. Occupational safety and health interventions to reduce musculoskeletal symptoms in the health care sector. J Occup Rehabil. 2010 Jun;20(2):199-219. Epub 2010/03/12.

[9]. Watkins IV R, Watkins III R, Williams L, Ahlbrand S, Garcia R, Karamanian A, et al. Stability provided by the sternum and rib cage in the thoracic spine. Spine. 2005;30(11):1283-6.

[10]. Wewers ME, Lowe NK. A critical review of visual analogue scales in the measurement of clinical phenomena. Res Nurs Health. 1990 Aug;13(4):227-36. Epub 1990/08/01.

[11]. Wong AY, Parent EC, Funabashi M, Kawchuk GN. Do changes in transversus abdominis and lumbar multifidus during conservative treatment explain changes in clinical outcomes related to nonspecific low back pain? A systematic review. The Journal of Pain. 2014;15(4):377. e1-. e35.

[12]. Castle NG, Engberg J. Organizational characteristics associated with staff turnover in nursing homes. Gerontologist. 2006 Feb;46(1):62-73. Epub 2006/02/03.

[13]. Roelofs PD, Bierma-Zeinstra SM, van Poppel MN, Jellema P, Willemsen SP, van Tulder MW, et al. Lumbar supports to prevent recurrent low back pain among home care workers: a randomized trial. Annals of internal medicine. 2007;147(10):685-92.

[14]. Ebadi S, Henschke N, Ansari NN, Fallah E, van Tulder MW. Therapeutic ultrasound for chronic low-back pain. Cochrane Database of Systematic Reviews. 2011;3.

[15].French SD, Cameron M, Walker BF, Reggars JW, Esterman AJ. Superficial heat or cold for low back pain. The Cochrane Library. 2006.

[16].van Middelkoop M, Rubinstein SM, Kuijpers T, Verhagen AP, Ostelo R, Koes BW, et al. A systematic review on the effectiveness of physical and rehabilitation interventions for chronic non-specific low back pain. European Spine J. 2011 Jan;20(1):19-39. Epub 2010/07/20.

[17]. Calmels P, Queneau P, Hamonet C, Le Pen C, Maurel F, Lerouvreur C, et al. Effectiveness of a lumbar belt in subacute low back pain: an open, multicentric, and randomized clinical study. Spine. 2009 Feb 1;34(3):215-20. Epub 2009/01/31.

[18]. Kraus JF, Schaffer KB, Rice T, Maroosis J, Harper J. A field trial of back belts to reduce the incidence of acute low back injuries in New York City home attendants. Int J Occup Environ Health. 2002 Apr-Jun;8(2):97-104. Epub 2002/05/22.

[19]. Valle-Jones J, Walsh H, O'Hara J, O'Hara H, Davey N, Hopkin-Richards H. Controlled trial of a back support ('Lumbotrain') in patients with non-specific low back pain. Current medical research and opinion. 1992;12(9):604-13.

[20]. Rostami M, Noormohammadpour P, Sadeghian AH, Mansournia MA, Kordi R. The effect of lumbar support on the ultrasound measurements of trunk muscles: a single-blinded randomized controlled trial. PM&R. 2014;6(4):302-8.

[21]. Al-Eisa E, Egan D, Deluzio K, Wassersug R. Effects of pelvic skeletal asymmetry on trunk movement: three-dimensional analysis in healthy individuals versus patients with mechanical low back pain. Spine. 2006 Feb 1;31(3):E71-9. Epub 2006/02/02.

[22]. Dieck GS, Kelsey JL, Goel VK, Panjabi MM, Walter SD, Laprade MH. An epidemiologic study of the relationship between postural asymmetry in the teen years and subsequent back and neck pain. Spine. 1985;10(10):872-7.

[23]. Fann AV. The prevalence of postural asymmetry in people with and without chronic low back pain. Archives of physical medicine and rehabilitation. 2002;83(12):1736-8.

[24]. Levangie PK. The association between static pelvic asymmetry and low back pain. Spine. 1999;24(12):1234-42.

[25].Mulligan BR. Mobilisations with movement (MWM'S). Journal of Manual & Manipulative Therapy. 1993;1(4):154-6.

[26]. Heggannavar A, Kale A. Immediate effect of modified lumbar snags in nonspecific chronic low back patients: a pilot study. Int J Physiother Res. 2015;3(3):1018-23.

[27]. Vicenzino B, Paungmali A, Teys P. Mulligan's mobilization-with-movement, positional faults and pain relief: current concepts from a critical review of literature. Man Ther. 2007 May;12(2):98-108.

[28]. Mannion AF, Elfering A, Staerkle R, Junge A, Grob D, Semmer NK, et al. Outcome assessment in low back pain: how low can you go? European Spine Journal. 2005;14(10):1014-26.

[29]. van Tulder MW, Esmail R, Bombardier C, Koes BW. Back schools for non-specific low back pain. Cochrane Database Syst Rev. 2000;2(2):CD000261. Epub 2000/05/05.

[30]. Magnussen L, Strand LI, Lygren H. Reliability and validity of the back performance scale: observing activity limitation in patients with back pain. Spine. 2004 Apr 15;29(8):903-7. Epub 2004/04/15.

[31]. Stratford PW, Binkley JM, Riddle DL. Development and initial validation of the back pain functional scale. Spine. 2000 Aug 15;25(16):2095-102. Epub 2000/08/23.

[32]. Jacob T, Baras M, Zeev A, Epstein L. Low back pain: reliability of a set of pain measurement tools. Arch Phys Med Rehabil. 2001 Jun;82(6):735-42. Epub 2001/06/02.

[33]. Ichinose H, Ito K, Sugino S, Akiyama K, Nejishima M, Gamada K. The immediate effects of ATM2 training on pelvic alignment, lower thorax expansion and pain in patients with low back pain during trunk extension. The journal of Japanese Society of Clinical Sports Medicine. 2013;21(3):725-30.

[34]. Davis KG, Marras WS. The effects of motion on trunk biomechanics. Clin Biomech. 2000 Dec;15(10):703-17. Epub 2000/10/26.

[35]. Kelsey JL, Golden AL. Occupational and workplace factors associated with low back pain. Occupational Medicine. 1988 Jan-Mar;3(1):7-16. Epub 1988/01/01.

[36]. Marras WS, Granata KP. Spine loading during trunk lateral bending motions. J Biomech. 1997 Jul;30(7):697-703. Epub 1997/07/01

.[37]. Marras WS, Lavender SA, Leurgans SE, Fathallah FA, Ferguson SA, Allread WG, et al. Biomechanical risk factors for occupationally related low back disorders. Ergonomics. 1995 Feb;38(2):377-410. Epub 1995/02/01.

[38]. Vleeming A, Stoeckart R, Volkers AC, Snijders CJ. Relation between form and function in the sacroiliac joint. Part I: Clinical anatomical aspects. Spine. 1990 Feb;15(2):130-2. Epub 1990/02/01.

[39]. Vleeming A, Volkers A, Snijders C, Stoeckart R. Relation between form and function in the sacroiliac joint. Part II: Biomechanical aspects. Spine. 1990;15(2):133-6.

[40]. Brasiliense LB, Lazaro BC, Reyes PM, Dogan S, Theodore N, Crawford NR. Biomechanical contribution of the rib cage to thoracic stability. Spine. 2011 Dec 15;36(26):E1686-93. Epub 2011/12/06.

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