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# “Degenerative spondylolisthesis : the preferable surgical technique”



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## ABSTRACT

**Introduction:** Degenerative Spondylolisthesis is the major cause of low back pain, radiculopathy, and neurogenic claudication. The incidence rate for the general population ranged from 5% to 7%. Surgical method on degenerative spondylolisthesis is highly recommended.

**Objective:** The purpose of this review is to determine the preferable surgical procedures for degenerative spondylolisthesis, which are still debatable.

**Methods:** A total of fifty relevant literatures were researched regarding degenerative spondylolisthesis, the diagnostic procedure, and the treatment from the period of 2007-2017. The author has chosen which surgical technique that is preferable between TLIF (Transforaminal Lumbar Interbody Fusion) and PLF (Posterior Lumbar Fusion), from the so-called 50 literature journals.

**Results and Discussion:** The results showed that there was no significant difference regarding the back pain using Visual Analog Scale (VAS) during the preoperative procedure, in the operating level, the treatment duration, and the post-surgical complications between the two groups. There was also no significant difference in terms of leg pain (using VAS) between those two groups. On the other hand, the amount of blood loss, the duration of the surgery and successful fusion were significantly higher in the TLIF group than the PLF group.

**Conclusion:** When determining the surgical procedure, the author discovered the TLIF to be comparatively superior to the PLF regarding the fusion success, despite the longer surgical duration and higher amount of blood loss.

**Keywords:** Spondylolisthesis, Decompression, Fusion, TLIF, PLF

**Cite This Article:** Irianto, K.A., Hatmoko, F.W., Laskar P.K. 2018. “Degenerative spondylolisthesis : the preferable surgical technique”. *Bali Medical Journal* 7(1): 215-219. DOI:10.15562/bmj.v7i1.873

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## INTRODUCTION

The term spondylolisthesis referred to “slipping”, or olisthesis, which means the shifting vertebra (“spondylos” in Latin) toward closely jointed vertebrae.<sup>1</sup> Spondylolisthesis is classified into dysplasia, isthmic, degenerative, traumatic, and pathologic.<sup>2,3</sup> Within this review article, degenerative spondylolisthesis will be analyzed.

Degenerative spondylolisthesis is the most common case of spondylolisthesis, which evidently cripples the patients.<sup>4,5</sup> Degenerative spondylolisthesis is often observed in middle-aged patients or older, with the estimated incidence rate in the US cohort study, ranging from 14 to 30% of the total population.<sup>6</sup>

The treatment for spondylolisthesis is still a challenge for orthopedic surgeons.<sup>7,8</sup> In the patient care for degenerative spondylolisthesis, a clinician is required to have the basic knowledge of epidemiology, diagnostic, and the proper management of the current condition.<sup>9</sup> A lot of patients with spondylolisthesis are managed with conservative therapy.<sup>10</sup> However, surgical method is highly recommended when the conservative therapy was deemed unsuccessful.<sup>11</sup> Surgical therapy on

degenerative spondylolisthesis provides a huge benefit which lasts longer than non-surgical therapy.<sup>5</sup> Surgical method has been proven to be more effective compared to non-surgical therapy in the last 4 years.<sup>12</sup> The preferred surgical technique for degenerative spondylolisthesis is still debatable to this day.

## EPIDEMIOLOGY

The incidence rate for spondylolisthesis in the general population is around 6%, with the comparison between men : women are 2:1.<sup>13</sup> The incidence rate of spondylolisthesis in children under 6 years of age is around 2,6%, while in adults is around 5,4%.<sup>14</sup> Degenerative spondylolisthesis rarely affects individual around 40 years of age, and the incidence is higher in women than in men, and more on the African-American than the Caucasian.<sup>9</sup> On the elderly population, degenerative spondylolisthesis is more common.<sup>15</sup> Anatomically, the most common causes include disc degeneration, facet arthropathy, ligamentous hyperlaxity, and declining muscular stability.<sup>16,17</sup>

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Received: 2017-10-04  
Accepted: 2017-12-6  
Published: 2017-12-12

## CLINICAL EVALUATION

Anamnesis and physical examination are still the best diagnostic approach in order to determine the treatment and management of spondylolisthesis.<sup>13,16</sup> Almost all patients with spondylolisthesis are at early ages, thus obscuring any relatable signs or symptoms.<sup>18</sup> Lumbar instability is considered to be the main cause of low back pain (LBP), and this fact is linked to the pathologic mechanism of several spine abnormalities, such as spondylolisthesis.<sup>19</sup> The diagnostic approach for spondylolisthesis is determined in two stages, inspection and the palpation. Interspinous gap changes during the flexion and extension of the lumbar, this is performed in order to detect any signs of lumbar instability, of which both are performed while standing upright. The patients are requested to flex their back, and the physician observes from the uppermost point until the base (cranial-caudal). The physician then proceeds to apply some pressure on the patients' hip toward the table located in front of the physician, resulting in lumbar extension from the previously flexed state. Tenderness is evident when the interspinous spaces are palpated with a wider gap, appearing during the shift from flexing to extending.<sup>20</sup>

## RADIOLOGIC EVALUATION

The role of imaging or radiology examination is to support the clinical diagnosis of degenerative spondylolisthesis.<sup>21</sup> Modalities that can be used are X-ray, MRI single and triple sequence, CT Scan, USG dan myelographic.<sup>22</sup> Lateral radiographic imaging proves to be beneficial for documenting spondylolisthesis.<sup>18</sup>

The Wiltse Classification divided spondylolisthesis according to the respective anatomy and etiology: isthmic, dysplastic, degenerative, traumatic, and pathologic.<sup>23</sup> On the contrary/On the other hand, Meyerding developed a grading system by measuring the number of shifts as the percentage of the vertebral diameter below the shifted vertebra. Meyerding defined the grade I with a range of shift between 0-25%, grade II between 26-50%, grade III between 51-75%, grade IV between 76-100%, and grade V (spondyloptosis) more than 100%.<sup>2,24</sup>

The development from spondylolisthesis can be observed by the degree of the *slipping* and the progression of the patients' symptoms.<sup>15</sup>

## MANAGEMENT

### A. Conservative

Majority of patients with spondylolisthesis or patients with spondylolisthesis responded to conservative treatment; the spondylolisthesis

would be of lower degree and or without radicular symptoms.<sup>10,25</sup> One method of therapy, which has been increasingly popular, is by applying restrictive braces. Braces are capable of maintaining the lordotic posture and anti-lordotic. The braces are meant to prevent movement due to stress fracture and provide a chance for osseous healing on the affected site. Recovery only occurred in several cases, instead of all the cases. The degree of the defect and the level of the spine are indications for union signs. A mild degree of defect often became union compared to the more severe cases.

"After medical treatment, in order to begin physical activity, conditioning the spine to be comprehensive or rehabilitated, which is seen as evidence-based intervention is the key to prevent abnormality progression.<sup>25</sup> Furthermore, declining in flexibility and stability of the muscles can have a negative impact towards the overall appearance, which also may be influenced by the worsening of the condition.<sup>26</sup>"

Past conservative therapy, in the event, that the *slipping* progress rapidly and resulted in radicular pain due to the pinched nerve root, surgical alternative would be then highly suggestible.<sup>27</sup>

### B. Surgery

Surgical alternative is considered for patients whose slipping progress rapidly, radicular pain occurred, and when previous conservative therapy has failed them.<sup>4</sup> Surgery is also the first option if the patients already having trouble in maintaining the standing duration or travelling distance<sup>10,28,29</sup> Patients whose already started to have problems in their urinary bladder or progressively leaning towards the weakening of the bladder, are also on the short list for surgical alternative.<sup>30,31</sup>

### Indications for surgery:

1. Progress in the Slipping  
The higher the *slip*, the higher the chance for worsened progression. The slipping rarely progresses into adulthood although asymptomatic progress alone is an obvious indication for surgery (since worsened slipping and failed conservative therapy already clear indications for surgery).
2. Sagittal Alignment  
High degree of slipping accompanied by significant kyphotic deformity of the lumbosacral resulting in the misalignment of the sagittal spinopelvic.
3. Neurological defect  
Surgery is considered when neurological weakness resulted in the compression of the root nerves? (Surgery is considered when there is

compression of the root nerves resulting in neurological weakness).

4. Back pain  
Low back pain is consequences of prolonged yet unresponsive conservative therapy.
5. Symptoms of the foot  
Radicular pain related to the compression of the root nerve found in radiographic study that failed to respond to conservative therapy.<sup>32</sup>

This classification below are recommended in order to determine the type of surgery.<sup>7</sup>

In spinal surgery, it is divided into two types, the open type and the Minimally Invasive Surgery (MIS).

### Open Surgery vs. Minimally Invasive Surgery

In the Open Surgery, vertebral fixation is performed using the muscle-dilating approach in order to minimize the length of the surgical incision, the size of the surgical cavity, and the injuries on soft tissue due to iatrogenic process related to the whole surgical process, in the hope of achieving the best end results. There have never been articles published straightforwardly mentioned that MIS is more superior; though, there is a tendency of which MIS on the vertebrae resulted in lower complication and morbidity rate related to the minimal soft tissue injury. In addition, there is reduced risk of intraoperative bleeding, better cosmetic result, reducing post-operative pain and narcotic use, and also promoting a shorter hospitalization period.<sup>31</sup>

MIS Fusion is indicated for low back pain along with/and grade I and II of spondylolisthesis related to radicular pain. Higher grade of spondylolisthesis proves to be more challenging and Open Surgery is recommended for optimal management.<sup>31</sup>

### Decompression

The decompression of the non-fusion root nerve, which is a *less* invasive operating technique for

patients with plantar pain due to grade I spondylolisthesis, has a clinical outcome that is on par with other operating techniques. A study by Gill with 43 patients yielded a satisfactory 86% results. Weiner and McCulloch performed a unilateral nerve decompression which resulted in 8 out of 9 patients having a good result (maybe could be explained what is a good result). In some cases, this technique can be considered as the alternative for instrumented fusion. In order to minimize the loss on the operation, identifying the selection/inclusion criteria of the patient undergoing the Gill procedure or primary fusion becomes crucial. If decompression surgery on patients with stable grade I degenerative spondylolisthesis did not result in injuries to facet joints, then it would not increase the chance for slippage to occur. In radicular patients with insignificant pain in the lumbar spine, where the spondylotic vertebra has been restabilizing from slippage, decompression would be sufficient.<sup>22</sup>

The ideal surgical procedure for degenerative spondylolisthesis is still controversial. The surgical procedure the author currently review is the Transforaminal Lumbar Interbody Fusion (TLIF) and Posterolateral Fusion (PLF). Both procedures have their own advantages and disadvantages regarding patient's preparation, operation duration, and post operation.

### TLIF vs. PLF

Posterolateral Fusion (PLF) with pedicle screw has been the gold standard for spondylolisthesis degenerative surgery. PLF is able to decompress the canal and fuse 360° using single posterior approach on spondylolisthesis. PLF showed satisfying results in majority of low to moderate grade cases, with a few correction here and there.<sup>33</sup> Even so, it is difficult to achieve *solid fusion* from posterior approach due to the fact that laminar bone removal limits the posterolateral bony host bed available for grafting.

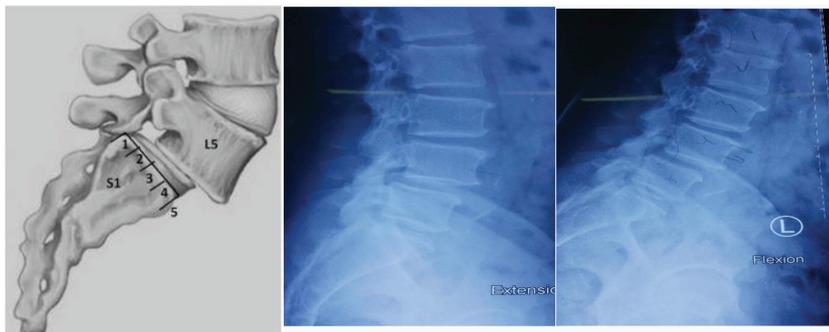
**Table 1** The scene for the classification of the instability on degenerative spondylolisthesis: A Qualitative guide for preoperative assessment of the stability

Parameter	Type I, Stable	Type II, Potentially Unstable	Type III, Unstable
Low-Back Pain	None, or very mild	Primary or secondary complaint	Primary or secondary complaint
Restabilization	Restabilization signs, grossly narrowed disc height	Some restabilization signs, reduced disc height	No restabilization signs, normal to slightly reduced disc height
Disc Angle	Lordotic disc angle on flexion radiographs or < 3mm of translation on dynamic films.*	Neutral disc angle on flexion radiographs or 3-5 mm of translation on dynamic films.*	Kyphotic disc angle on flexion radiographs or > 5 mm of translation on dynamic films.*
Joint Effusion	No Facet joint effusions on MRI	Facet joint effusion on MRI without joint distraction	Large facet joint effusion on MRI

\*Dynamic films include flexion and extension radiographs or supine to standing radiographs.

**Table 2** Therapeutical guideline according to the stratification of the grades in stability

Type of Stability Grade	Treatment
I. Stable	Decompression Alone
II. Potentially Unstable	Decompression & Posterior Fusion
III. Unstable	Decompression & Posterior Fusion + Interbody Fusion



**Figure 1** (a) Degree of Slippage between each segment of vertebrae. (b). X-Ray lateral view, Extension, and Flexion



**Figure 2** Pre-operative (a) and Post-operative X-ray Spondylolisthesis L4L5 after PLF(b) and TLIF (c)

Another fusion procedure is the Transforaminal Lumbar Interbody Fusion (TLIF). Theoretically, TLIF provides several advantages compared to PLF such as immobilizing a segment of the degenerating, decompressing nerve root, and returning the disc height and the root dimension canal. It is also capable to withstand the weight of the anterior structure. A successful interbody construction reduces the post-operative segment mobility and enabling a better union with the graft.<sup>34</sup>

In previous research conducted by Ghasemi AA in 2016 comparing/which compared TLIF with PLF in degenerative spondylolisthesis, the following data was found: There was no significant difference from the VAS relating to the pre-operative back pain between both groups. Furthermore, there was no significant in the group on the operative level, length of stay and postoperative complications. Also, there was no significant difference between those two groups regarding the VAS from leg pain. That study though showed that TLIF is superior

compared to PLF regarding functionality and fusion success.<sup>34</sup>

Another study stated that compared to other techniques, TLIF is capable of maintaining the ligament structure, thus allowing it to protect the biomechanical stability of the segment structure and its surroundings. In TLIF, a single unilateral incision is able to provide support in the bilateral anterior column.<sup>31</sup>

**CONCLUSION**

Spondylolisthesis is when a slippage occurs between closely positioned vertebrae. Anamnesis and physical examination become crucial in making the diagnosis of degenerative spondylolisthesis and in order to plan the treatment for degenerative spondylolisthesis using conservative therapy. However, in the event where conservative therapy failed, the surgical alternative would be recommended.

Surgical therapy on degenerative spondylolisthesis can be divided into 2 techniques, Open and Minimal Invasive Surgery, where both have their own advantages and disadvantages. The preferable surgical technique for degenerative spondylolisthesis is still controversial. In this review article, the author focused more on the comparison between two surgical procedures for degenerative spondylolisthesis, the Transforaminal Lumbar Interbody Fusion (TLIF) and Posterolateral Fusion (PLF). Both surgical procedures each have their advantages and disadvantages. This study showed that TLIF is superior compared to PLF regarding successful fusion though with more bleeding and longer period of hospital stay.

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