

CORRELATION SAGITTAL BALANCE WITH HEALTH RELATED QUALITY OF LIFE ON PATIENTS AFTER POSTERIOR SPINAL FUSION



Orthopaedic

KEYWORDS: Pelvictilt, Health related quality of life

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ABSTRACT

The sagittal balance analysis has gain importance in surgery of the spine. With the increasing use of spinal fusion, these effects on sagittal balance are related to the locked position of the fused spinal. Clinical evidence has indicated that if fusion surgery is undertaken, improved outcome can be achieved by correcting any sagittal deformity present. Some studies have shown the correlation of spinopelvic parameters with health related quality of life and pain measures.

The study is a retrospective study and the purpose of the study is to examine the effect of radiographic pelvic and spinal parameters for sagittal balance analysis and the health related quality of life measured by Oswestry Disability Index (ODI) and Visual Analogue Scores (VAS). Each patient was performed a radiological examination with spine photo antero-posterior (AP) and lateral preoperative and postoperative. The spinopelvic parameters (sagittal vertebral axis, pelvic tilt, pelvic incidence, lumbar lordosis), age, visual analogue scale (VAS) and oswestry disability index (ODI) was measured. Patients with improvement of sagittal spinopelvic parameters after posterior spinal fusion are 35 people (79, 5%) have average ODI 50.85 and average VAS 5.25 preoperatively, and these improved to average ODI 25.54 and average VAS 2.34 post operatively. Patients without improvement of sagittal spinopelvic parameters after posterior spinal fusion are 9 people (20,5%) have average ODI 52.22 and average VAS 5.66 preoperatively, and these improved to average ODI 31.55 and average VAS 3.33 post operatively. The most significant spinopelvic parameter that improve VAS and ODI was pelvic tilt ($p < 0.05$, pearson coefficient VAS -0.55 and ODI 0.80). Patients with improvement of sagittal spinopelvic parameters after posterior spinal fusion were found to have a better health related quality of life. Spinopelvic parameters were highly influenced by pelvic tilt.

INTRODUCTION

Spinal deformity in adults has a very broad diagnosis classification and radiological can be divided into two major parts planar deformity coronal and sagittal planar deformity. Planar sagittal deformity will lead to compensation on sagittal balance. When there is a decompensation there will be problems in the sagittal balance such as pain and disability. The ideal alignment of the spine will minimize energy consumption by muscle in individuals in a standing position. This situation can be achieved through a complex relationship between the physiological curvature of the spine, the morphology of the pelvis, the state of the axial and appendicular body muscles.^{1,2}

The importance of the relationship between the spine and pelvis balance the posture and energy used while standing and walking depicted on the economy cone Dubousset. Sagittal imbalance would lead to an increase in body position learning away from the cone and will lead to an increase in muscle force and energy consumption to balance the body so that it will cause pain, fatigue and disability. Analysis of sagittal balance began to play an important role in bone surgery. The effects of sagittal balance will be associated with the position of spinal fusion. In the spinal fusion surgery, improving the quality of the end can be achieved by improving the existing sagittal any abnormalities. Some studies also show a link between radiological parameters of the spine and pelvis with quality of life and patient pain scale. Radiological parameters were used as a reference in conducting operative measures that achieve "Spinopelvic Harmony" which consists of SVA < 5 cm, PT < 20 degrees, and LL = PI + 9 degrees.² The parameters used in evaluating the quality of life of patients before and after the operative procedure is Visual Analogue Scale (VAS) and Oswestry Disability Index (ODI). Improvement of the radiological parameters will affect the increased value of VAS and ODI of patients.^{3,6}

The aim of the study was to determine the relationship between parameters of radiological spine and pelvis to the analysis of equilibrium sagittal quality of life as measured by the index Disabilities Oswestry (ODI) and the Scale of pain visual (VAS) in patients who have done spinal fusion at the Dr. Hasan Sadikin Hospital Bandung.

MATERIAL AND METHODS

The study was conducted with the data derived from medical records of patients in the period July 2013 to July 2015; the number of patients with spinal fusion is 44 peoples. Each patient was performed a radiological examination with antero - posterior (AP) and lateral view x-ray, preoperative and postoperative. Patients stand in an upright position, hip and knee full extension to reduce the effect of compensation, full flexion elbow and hands placed in the supraclavicular without external support.⁴

Data processed descriptively that include:

1. Gender
2. Age
3. Spinopelvic Harmony
4. Oswestry Disability Index (ODI)
5. Visual Analogue Scale (VAS)

Operating procedures

Spine surgery performed by consultants, performed a posterior spinal fusion with pedicle screw, with or without performed laminectomy and decompression. To repair the deformity, the rod is precontoured then carried reduction of the deformity by giving force to the spine. The installation of the pedicle screw rod is mounted on the spine to maintain reduction. Posterior fusion is achieved by inserting a bone graft either allograft or auto graft in the lamina.⁴

Statistical Analysis

Statistical analyzes was performed to determine significant differences between the groups and the relationship between the measured parameters. Statistical analysis was performed using SPSS version 13 software and medcalc version 11.5.

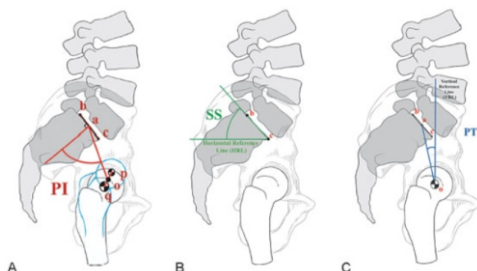
Radiological analysis

Three parameters of the pelvis that affect the sagittal balance is^{1,2,7}

1. Pelvic Incidence (PI) is the angle formed by the line connecting the midpoint of the femoral head with the midpoint of the sacral end plate with a line perpendicular to the midpoint of the sacral end plate. The average value is 52 ± 10

2. Sacral Slope (SS) is the angle formed by the horizontal line with a line perpendicular to the midpoint of the sacral end plate. The average value of is 30°90

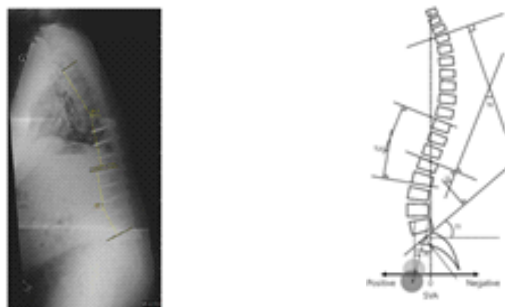
3. Pelvic Tilt (PT) is the angle formed by the vertical line with the line connecting the midpoint of the femoral head with the midpoint of the sacral end plate. The average value of 15°70.



Picture 1

A. Pelvic Incidence (PI) B. Sacral Slope (SS) C. Pelvic Tilt (PT)^{1,2,7}

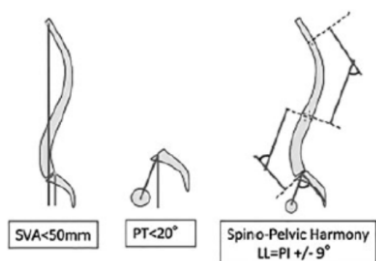
Global sagittal alignment is measured by drawing a vertical line from the midpoint of the C7 vertebral bodies to the sacrum, referred to as the sagittal Vertebral Axis (SVA). In the spine balanced, SVA will pass posterosuperior part of the S1 vertebral bodies. When SVA past the front or the rear, the sagittal balance is called negative or positive. SVA 2.5cm > is called abnormal. Regional sagittal alignment is measured by measuring thoracic kyphosis (T5 - T12) with an average value of 41 ± 12 degrees and lumbar lordosis (T12 - S1) with an average value of 60 ± 12 degrees.



Picture 2 Measurement of thoracic kyphotic angle dan lumbar lordotic angle, sagittal vertebral axis.⁸

Analysis of sagittal balance began to play an important role in spinal surgery. More and more often performed spinal fusion surgery; the effects of sagittal balance will be associated with the position of spinal fusion. In the spinal fusion surgery, improving the quality of the end can be achieved by improving the existing sagittal any abnormalities.

Radiological parameter measurement of the spine and pelvis will affect the quality of life and patient pain scale. These parameters are used as a reference in conducting operative measures that achieve "Spino pelvic Harmony" which consists of SVA < 5 cm, PT < 20 degrees, and LL = PI + 9 degrees.^{1,2,5,7}



Picture 3 Spino pelvic Harmony¹

ANALYSIS OF QUALITY OF LIFE

Visual Pain Scale (VAS) is a psychometric scale to measure the characteristics and levels of pain that cannot be measured directly. Patients pointing at pain scale with values between 0-10 (no pain to very severe pain). 9,10 Disability Index Oswestry an index derived from the questionnaire oswestry on spinal pain, which is used to clinicians and researchers to measure the degree of disability in spinal pain. This index is considered as the gold standard in determining the degree of disability and estimate the quality of life in patients with spinal pain.

The questionnaire filled in by the patient and consists of ten topics concerning the intensity of pain , ability to lift objects , the ability of everyday activities , the ability to walk, the ability to sit, sexual function, ability to walk, social life , quality of sleep and ability to travel. Patients choose the statement that best suits the current condition. Each statement has a value of 0-5, a value of 0 describe minimal disability while 5 illustrates the severe disability. This value is summed and multiplied by two to reach the index (0-100). Value 0 illustrates the absence of disability, the maximum value of 100 illustrate disability.¹⁰

RESULT

The numbers of patients who had posterior spinal fusion done in Hasan Sadikin hospital and meet the criteria in the period July 2013 to July 2015 are 44 peoples. The distribution of patients by sex, namely, male 30 cases (68%) and women 14 cases (32 %). Distribution of patients with posterior spinal fusion based on age, age < 20 years there were 2 cases (4.5 %), age of 20-39 years there were 20 cases (45.5 %), age 40-59 years there were 16 cases (36.3 %), and age > 60 years there were 6 cases (13.6 %). The age group 20-39 years is the group with the highest distribution of cases.

Table-1 Distribution of patient based on age, gender, radiological parameter "spino pelvic harmony" and improvement of radiological parameter post operative

	Number	Percentage	
		Gender	
Male	30	68 %	
Female	14	32 %	
		Age	
< 20	2	4.5 %	
20-39	20	45.5 %	
40-59	16	36.3 %	
>60	6	13.6 %	
	Radiological Parameter		Post-operative Radiological Parameter
	Meet criteria "spino pelvic harmony"	Didn't meet criteria "spino pelvic harmony"	Improve Not Improve
Pre-operative	25 (56.8%)	19 (33.2%)	
Post-operative	31 (70.4%)	13 (29.6%)	35 (79.5%) 9 (20.5%)

Distribution of patients based on the parameters of radiological "spino pelvic harmony", the distribution of patients prior to fusion of the posterior spinal there were 25 cases (56.8 %) with the parameters of radiological meet the " spino pelvic harmony" and 19 cases (33.2 %) with the parameters of radiological does not meet the " spino pelvic harmony ". After posterior spinal fusion, there were 31 cases (70.4%) cases with radiological parameters meet the "spino pelvic harmony" and 13 cases (39.6%) with radiological parameters do not meet the "spino pelvic harmony". Distribution of patients based Oswestry Disability Index (ODI) and Visual Pain Scale (VAS). Group A is the patient with improved radiological parameters of the spine and pelvis amounted to 35 (79.5 %) had an average value of 50.4 ODI and

the average value of preoperative VAS 5.83, and this value is reduced postoperative , the average value of 25.5 ODI and the average value of VAS 2.35

Group B is the patients without improvement of parameters of radiological spine and pelvis total 9 (20.5 %) had an average value ODI 52.2 and the average value of VAS 5.67 preoperative , and this value is reduced postoperative, the average value ODI 32.4 and values average VAS 3:33

Table-2 The relationship between the quality of life in both groups based on improvement of radiological parameters

	VAS		Im prove ment VAS	ODI		Im prove ment ODI
	Pre operati ve	Post operati ve		Pre operativ e	Post operativ e	
Group A (n=35)	5.25+ 1.03	2.34+ 0.96	55.4%**	50.85+5. 36	25.54+ 4.60	49.7%**
Group B (n=9)	5.66+ 0.86	3.33+ 0.70	41.1%**	52.22+ 9.35	31.55+ 6.85	39.58%**
P value*		< 0.05	< 0.05		< 0.05	< 0.05

* Wilcoxon's signed rank test.

** Mann-Whitney U tests.

Table-4 Spino-pelvic radiologic parameter and pearson coefficient correlation between spinopelvic parameter and clinical parameter

Measurement	Pre operative	Post operative	p*	ΔVAS	Δ ODI
Sagittal Vertebral Axis	3.22 + 1.4	2.75 + 1.4	<0.05	0.0167	0.1833
Pelvic Tilt	19.77 + 3.0	18.8 + 2.96	<0.05	-0.5513**	0.8016**
Pelvic Incidence	52.22 + 3.17	52.1 + 3.26	<0.05	-0.017	0.1667
Lumbar Lordosis	60.9 + 4.29	60.3 + 4.24	<0.05	0.0959	0.1412

ΔVAS = Improvement rate between preoperative VAS and postoperative VAS;

ΔODI = Improvement rate between preoperative ODI and postoperative ODI.

**p < 0.05

* Wilcoxon's signed rank test

DISCUSSION

In recent studies, there is growing literature about spinoplevic parameters/ harmony in patients underwent spinal surgery.8, 11-15 In this study, we concentrated on surgery of lumbal disc degenerative diseases. Posterior spinal fusion can result loss of lumbar lordosis (LL) or flat back, with decreased sacral slope (SS) and increased pelvic tilt (PT).Many studies have demonstrated various relationships between pain (VAS) and imaging parameters to other clinical entities.16-19 In case of spinal deformity, also allowed for establishment of a relationship between quality of life (ODI) and imaging parameters. Increased PT after spinal fusion is correlated with VAS and ODI.19, 20 It is importance to assess before posterior spinal fusion amount LL which is required to achieve good sagittal balance. Increased pelvic inclination (PI) require more than lumbar correction for sagittal balance and it is frequently under corrected.21,22

In our study, there were 44 patients who had performed a posterior spinal fusion. The patients were divided into 2 groups: Group A (patients with improved radiological parameters spine and pelvis) and group B (patients without improvement radiological parameters of the spine and pelvis).Tables 1 and 2 show the demographic characteristics, there are 30 men and 14 women, age range between 19-70 years (mean age 42.8 years). Most patients showed the values of radiological parameters based “spino-pelvic harmony”, prior to posterior spinal fusion is, 25 cases (56.8 %) with radiological

parameters meet the “Spinopelvic harmony” that had increased to 31 cases (70.4 %) after surgery. Of the 19 cases (33.2%) with radiological parameters do not meet the "spinopelvic harmony", reduced to 13 cases (39.6 %) after surgery. Table 4 shows the improvement of radiological parameters after posterior spinal fusion, there were 35 cases (79.5%)with radiological parameters improvement and 9 cases (20.5 %) without improvement radiological parameters.Tables 5 and 6 showed all patients had improved clinical signs, particularly pain associated with radiculopathy after surgery. The average value of VAS on all patients is 5.34 (range 3-7) preoperatively and improved after surgery becomes 2:54 (range 1-4). The average value ODI on all patients was 51.1 (range 38-60) preoperatively and improved after surgery to 26.8 (range 18-34).In the group A there is an increase in VAS of 55.4 % and an increase of 49.7 % postoperative ODI. In the group B there is an increase in VAS of 44.1 % and an increase of 39.8 % postoperative ODI %.

We founded that a change spinopelvic harmony/parameter after posterior spinal fusion was correlated with improvement in VAS and ODI. The statistical correlation made with group A and group B. There was a significant correlation between group A and group B with an increase in the value of VAS and ODI value after posterior spinal fusion surgery, calculation is performed by Mann - Whitney U test and Wilcoxon 's signed rank test with a P value <0.05. According to improvement spino-pelvic harmony after posterior spinal fusion demonstrated which is pain and disability were more decreased in group A than group B. Most patients with non-improved spino-pelvic harmony after posterior spinal fusion had lower HRQOLs and also had tendency to poor clinical result.

In term of spinopelvic harmony, sagittal imbalance is defined by loss of lordosis, anterior deviation of the C7 plumb line and also retroversion of pelvis with verticalization of sacrum (increased PT). The pelvic angle or pelvic tilt has recently been suggested to be necessary for evaluating spinopelvic harmony. Pelvic tilt (PT) is an important parameter if there is compensation in pelvis for a loss of balance. In our study, we founded role of morphology and spino-pelvic harmony or positioning in the sagittal balance.It was demonstrated that pelvic position (PT parameter) is related to quality of life (ODI, VAS) and can't be ignore in preoperative planning. Pelvis tilt (PT) and pelvis incidence (PI) after posterior spinal fusion had played a significant role to achieve optimal clinical result as determined by VAS and also determine LL. PT is reflect compensation parameter to spinal deformity and correlated with HRQOL in adult spine deformity. Lumbar lordosis had related to improvement of clinical result in our study. LL has a role of importance that is a key consideration in analyzing x-ray. It is thought to cause chronic low back pain by increasing traction loading on posterior elements of spine, including the paravertebral muscle. So, obtaining lordosis at fused segments may be useful for controlling low back pain.

CONCLUSIONS

From the results of this study, it can be concluded that there is a significant correlation between radiological parameters of the spine and pelvis in the sagittal balance analysis on quality of life as measured by Oswerty Disability Index (ODI) and Visual Pain Scale (VAS). Patients with radiological parameters repair the spine and pelvis after the fusion, have a better quality of life based on the value Oswerty Disability Index (ODI) and Visual Pain Scale (VAS). Assessment of radiological parameters of the spine and pelvis as well as an increase in sagittal balance is important to do when performing spinal fusion surgery.

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