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Changes in spino-pelvic alignment after surgical treatment of isthmic spondylolisthesis

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ABSTRACT

Background and purpose: To analyze the changes in spino-pelvic parameters after surgical treatment of lumbar isthmic spondylolisthesis.

Materials and methods: Sixty patients recruited from a group of consecutive series of 128 cases with isthmic spondylolisthesis operated on between 2002 and 2012 in the Department of Neurosurgery, Tarnow, Poland. All patients were operated on by the same surgeon (the first author). Spino-pelvic parameters: PI, SS, PT, LSA, and LL were measured manually on standing lateral view radiograms. Patients were divided according to Spinal Deformity Study Group classification which we modified for means of analysis: (A) low-grade group: subgroups with balanced pelvis and unbalanced pelvis (instead of normal and high PI subgroups), (B) high-grade group: subgroups with balanced and unbalanced pelvis.

Results: Twenty-nine patients had unbalanced pelvis before the operation. In 10 of them (34%), the procedure resulted in full correction of pelvis position meaning that they achieved balanced pelvis after the surgery. There were 6 patients with low-grade slip who had balanced pelvis preoperatively but showed unbalanced pelvis after the surgery but this loss of balanced pelvis did not affect the clinical outcome which overall was good among them. Patients with unbalanced pelvis presented changes towards restoration of spino-sacro-pelvic anatomy postoperatively: PT decreased while SS increased, although these changes were not statistically significant.

Conclusion: Further studies are needed to confirm whether surgical correction of spino-pelvic parameters results in better clinical outcome in patients with isthmic spondylolisthesis.

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1. Introduction

Over the last two decades the analysis of spino-sacro-pelvic parameters became a hot topic in spine surgery. The analysis of these parameters allows thorough assessment of the results of different spinal pathologies and spondylolisthesis in particular. Thanks to that we know that in spondylolisthesis the symptoms go beyond the typical clinical picture of foraminal stenosis at the level of the slip and lumbar stenosis and the upper adjacent segment. They also include disturbance in anatomic relationship between pelvis, sacrum and spine. These can finally affect posture and even sagittal balance of the whole body. The analysis of spino-sacro-pelvic parameters allows for qualitative and quantitative assessment of these changes. In literature there are more and more reports assessing the efficacy of spondylolisthesis surgery in terms of correction of disturbed spino-sacro-pelvic relationships. This is a relatively new approach and philosophy in operative treatment of isthmic slip. Thanks to this, the method of assessment and the final objective of spondylolisthesis surgery are changing. Instead of asking whether the correction of slip or lumbo-sacral kyphosis influences the clinical effect of surgery, we are thinking of posing this question in a different way: 'Does surgical correction of sacro-spino-pelvic anatomy have a direct influence on the outcome of surgery?' Thus, the ''eternal'' question about the necessity of slip reduction and of the other aspects of operative technique is put in a new context: do the reduction of slip and other aspects of operative techniques have an influence on the correction of the parameters of spino-sacro-pelvic equilibrium.

Apart from fusion and decompression of compromised neural structures, the correction of spino-sacro-pelvic parameters becomes an equally important goal of surgery in spondylolisthesis. So far, it is not known whether the correction of spino-sacro-pelvic parameters affects clinical outcomes. The authors of this paper present how surgical correction and fusion changed the parameters of spino-sacro-pelvic balance in their series of consecutive patients with isthmic spondylolisthesis. This is the first stage of the studies the purpose of which is to examine: (a) if there is a relationship between the clinical effect of treatment and the correction of sacro-spino-pelvic parameters and (b) which aspects of surgical technique (e.g. slip reduction) influence the correction of spino-pelvic anatomy

2. Materials and methods

The studied group consisted of 60 cases from the series of 128 consecutive patients with isthmic spondylolisthesis operated on between 2002 and 2012 in the Department of Neurosurgery at St. Luke Hospital, Tarnów, Poland. These were the patients whose pre- and postoperative standing radiograms of lumbar spine with both femoral heads were available for analysis. The study group consisted of 30 women and 30 men. The mean age of patients was 54 years. Twenty-seven cases presented with grade I, 26 patients with grade II, five patients with grade III, one patient with grade IV slip, and one patient with spondyloptosis (Table 1).

Table 1 – Grade of slip.

Grade of slip	Number (%)	Total
Group I (low-grade)		
I°	27 (45%)	53 (89%)
II°	26 (44%)	
Group II (high-grade)		
III°	5 (8%)	7 (11%)
IV°	2 (3%)	

2.1. Surgical technique

All patients were operated by the same surgeon, the first author of the paper. Whenever feasible, the surgical protocol included: (a) complete reduction of slip and correction of kyphosis (Fig. 1a and b); (b) monosegmental stabilization limited to the level of slip (Fig. 1a and b); (c) 360° fusion: posterolateral with PLIF (posterior lumbar interbody fusion) or ALIF (anterior lumbar interbody fusion) (Fig. 1a–c); (d) foraminotomy at the level of slip; (e) laminectomy of the upper adjacent segment (for decompression of stenosis produced at the segment above the slip).

It is obvious that this protocol was impossible to implement among all the patients. Either it was unfeasible at some point (s) (e.g. failure to mobilize the affected segment which appeared extremely stiff) or some of its elements were abandoned on purpose (e.g. reduction of slip in obese or heavy patients requiring significant destabilization of the offending segment and therefore exposure of transpedicular construct to extreme loads and risk of failure).

2.2. Slip reduction

Complete or almost complete reduction of slip (at least by 80%) was achieved in 60% patients. The reduction was always performed through the posterior approach. In very stiff slips, surgical mobilization was always attempted in order to perform reduction. Slip reduction failed only in a few cases in which the course of L5 nerve root did not allow exposure and therefore entrance to L5/S1 interspace, thus not allowing for mobilization of the slip. In some cases the slip reduction was rejected upfront because of obesity or high body mass of patients. The rationale behind this is that surgical mobilization of the slipped segment produces complete transverse destabilization of the spine and weakens its load bearing capabilities. Therefore any construct in the extremely destabilized spine in heavy patients will be exposed to extreme loads and therefore to higher risk of failure than in individuals of normal body weight. Thus, in obese patients, it is better to leave the slipped segment unreduced in a stable position than to destabilize it in order to reduce the slip. Such cases where a decision was made not to make any reduction reached 20% in our series.

2.3. Monosegmental stabilization

In many cases one or more segments adjacent to the slip had to be stabilized. Usually this took place in two situations: (a) adjacent segments were unstable preoperatively (e.g. spondylolysis in the neighbouring segment) – Fig. 2a and b; (b)