

Differences of Spinopelvic Parameters Before and After Posterior Spinal Fusion in Lumbosacral Spinal Stenosis Patients at H. Adam Malik Hospital Medan

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Abstract

Fusion and instrumentation during decompression surgery are suggested to reduce pain and overcome instability. However, spinal fusion also has some consequences as fusion changes the normal biomechanics of the spine and reduces spinal mobility. Evaluation of spinopelvic balance after posterior spinal fusion has not been widely studied. Therefore, the purpose of this study was to assess spinopelvic balance in adult patients who had been diagnosed with lumbosacral spinal stenosis and received spinal fusion procedures. This analytical study, using a pre-test and post-test design, was conducted from August to September 2022. The study population was patients with more than 40 years old who had been diagnosed with lumbosacral spinal stenosis and underwent spinal fusion at H. Adam Malik Hospital Medan in 2017-2021. Inclusion criteria were patients who had a lumbosacral x-ray before surgery, < 6 months after surgery, and > 6 months after surgery, and the lumbosacral x-ray is visible until the hip joint, and those lumbosacral spinal stenosis underwent spinal fusion. Exclusion criteria were incomplete data and implant failure after spinal fusion. The dependent t test or Mann-U-Whitney test was used to assess the statistical analysis. There were 22 samples included in this study. A total of 22 patients, The age ranged from 50-68 years old, with mean age of 59.48 ± 9.08 years old. There were more female samples (68.2%) than males (31.8%). Pelvic tilt mean angle were $19.14^{\circ} \pm 22.28^{\circ}$ vs $17.68 \pm 8.02^{\circ}$ vs $14.27^{\circ} \pm 5.34^{\circ}$. Sacral slope mean angle were $43.23^{\circ} \pm 20.22^{\circ}$ vs $17.68^{\circ} \pm 8.02^{\circ}$ vs $14.27^{\circ} \pm 5.34^{\circ}$. Pelvic incidence mean angle were $57.68^{\circ} \pm 11.56^{\circ}$ vs $55.59^{\circ} \pm 12.28^{\circ}$ vs $52.64^{\circ} \pm 10.05^{\circ}$. Lumbar lordosis mean angle were $43.91^{\circ} \pm 13.02^{\circ}$ vs $41.55^{\circ} \pm 12.77^{\circ}$ vs $41.18 \pm 13.12^{\circ}$. Pelvic incidence lumbar lordosis mismatch mean angle were $14.86^{\circ} \pm 10.26^{\circ}$ vs $14.50^{\circ} \pm 10.79^{\circ}$ vs $11.23^{\circ} \pm 8.55^{\circ}$. The analysis showed changes in angles among the three groups in all evaluated spinopelvic parameters, but not statistically significant ($p > 0.05$). Previous research indicated that spinopelvic examinations such as lumbar lordosis, pelvic incidence, and pelvic tilt were highly correlated with sagittal balance, where pelvic incidence was a particularly important key parameter. In this study, spinopelvic parameters in three groups were examined, compared and evaluated at three different times, yielding no significant differences. The pelvic incidence lumbar lordosis mismatch is an important parameter to examine. However, the results of this study did not show any significant differences among the values before and after posterior spinal fusion surgery. There was no significant differences in spinopelvic parameters before posterior spinal fusion, < 6 months, and > 6 months after posterior spinal fusion surgery in patients with lumbosacral spinal stenosis.

Keywords: Sagittal Balance; Spinopelvic Parameter; Spinal Stenosis

1. Introduction

The term "spinopelvic balance" refers to the spinal alignment in the sagittal plane that is the balance result of the pelvic between the spine and the lower limbs (Barrey et al., 2017). Spinopelvic balance is a concept that has been widely used and applied to the diagnosis and treatment of spinal diseases. Poor clinical outcomes are associated with the imbalance of the spinopelvic balance (Legaye et al., 1998; Glassman et al., 2005) This is brought on by the spine's morphological or anatomical location (Schwab et al., 2022)

Patients with degenerative disc degeneration and chronic low back pain typically have anterior sagittal imbalance, loss of lumbar lordosis, and increased pelvic tilt (Hanson et al., 2022; Barrey et al., 2007). It has long been controversial to perform surgery on people with low back pain symptoms. For degenerative lumbosacral discs, there are numerous surgical alternatives. Patients with degenerative lumbosacral disc with the signs of neurological claudication, decompression surgery is a crucial procedure (Fritzell et al., 2001). On the other hand, fusion and instrumentation procedure during decompression surgery is recommended to lessen discomfort and improve instability. The typical biomechanics of the spine are altered as a result of spinal fusion, which also limits spinal mobility (Schlegel et al., 1996; Masevnin et al. 2015).

The evaluation of spinopelvic balance has not received much research, especially after posterior spinal fusion. Therefore, it is still necessary to evaluate spinal posterior fusion in cases with lumbar degenerative discs.

2. Methods

This study is an analytic study with a pretest and post test design to evaluate the spinopelvic balance in adult patients who underwent spinal fusion surgeries at H. Adam Malik General Hospital in Medan after being diagnosed with lumbosacral spinal stenosis.

This study was carried out from August to September of 2022. The spinopelvic parameters were evaluated using data from the medical record. The recorded data is then organized, processed, analysed and to be presented analytically and descriptively with the chosen research design.

3. Results

Total of 22 patients that fit the inclusion and exclusion criteria were included in this study. Three lumbar radiological exams were carried out on each respondent to assess the importance of pelvic tilt, sacral slope, lumbar lordosis, and pelvic incidence. All of these values were assessed at three distinct intervals, namely preoperative X-rays, X-rays taken during a period of six months, and X-rays taken in the last six months or more. The ages of the respondents ranged from 50 to 68 years, with a proportion of female respondents reaching 68.2% and male respondents 31.8% in each of the three categories.

Table 1. Characteristic of the respondents

Variable	Result
Age (mean±SD)	59.48 ± 9.08
Male (%)	31.8%
Female (%)	68.2%
Pelvic Tilt (mean±SD)	19.14 ± 22.28
Sacral Slope (mean±SD)	43.23 ± 20.220
Pelvic Incidence (mean±SD)	57.68 ± 11.56
Lumbar Lordosis (mean±SD)	43.91 ± 13.02

 Pelvic Incidence – Lumbal Lordosis (mean±SD) 14.86 ± 10,26

Table 2. Comparison between X-ray evaluation

Variable	X-ray < 6 months period (mean±SD)	X-ray > 6 months period (mean±SD)	Difference between pre operative and post operative (<6 months period) (P-Value)	Difference between pre operative and post operative (<6 months period) (P-Value)	Difference between pre operative and post operative (<6 months and >6 months period) (P-Value)
PT	17.68 ± 8.02	14.27 ± 5.34	0.54*	0.58*	0.14
SS	35.95 ± 10.91	37.05 ± 8.20	0.10*	0.22*	0.97*
PI	55.59 ± 12.28	52.64 ± 10.05	0.51	0.14	0.36
LL	41.55 ± 12.77	41.18 ± 13.12	0.54*	0.28	0.61*
PI-LL	14.50 ± 10.79	11.23 ± 8.55	0.84	0.12	0.08

*Wilcoxon sign test

According to the results table above, the first group has the lowest pelvic tilt value of the other two groups. The differences in values between the second and third groups were minor and statistically not significant. The sacral slope value did not differ significantly between the three groups. Pelvic incidence in all respondents in the three groups did not differ significantly, with the value in the first group was 57.68, second group was 55.59, and third group was 52.64. The value of lumbar lordosis in all three groups of respondents did not show a significant difference in the results.

All responder groups have the pelvic incidence and lumbar lordosis values not significantly differ from one another. Due to the constraints of the equipment available at the conducted study, it is impossible to capture a panoramic X-ray for this study in order to quantify a comprehensive spinopelvic parameter from a sagittal cross section.

4. Discussions

Lumbar spinal stenosis occurs when the anteroposterior and lateral diameters of the bony canal are narrower than normal, or the size of the canal's cross section is abnormal. There are two types of spinal stenosis: congenital and acquired. Acquired stenosis is typically caused by a degenerative process, with degenerative arthritis of the spine being the most common cause of spinal stenosis. The facet joint and ligamentum flavum are the most commonly affected areas. Imaging studies can be used to assess and help with the diagnosis. A mid-sagittal diameter of a canal less than 10mm to 13mm is considered an absolute stenosis. If conservative treatment fails to alter or improve the symptoms, surgery is then done. If pain that radiates to the leg exists, surgery is also indicated. Decompression is used to lessen venous congestion, which harms bones and nerves. In terms of anterior column support, more effective decompression, and restoration of lumbar alignment, surgery with posterior fusion is seen as superior procedures to previous techniques. This is supported by research conducted by Chen Y et al (2018).

All analyzed spinopelvic parameters in the three groups of this study indicated differences and changes in

angle according to the findings, however none of these measures revealed appreciable differences or changes. Results are deemed significant if $p < 0.05$. All spinopelvic parameters in the first and second groups did not show a statistically significant differences, however there was a sizable average difference between the two groups. Despite a shift in the spinopelvic parameter's angle, there was no statistically significant difference between the first and third groups during the spinopelvic assessment. This also applied to the data analysis findings for the second and third groups, where there was no statistically significant difference in the spinopelvic values. On the contrary, the study done by Shuangjun et al., discovered that outcomes they obtained were a considerable rise in spinopelvic parameters following surgery by posterior fusion. PI-LL is one of the significant measurement outcomes to be performed on spinopelvic parameters. It has been discovered that this metric and HRQOL are closely related. The values between three distinct period; before surgery, <6 months after surgery, and >6 months after surgery, there was no statistically significant difference in this study. The mean PI-LL value resulted in a drop, although this value was not statistically significant (Endo et al., 2010; Urquhart et al., 2018; Ye et al., 2013; Mukai et al., 2013; Harroud et al., 2013; He et al., 2020)

Rothenfluh et al. conducted a study on 84 patients after posterolateral fusion in 1, 2, or 3 segments where patients with ASD found higher PI-LL values (>10) and had a 10-fold higher risk compared to controls, the purpose of this study was to compare the spinopelvic parameters before and after surgery (Matsumoto et al., 2017).

The limitation of the equipment available at the conducted study make it impossible to capture a panoramic X-ray for this study in order to quantify a comprehensive spinopelvic parameter from a sagittal cross section

5. Conclusions

According to the findings of the study, it can be concluded that:

1. At H. Adam Malik Hospital, 68.2% of patients who underwent posterior spinal fusion for degenerative disease were female, and their mean age (Mean SD) was 59.48 9.08 years.
2. Before surgery or group 1, the average of the respondent's spinopelvic angle was 12.5, 39.5 for sacral slope, 57.68 for pelvic incidence, 43.91 for lumbar lordosis, and 14.86 for pelvic incidence-lumbar lordosis.
3. After undergoing posterior fusion and having an X-ray taken within six months period, the mean spinopelvic angle parameters of the respondents were 17.68 for pelvic tilt, 35.95 for sacral slope, 55.59 for pelvic incidence, 46.50 for lumbar lordosis, and 14.50 for pelvic incidence - lumbar lordosis.
4. After undergoing posterior fusion surgery and having an X-ray taken every six months, the respondent's mean spinopelvic angles were 14.27 for pelvic tilt, 35.95 for sacral slope, 52.64 for pelvic incidence, 41.18 for lumbar lordosis, and 11.23 for pelvic incidence-lumbar lordosis.
5. Both six months and more after posterior spinal fusion surgery, there was no significant difference in spinopelvic parameters before and after posterior spinal fusion.

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