

The Effect of Sahrman's Exercises on the Stability Indices in Chronic Low Back Pain Patients with Rotation-Extension Syndrome

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Cite this paper as: Fateme Ghiasi, Narges Jahantigh Akbari, Mohammad Hosseinifar, Asghar Akbari (2025), The Effect of Sahrman's Exercises on the Stability Indices in Chronic Low Back Pain Patients with Rotation-Extension Syndrome. *Frontiers in Health Informatics*, 14(2) 3117-3127

ABSTRACT

Background: Sahrman's exercises are recommended for patients with low back pain, through correcting movement, adjusting posture and improving balance. Therefore, this study aimed to determine the effect of Sahrman's Exercises on the stability indices in chronic low back pain patients with rotation-extension syndrome.

Methods: In this single blinded randomized clinical trial, 30 subjects with chronic low back pain patients with rotation-extension syndrome were included. The subjects were randomly divided into a control group, and Sahrman's Exercises group. Interventions were conducted three times per week for 4 weeks. Static and dynamic anteroposterior stability index, mediolateral stability index and overall stability index were measured before and after intervention by the biodex balance system in opened/closed eyes and double/single leg position. Data were analyzed with the paired sample and independent t-tests ($p < 0.05$).

Results: In the Sahrman's Exercises group, overall, the static and dynamic stability index significantly changed ($p > 0.05$). For example, in open and close eyes status, the overall static stability index significantly changed from 0.58 ± 0.33 to 0.38 ± 0.16 ($p = 0.03$), and 1.54 ± 0.09 to 1.00 ± 0.7 ($p = 0.02$), respectively. There is no significant difference in the stability index between control and Sahrman's Exercises groups ($p > 0.05$).

Discussion: According to the results of the study, the positive effects of Sahrman's Exercises group on postural control reactions were shown, so we suggest that in addition to routine exercises, Sahrman's Exercises should also be considered in chronic low back pain subjects with rotation-extension syndrome.

Key words: Sahrman's Exercises, Rotation-extension syndrome, Static and dynamic Balance Index.

INTRODUCTION

Low back pain is one of the most prevalent musculoskeletal disorders in industrialized societies (1–6). It is estimated that 70–80% of individuals experience at least one episode of low back pain during their lifetime (1, 7–11). In Iran, its prevalence is considerably high, ranging from 14.4% to 84.1% (12). Chronic low back pain can lead to a range of complications, including reduced range of motion, diminished muscular strength and endurance, and impaired postural stability (8). These individuals often show increased fluctuations in

their center of pressure, and the condition negatively affects the neuromuscular responses required for maintaining balance. Effective control of balance in both static and dynamic states is essential for all functional activities (13, 14). Additionally, in people with chronic low back pain, alterations in sensory input led to changes in motor output, causing delayed muscle activation and abnormal postural responses (15, 16).

Most studies reporting postural control impairments in chronic low back pain patients have emphasized therapeutic exercise as an intervention (17, 18–21). However, no specific exercise program has been clearly defined for different subgroups of these patients, and no consistent classification system exists. One of the suggested exercise programs for individuals with nonspecific chronic low back pain is Sahrman's exercise approach (19). The Sahrman classification system was designed to identify the type of movement impairment in each patient and to guide appropriate treatment (31). Each subgroup within this system describes a particular direction of faulty movement or posture that contributes to symptom aggravation (22). Accordingly, this system may be used both for diagnosing movement impairments and for prescribing corrective interventions aimed at improving stability.

No study was found that directly examined the effects of Sahrman's exercises in individuals with nonspecific low back pain. However, Panjabi and colleagues (1991) reported that proper neuromuscular control is essential for maintaining postural stability (23–28). In another study, Rhee et al. (2012) used spinal stabilization exercises to reduce pain and disability and to enhance balance in patients with chronic low back pain (19). Similarly, McDonnell and colleagues (2005) demonstrated that Sahrman's exercises were effective in a 46-year-old patient with cervicogenic headache, leading to reduced pain and disability and improved cervical mobility (29).

The classification of movement system impairment syndromes is based on the kinesiopathologic model. This model suggests that repetitive movements place stress on soft tissues, which, over time, leads to the accumulation of tissue strain and the development of pathology in the lumbar region. Repeated mechanical stress and excessive motion in small joints of the spine may result in injury. In the absence of adequate spinal stability, the lumbar area becomes more mobile than the hips, which increases the likelihood of balance disturbances. When movement patterns are repeatedly performed in improper directions, joint surface degeneration and microtrauma gradually develop. In patients with chronic low back pain, the balance between muscles and joints becomes disrupted, and over time, repeated movements lead to stress and pain in the lumbar region (30). Considering these factors, it can be argued that Sahrman's exercises, through their specific mechanism of action, may help correct repetitive rotation-extension movements in patients with chronic low back pain and rotation-extension syndrome. This correction may reduce stress and microtrauma and ultimately improve daily function. In addition, due to the nature of these exercises, teaching proper movement patterns can enhance neuromuscular function by improving movement control, proprioception, intersegmental coordination, and indirectly restoring balance between trunk and abdominal muscles. Altogether, these effects suggest that Sahrman's exercises may serve as an effective intervention for improving balance indices (30).

Studies have identified a lack of sufficient information regarding appropriate diagnosis and treatment in chronic low back pain patients (31). Some authors argue that the absence of strong evidence supporting a single intervention is due to treating heterogeneous groups of patients rather than specific subgroups (32). Since no clinical trial has yet examined the effects of Sahrman's exercises in patients with chronic low back pain—and considering that the rotation-extension syndrome is relatively common among them—the present study was designed based on the assumption that Sahrman's exercises could enhance postural stability by correcting movement and posture. The aim was to investigate the effect of Sahrman's exercises on the stability indices in chronic low back pain patients with rotation-extension syndrome of these exercises.

Method and Materials

This study was single-blinded randomized controlled trial. Thirty subjects chronic low back pain patients with rotation-extension syndrome participate in this study and were divided into two groups by simple non-probability sampling method. The medical ethics committee at the Zahedan University of Medical Sciences approved the study ethics and issued the ethics certification number as IR.ZAUMS.REC.1395.192 and registered with the region's Clinical Trials Registry (IRCT2017012028186N2). All participants signed written informed consents.

Inclusion criteria included men and women aged between 18 and 50 years, chronic LBP between the 12th rib and the buttock region, pain in lumbar spine region without referral to the lower limbs (without root cause), a 3-month or prolonged course of the disease, positive clinical rotation-extension tests based on sahrmann's method, no history of fracture, structural abnormalities, no history of dizziness and trauma. Also, no history of progressive rheumatic and neurological diseases, no history of long-term use of corticosteroids, no history of injury, malignancy and pregnancy (33-35).

Exclusion criteria included pain or inflammation in the low back, receiving other treatment during the research, unwillingness to continue treatment, not completing the course of treatment, and taking painkillers, sedatives, and alcohol 48 hours before the test (5).

The sample size was determined based on a pilot study. Ten subjects were divided randomly into two equal groups, and the main part of study was conducted on them. The means and SDs for the parameters from this pilot study, with $\alpha=0.05$ and 90% power were used to calculate the sample size. According to the results of the pilot and the formula stated, the sample size in each group was considered 15 patients.

$$n = (Z_{1-\alpha/2} + Z_{1-\beta})^2 (S_1^2 + S_2^2) / (\mu_1 - \mu_2)^2$$

$$Z_{1-\alpha/2} = 1.96$$

$$Z_{1-\beta} = 1.28$$

The sampling method was the simple, non-probabilistic sampling method and from the available population. The participants will then be allocated randomly to two intervention groups, the control group and Sahrman's Exercises group. Randomization would be performed using random number sequence. The administrator and participants were informed about the grouping data. But the physiotherapist who assessed the subjects, recorded the outcome, and analyzed the data about the grouping was blinded.

Procedure

The initial clinical examination study was performed by measuring demographic information and performing clinical tests. Then, the main research information, including overall stability index (OSI), anteroposterior stability index (APSI), and mediolateral stability index (MLSI), was recorded by the Biodex Balance System (SD 950-340, Biodex Medical Systems, Inc., Shirley, NY, USA). It has reliability and validity for measuring balance indices (36-37).

The Biodex system consists of a circular moving desk with a diameter of 55 cm, which is placed at a height of 20 cm above the ground inside the body of the equipment. This desk can tilt in different directions up to 20 degrees relative to the horizon plane. The overall stability index shows the variance in plate deviation from the horizontal plane. The anteroposterior and mediolateral indices show the deviation of the plate from the horizontal position in the sagittal and frontal planes, respectively. The indices' scores show the deviation

from the horizontal position, so the lower scores indicate better balance. The difficulty level is also adjustable, meaning the system can change the stiffness from 1 (least stable) to 12 (most stable).

To measure stability indices in the two-leg position, single leg position with open and close eyes, the subjects stood on the balance board without shoes or stockings. The right heel was placed at the intersection of lines E and 9. The left heel was placed on the intersection of lines F and 12. The feet were 20 degrees out of alignment. The hands were laid one across the other on the thorax. To measure dynamic balance indices, subjects at a stability level of 8 were tested.

Each test lasted 20 seconds and was repeated three times, and the rest time was selected to be 10 seconds. The parameters of the overall balance index, anteroposterior stability index, and mediolateral stability index were recorded before and after intervention.

Intervention

Subjects were randomly divided into two groups: the control group, Sahrman's Exercises group.

Sahrman's Exercises group: Sahrman's exercises in 8 positions (standing, supine, side lying, prone, quadruped, sitting, sitting to standing and walking position) were performed based on the sahrman's method (22,38).

Control group: in control group, patients received TENS (burst, 20min) and hot pack (20min) (43).

The subjects performed exercises three times a week for four weeks under the supervision of a physiotherapist.

Statistical analysis

The results were presented as mean values and standard deviations (SD). Criterion of significance was set as $p < 0.05$. Data analysis was performed with SPSS version 17. The assumption of a normal distribution was assessed using the Shapiro-Wilk test. The assumption of equality of variances was evaluated using Levene's test. The paired and student t-tests were used for within- and between-group comparisons.

Results

Using a pilot study, the sample size was estimated to be 30 subjects for both groups. The demographic characteristics of the subjects were compared between the groups. There was no significant difference among the two groups ($p > 0.05$) (Table 1).

Table-1- Comparison of demographic characteristics between two groups

Variable	Control group (n=15)*	Sahrman's Exercises group (n=15)*	P-value**
Age (days)	32.8 ± 0.76	31.6 ± 0.6	0.49
Weight (g)	71.86 ± 14.1	74.1 ± 13.2	0.61
Height (Cm)	165.1 ± 0.64	167.1 ± 0.64	0.67
BMI (kg/m ²)	26.68 ± 7.1	26.3 ± 9.3	0.96

*mean ± standard deviation. ** A significance level of less than 0.05.

Data were analyzed in SPSS 17 software. The normality of data distribution was examined by the Shapiro-Wilk test. The p-value was not less than 0.05 in the variables of the study. Thus, the tests do not reject the hypothesis of normality and the data are normal ($p > 0.05$).

Table 2- Within and between groups comparison of overall, posterior-anterior, and mediolateral stability indices in two groups in the static status.

Variable	Sahrmann's exercises group (n=15) *			Control group (n=15) *			P value between groups**
	Before	After	P value**	Before	After	P value**	
SMOSIBEO	0.58±0.33	0.38±0.16	0.03	0.45±0.22	0.42±0.32	0.44	0/72
SMOSIBEC	1.54±0.90	1.00±0.70	0.02	1.95±0.87	1.47±0.73	0.05	0.08
SMAPIBEO	0.42±0.24	0.26±0.14	0.02	0.36±0.18	0.34±0.30	0.65	0.36
SMAPIBEC	1.40±0.96	0.74±0.69	0.002	1.61±0.88	1.22±0.71	0.08	0.07
SMMLIBEO	0.29±0.22	0.20±0.07	0.10	0.20±0.08	0.18±0.11	0.61	0.71
SMMLIBEC	0.70±0.43	0.50±0.27	0.04	0.72±0.51	0.59±0.28	0.41	0.37
SMOSILSEO	9.86±3.24	9.03±3.23	0.15	8.74±4.15	8.84±3.07	0.90	0.86
SMOSILSEC	10.39±2.66	9.30±2.67	0.12	9.48±3.70	9.59±2.68	0.80	0.76
SMAPILSEO	1.88±1.32	1.47±1.20	0.19	1.75±1.95	1.79±1.40	0.87	0.51
SMAPILSEC	3.50±1.62	2.63±1.85	0.03	2.85±1.63	2.45±1.45	0.05	0.77
SMMLILSEO	9.54±3.15	8.80±3.14	0.21	8.36±3.91	8.80±2.95	0.85	0.78
SMMLILSEC	9.45±2.67	8.65±2.47	0.23	8.78±3.72	9.06±2.53	0.70	0.66
SMOSIRSEO	7.24±3.60	6.68±3.44	0.12	7.12±2.95	7.20±3.41	0.86	0.68
SMOSIRSEC	10.17±6.97	7.50±3.20	0.18	8.24±2.61	8.37±3.43	0.79	0.47
SMAPIRSEO	1.39±0.87	1.38±1.34	0.19	1.72±1.07	1.28±1.20	0.16	0.86
SMAPIRSEC	2.68±1.54	2.30±1.75	0.49	2.96±1.62	2.34±1.08	0.12	0.94
SMMLIRSEO	6.95±3.68	6.41±3.24	0.17	6.77±2.87	6.96±3.34	0.70	0.65
SMMLIRSEC	7.34±3.45	6.86±3.06	0.20	7.42±2.62	7.80±3.38	0.50	0.43

*mean ± standard deviation. ** A significance level of less than 0.05.

A paired and student t-tests were used to compare stability index variables in both groups. The results of Table 2 show that in the Sahrmann's Exercises group, there were significant differences in all of the static stability indices before and after training ($p < 0.05$), in all of status, except for the mediolateral static stability index in open eye status, which did not change significantly ($p > 0.05$). In the control group, not significant changes were observed in the overall, anteroposterior, and mediolateral static stability indices ($p > 0.05$).

The results of the between group comparison show no significant difference in overall variable ($p > 0.05$).

Table 3- Within and between groups comparison of Overall, posterior-anterior, and mediolateral stability indices in two groups in the dynamic status.

Variable	Sahrmann's group (n=15)*			Control group (n=15)*			P value between groups*
	Before	After	P value*	Before	After	P value*	
DMOSIBEO	1.81±0.68	1.20±0.35	0.001	2.25±1.47	1.54±0.71	0.02	0.11

DMOSIBEC	4.52±1.4 9	2.89±1.40	0.000	5.27±2.92	4.14±2.33	0.01	0.08
DMAPIBEO	1.30±0.6 6	0.77±0.33	0.01	1.53±1.07	1.24±0.96	0.12	0.02
DMAPIBEC	3.19±1.2 4	2.06±1.06	0.001	3.90±2.56	3.20±1.86	0.11	0.05
DMMLIBEO	0.95±0.3 6	0.63±0.24	0.01	1.21±1.08	0.62±0.21	0.03	0.87
DMMLIBEC	2.39±0.9 2	1.60±0.88	0.001	2.68±1.22	1.98±1.18	0.001	0.32
DMOSILSE O	14.16±5. 14	11.77±4.61	0.07	13.64±5.8 9	13.05±6.0 3	0.18	0.52
DMOSILSE C	15.96±5. 09	12.26±4.61	0.03	15.91±4.3 3	14.43±5.1 7	0.02	0.23
DMAPIILSE O	2.24±0.9 9	2.01±1.37	0.47	3.14±2.46	2.03±1.78	0.01	0.97
DMAPIILSE C	3.95±2.0 7	2.98±2.46	0.12	4.94±2.55	3.44±1.83	0.02	0.56
DMMLILSE O	13.80±5. 07	11.46±4.45	0.07	12.95±5.7 5	12.69±5.9 9	0.63	0.53
DMMLILSE C	15.14±4. 98	11.56±4.16	0.03	14.66±4.2 2	13.65±5.2 1	0.18	0.23
DMOSIRSE O	11.17±5. 11	9.68±5.42	0.06	11.49±6.2 7	11.35±6.0 5	0.83	0.43
DMOSIRSE C	12.49±5. 23	10.41±5.31	0.06	12.89±5.0 0	12.54±5.1 6	0.71	0.27
DMAPIRSE O	2.22±0.8 9	1.74±1.03	0.07	2.80±1.78	2.40±2.03	0.57	0.27
DMAPIRSE C	3.82±1.7 2	2.10±1.31	0.01	4.24±1.63	3.60±2.66	0.30	0.06
DMMLIRSE O	10.73±5. 07	9.34±5.38	0.08	10.82±6.2 4	10.82±5.8 0	0.99	0.47
DMMLIRSE C	11.31±5. 56	9.85±5.54	0.19	11.60±5.3 8	11.52±4.9 3	0.91	0.39

*mean ± standard deviation. ** A significance level of less than 0.05.

A paired and student t-tests were used to compare stability index variables in both groups. The results of Table 3 show that in the Sahrman's Exercises group, there were significant differences in all of the dynamic stability indices before and after training ($p < 0.05$), in all of status. In the control group, not significant changes were observed in the overall, anteroposterior, and mediolateral static stability indices ($p > 0.05$).

The results of the between group comparison show no significant difference in overall variable ($p > 0.05$).

Discussion

The findings of this study indicate that Sahrman's exercises can improve balance indices in patients with rotation-extension syndrome and contribute to increased postural stability.

The movement system impairment classification stems from the kinesiopathologic framework, which

suggests that repeated movements can overload soft tissues, leading to progressive tissue strain and the development of lumbar disorders (22, 32). Continuous stress and excessive motion in small joints—such as those of the spine—may contribute to structural damage. When spinal stability is compromised, the lumbar spine tends to move more than the hip joints. Over time, if movements are repeated in faulty directions, joint surfaces gradually deteriorate and microtrauma accumulates (39).

The improvement in postural stability achieved through Sahrman's exercises can be understood based on the three core neuromuscular principles of Sahrman's approach: motor control, muscle length-tension, and relative flexibility. According to the first principle, the quality of movement depends on the normal timing and specific activation of muscles. When one muscle becomes more active than its opposing counterpart, the balance of forces around the joint is disrupted, increasing the likelihood of postural impairments. In this study, participants with chronic low back pain and rotation-extension syndrome were evaluated, a group in which excessive activation of the posterior trunk muscles relative to the abdominal muscles is commonly expected. Therefore, Sahrman-based exercises were implemented to modify and reduce these faulty and repetitive movement patterns. Regarding muscle length, it represents each muscle's contribution to movement. When one muscle becomes shortened and another elongated, continuous activity and repetitive loading over time can lead to tissue damage, pain, and inflammation. This highlights the need to maintain balance between posterior trunk muscles and the abdominal muscles—particularly in rotation-extension syndromes—to ensure spinal health and stability. Relative flexibility refers to the movement relationship between two segments. In chronic low back pain, this balance is disrupted, and the lumbar region becomes more flexible and mobile than the hips. Over time, repetitive movement in this pattern leads to stress and pain in the lumbar area. Based on these three neuromechanical foundations, it can be concluded that in patients with chronic low back pain and rotation-extension syndrome, the balance between abdominal and posterior trunk muscles is disturbed, and Sahrman's exercises aim to correct repetitive rotation-extension patterns to restore spinal stability (30,39).

Rhee and colleagues reported that four weeks of spinal stabilization training improved balance in patients with chronic low back pain; however, improvements were also seen in the control group, which aligns with our findings. It is possible that balance improvement in their study was due to enhanced compensatory postural strategies and reduced muscular imbalance through better coordination between trunk and abdominal muscles (19). Heo et al. showed that 12 weeks of segmental lumbar stabilization and thoracic mobilization improved balance indices in chronic low back pain patients. This is consistent with the results of the present study and may be attributed to increased postural stability resulting from co-contraction of trunk and abdominal muscles and decreased repetitive movement in lumbar segments (17). Kim and colleagues found that lumbar stabilization using a sling improved both static and dynamic balance indices in chronic low back pain patients, which supports our findings. These improvements were likely due to enhanced trunk-hip coordination (21). Yeong et al. reported that lumbar stabilization exercises combined with hip muscle strengthening improved balance indices in women with chronic low back pain. This improvement was attributed to increased hip stability, reduced excessive lumbar motion, and correction of lumbar and pelvic alignment, which aligns with our results (6). Based on these findings, Sahrman's exercises can be considered an effective intervention for improving balance indices.

Conclusion

Based on the results of the present study, Sahrman's exercises improved postural stability in subjects with chronic nonspecific LBP. Therefore, we suggest that Sahrman's exercises should also be considered in rehabilitation programs for subjects with chronic nonspecific LBP in addition to routine exercises.

Funding

This study was supported and approved by the Zahedan University of Medical Sciences.

Authors' contributions

All authors made substantial contributions to conception, design, acquisition, analysis and interpretation of data.

Conflict of interest

The authors declared no conflict of interest.

Acknowledgements

This paper was derived from a MSc. thesis on physiotherapy. Authors of this paper appreciate for the cooperation of Research Deputy of Medical Science University of Zahedan in due to their collaboration in conducting this project and all people participated in this study.

Abbreviation

SMOSIBEO: STATIC MEAN OVERAL STABILITY INDEX BILATERAL EYES OPEN
SMOSIBEC: STATIC MEAN OVERAL STABILITY INDEX BILATERAL EYES CLOSE
SMAPIBEO:STATIC MEAN ANTERIOR POSTERIOR INDEX BILATERAL EYES OPEN
SMAPIBEC: STATIC MEAN ANTERIOR POSTERIOR INDEX BILATERAL EYES CLOSE
SMMLIBEO: STATIC MEAN MEDIAL LATERAL INDEX BILATERAL EYES OPEN
SMMLIBEC: STATIC MEAN MEDIAL LATERAL INDEX BILATERAL EYES CLOSE
SMOSILSEO: STATIC MEAN OVERAL STABILITY INDEX LEFT STANCE EYES OPEN
SMOSILSEC: STATIC MEAN OVERAL STABILITY INDEX LEFT STANCE EYES CLOSE
SMAPILSEO: STATIC MEAN ANTERIOR POSTERIOR INDEX LEFT STANCE EYES OPEN
SMAPILSEC: STATIC MEAN ANTERIOR POSTERIOR INDEX LEFT STANCE EYES CLOSE
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SMMLILSEC: STATIC MEAN MEDIAL LATERAL INDEX LEFT STANCE EYES CLOSE
SMOSIRSEO: STATIC MEAN OVERAL STABILITY INDEX RIGHT STANCE EYES OPEN
SMOSIRSEC: STATIC MEAN OVERAL STABILITY INDEX RIGHT STANCE EYES CLOSE
SMAPIRSEO: STATIC MEAN ANTERIOR POSTERIOR INDEX RIGHT STANCE EYES OPEN
SMAPIRSEC: STATIC MEAN ANTERIOR POSTERIOR INDEX RIGHT STANCE EYES CLOSE
SMMLIRSEO: STATIC MEAN MEDIAL LATERAL INDEX RIGHT STANCE EYES OPEN
SMMLIRSEC: STATIC MEAN MEDIAL LATERAL INDEX RIGHT STANCE EYES CLOSE

DMOSIBEO: DYNAMIC MEAN OVERAL STABILITY INDEX BILATERAL EYES OPEN
DMOSIBEC: DYNAMIC MEAN OVERAL STABILITY INDEX BILATERAL EYES CLOSE
DMAPIBEO: DYNAMIC MEAN ANTERIOR POSTERIOR INDEX BILATERAL EYES OPEN
DMAPIBEC: DYNAMIC MEAN ANTERIOR POSTERIOR INDEX BILATERAL EYES CLOSE
DMMLIBEO: DYNAMIC MEAN MEDIAL LATERAL INDEX BILATERAL EYES OPEN
DMMLIBEC: DYNAMIC MEAN MEDIAL LATERAL INDEX BILATERAL EYES CLOSE
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