

Spinal pelvic parameters before and after the Spine fixation and its impact on clinical outcomes: A study from a tertiary care hospital

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Abstract

Degenerative spine disease (DSD) is a progressive disease of the spine affecting inter vertebral discs, bones, soft tissues and joints. This condition not only affects the stability of the spine but it also affects its alignment. Alignment of the spine is of special importance at Spinal-pelvic junction specially its sagittal alignment, broadly referred to as Spinal sagittal balance. Main objective parameters that determine the Spinal sagittal balance is Sacral slope (SS), Pelvic tilt (PT), Lumbar lordosis (LL) and Pelvic incidence (PI).

Lumbar spine fixation is a surgical procedure aimed to restore not only the stability but also the alignment of the spine. In this retrospective study spanning over 2 years at a tertiary care hospital, we evaluated patients before and after the spine fixation surgeries in terms of their Spinal sagittal parameters. Total 52 patients were included in the study and followed for one year period, with majority (32) patients showing correction of the parameters especially Sacral slope, Lumbar lordosis and Pelvic tilt. Patients with corrected spinal alignment also showed significant clinical improvement in terms of low back pain and Oswestry disability index (ODI).

Based on the results of the study, we can conclude that Spine fixation improves Sagittal balance of the spine in selected population.

Keywords: Lumbar Spine fixation; Spine-Pelvic parameters; Spine biomechanics; Degenerative spine disease; Oswestry disability index

1. Introduction

Lumbar spine is an important part of the spine as it transmits upper body weight to the pelvic girdle and hence lower limbs.¹ It also helps maintains the upright posture of the body mainly owing to its flexibility, lordosis and alignment at the Spinal pelvic junction.² Lumbar lordosis is unique to humans and it helps support the bipedal locomotion of the human body and its upright posture. Lumbar lordosis in particular and spinal sagittal alignment in general is affected by the pelvic stability, health of the musculature, bones, joints and the intervertebral discs.³

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Lumbar lordosis is measured as angle between a line drawn parallel to the lower end plate of the 12th Thoracic (T12) and upper end plate of the 1st Sacral (S1) vertebra. ⁴ Normal measures of the Lumbar lordosis in a healthy adult are within 55-65° degrees as measured by a lateral radiograph. ⁵

Sacral slope is measured by the line drawn over the superior end plate of S1 and a line drawn parallel to the bottom of the radiograph from the anterior superior edge of the S1. ⁶ The normal ranges of Sacral slope lie within 20° and 30° as measured on a lateral radiograph.

Pelvic tilt is another very important parameter determining the Sacral-pelvic balance and it is measured at the junctions of two lines drawn on a lateral radiograph, a reference vertical line and a line drawn from this point to midpoint of the 1st Sacral (S1) vertebra. Normal ranges lie within 0° and 27° with a mean of 13.0 +/- 4.5° of anterior tilt. ⁷ Pelvic incidence is the sum of Sacral slope and the Pelvic tilt, and determines the overall Sagittal spinal alignment. PI-LL determines the overall biomechanical harmony at the Lumbar spine-pelvic junction, its normal ranges lie within 11°. ⁸

Degenerative diseases of the spine affect the stability of the spine by virtue of affecting bones, discs, joints and soft tissues including muscles and ligaments. Besides the anatomical stability, it also affects the sagittal alignment of the spine. Degenerative Lumbar disease can lead to the loss of Lumbar lordosis, reduced Pelvic tilt and anterior Sagittal balance. ⁹ Literature shows that the misalignment of the degenerative spine is an important component of the worst clinical picture.

Aim of the Lumbar spine fixation surgery is not only to stabilise the spine but also to restore the spinal sagittal balance. In this retrospective study spanned over 2 years, we calculated the spine-pelvic parameters before and after the surgery to look for the degree of correction in the sagittal balance and its impact on the clinical outcomes. ¹⁰

2. Methods

This cross-sectional study of the retrospective data was conducted at Lady Reading hospital Peshawar, the largest tertiary care hospital in the province. Patient's data of previous 2 years was collected, parameters such as Lumbar lordosis (LL), Sacral slope (SS), Pelvic tilt (PT) and PI-LL were calculated based on the preop and postop lateral standing radiographs of the patients. Clinical data in the form of Oswestry disability index (ODI) was recorded as well.

Inclusion criteria included adult patients with age > 18 years, diagnosis of DSD who had undergone spine fixation surgery. Exclusion criteria included patients younger than 18 years, patients with traumatic fractures, congenital deformities such as scoliosis and conditions like tumours or inflammatory conditions.

Descriptive statistical analysis in the form of means and ranges were carried out using SPSS 26.0. Data was presented in both descriptive as well as tabulated forms.

3. Results

Total 52 patients were selected for the study, with mean age of 49 ± 3 years with female predominance (F=28, M= 24). Majority 32 (61.5%) of the patients showed significant improvements in radiological parameters as well clinical outcome scores.

Average degree of correction was 5°-8° in sacral slope (SS), 10°-15° degrees in Lumbar lordosis (LL) and 4°-7° degrees in the pelvic tilt (PT). No significant change was seen in the Pelvic incidence (PI) while PI-LL was significantly improved to <10°. Similarly, Oswestry disability index (ODI) significantly improved from 55% to 30%.

Table 1 Spine pelvic parameters before and after the surgery

Parameter	Preoperative value	Postoperative value	Degree of correction
Lumbar Lordosis (LL)	40°-50°	50°-65°	10°-15°
Pelvic tilt (PT)	15°-25°	10°-18°	4°-7°
Sacral Slope (SS)	20°-30°	25°-38°	5°-8°
Pelvic incidence (PI)	45°-60°	45°-60°	No change

Pelvic harmony (PI-LL)	>10°	<10°	Significant change
ODI	55%	30%	25%

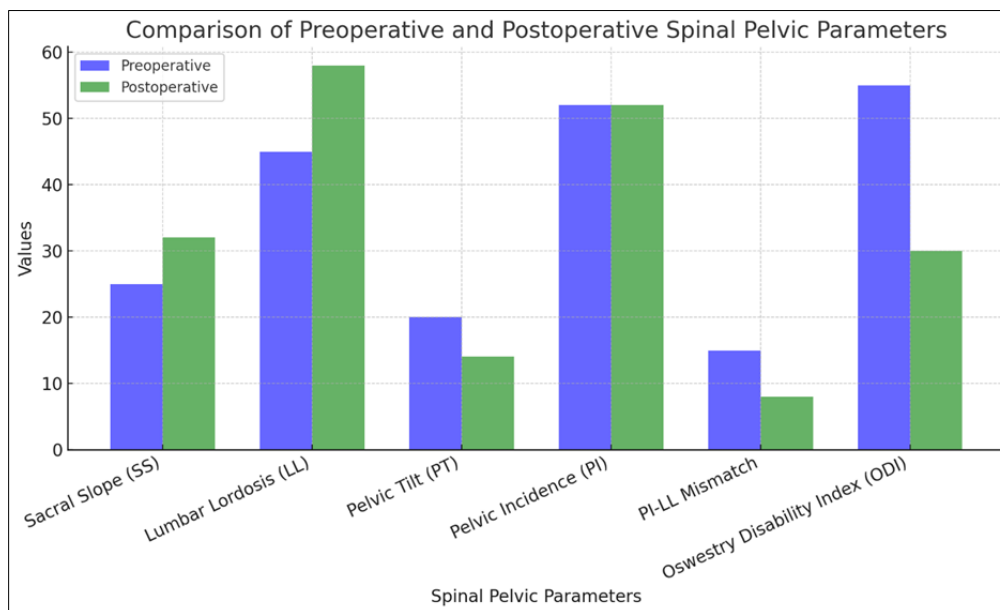


Figure 1 Comparison of Preoperative and Postoperative Spinal pelvic parameters

4. Discussion

Human spine is a dynamic, mobile structure unlike rigid long bones. This mobility is ensured by intervertebral discs, muscles and ligaments and intervertebral joints. Spine has many curves like cervical lordosis, thoracic kyphosis and lumbar lordosis etc that contribute to the overall mobility and stability of the spine which helps human body stand erect and contribute to the bipedal mobility.¹¹

Just like other human body organs, spine also degenerates over time. This process can start at any point in the spine primarily at the disc, and is affected by a multitude of factors.¹² Degenerative process not only affects the stability of the spine but as the disease progresses, it also destabilized the alignment of the spine.¹³ Vast amount of literature shows that misalignment of the spine can lead to a variety of clinical presentations, from pain, instability and fatigue.¹³

It is also widely published that realignment of the spine helps with the alleviation of the symptoms and improvement of quality of life.¹⁴ Various modalities like conservative and surgical are generally employed for the correction of the spinal misalignment. Surgery in the form of spinal fixation are widely used to stabilize the spine as well as correct its alignment.^{14,15}

Just as published in the scientific literature, our study showed that Spine fixation helps with realignment of the spine specially at the Lumbar spine-pelvic junction. This correction translates in better clinical outcomes as calculated by Oswestry disability index (ODI).¹⁶

5. Conclusion

Spine fixation surgery helps realign the spine at Spine-Pelvic junction and improves the clinical outcomes in patients suffering with degenerative spine disease.

Compliance with ethical standards

Acknowledgement

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Disclosure of conflict of interest

No conflict of interest to be disclosed.

Statement of ethical approval

'The present research work does not contain any studies performed on animals/humans subjects by any of the authors'.

Ethical approval for data collection was taken from the hospital's Ethical review Boards (ERB).

Statement of informed consent

Informed consent was obtained from all individual participants included in the study.

References

- [1] Berven, S.H., & Wadhwa, R.K. (2018). Sagittal Alignment of the Lumbar Spine. *Neurosurgery clinics of North America*, 29 3, 331-339.
- [2] Sparrey, C.J., Bailey, J.F., Safaee, M.M., Clark, A.J., Lafage, V., Schwab, F., Smith, J.S., & Ames, C.P. (2014). Etiology of lumbar lordosis and its pathophysiology: a review of the evolution of lumbar lordosis, and the mechanics and biology of lumbar degeneration. *Neurosurgical focus*, 36 5, E1.
- [3] McGregor, A.H., & Hukins, D.W. (2009). Lower limb involvement in spinal function and low back pain. *Journal of back and musculoskeletal rehabilitation*, 22 4, 219-22.
- [4] Been, E., & Kalichman, L. (2014). Lumbar lordosis. *The spine journal: official journal of the North American Spine Society*, 14 1, 87-97.
- [5] Troyanovich, S.J., Cailliet, R., Janik, T.J., Harrison, D.D., & Harrison, D.E. (1997). Radiographic mensuration characteristics of the sagittal lumbar spine from a normal population with a method to synthesize prior studies of lordosis. *Journal of spinal disorders*, 10 5, 380-6.
- [6] Suzuki, H., Imai, N., Nozaki, A., Hirano, Y., & Endo, N. (2019). Anatomical sacral slope, a new pelvic parameter, is associated with lumbar lordosis and pelvic incidence in healthy Japanese women: A retrospective cross-sectional study. *Journal of Orthopaedic Surgery*, 28.
- [7] Mac-Thiong, J., Mac-Thiong, J., Roussouly, P., Berthonnaud, E., & Guigui, P. (2011). Age- and sex-related variations in sagittal sacropelvic morphology and balance in asymptomatic adults. *European Spine Journal*, 20, 572-577.
- [8] Asaid, M., Cox, A.A., Breslin, M., Siedler, D.G., Sutterlin, C.E., & Dubey, A. (2020). Restoring spinopelvic harmony with lateral lumbar interbody fusion: is it a realistic goal? *Journal of spine surgery*, 6 4, 639-649 .
- [9] Barrey, C.Y., Roussouly, P., Perrin, G., & Huec, J.C. (2011). Sagittal balance disorders in severe degenerative spine. Can we identify the compensatory mechanisms? *European Spine Journal*, 20, 626-633.
- [10] Goldstein, J.A., Macenski, M.J., Griffith, S.L., & McAfee, P.C. (2001). Lumbar Sagittal Alignment After Fusion With a Threaded Interbody Cage. *Spine*, 26, 1137-1142.
- [11] Kozlov, A.D., & Potekhina, Y.P. (2018). Phylogenetic aspects of functional and structural entity of human vertebral spine. *Russian Osteopathic Journal*.
- [12] Benoist, M. (2003). Natural history of the aging spine. *European Spine Journal*, 12, S86-S89.
- [13] Iorio, J.A., Jakoi, A.M., & Singla, A. (2016). Biomechanics of Degenerative Spinal Disorders. *Asian Spine Journal*, 10, 377 - 384.
- [14] Patel, P.D., Arutyunyan, G., Plusch, K., Vaccaro, A.R., & Vaccaro, A.R. (2020). A review of cervical spine alignment in the normal and degenerative spine. *Journal of spine surgery*, 6 1, 106-123.

- [15] Shakil, H., Iqbal, Z.A., & Alghadir, A.H. (2014). Scoliosis: review of types of curves, etiological theories and conservative treatment. *Journal of back and musculoskeletal rehabilitation*, 27 2, 111-5.
- [16] Kelly, P.D., Sivaganesan, A., Chotai, S., Parker, S.L., McGirt, M.J., & Devin, C.J. (2016). Matched-pair cohort study of 1-year patient-reported outcomes following pelvic fixation. *The spine journal : official journal of the North American Spine Society*, 16 6, 742-7 .