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CASE REPORT

# Trans-sacral screw fixation in the treatment of high dyplastic developmental spondylolisthesis

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Author contributions: The work was carried out in collaboration between all authors; Landi A, Marotta N and Defini R defined the research theme andperformed surgery; Mancarella C contributed to acquisition of data, interpretation of results and wreote the paper; Tarantino R co-worked on interpretation of data; all authors have contributed to, seen and approved the manuscript.

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## Abstract

We describe the case of a 67-year-old woman with L5-S1 ontogenetic spondylolisthesis treated with pedicle fixation associated with interbody arthrodesis performed with S1-L5 trans-sacral screwing according to the technique of Bartolozzi. The procedure was followed by a wide decompressive laminectomy. The patient had a progressive improvement of the symptoms which gradually disappeared in 12 mo. The radiograph at 6 and 12 mo showed complete fusion system. The choice of treatment in L5-S1 ontogenetic spondylolithesis is related to a correct clinical and diagnostic planning (X-ray, computer tomography magnetic resonance imaging, Measurement). In particular, the severity index and the square of unstable zone, and the standard measurements already described in the literature, are important to understand and to plane the correct surgical strategy, that require, in most of the times, fusion and interbody artrodesis.



**Key words:** High-dysplastic developmental spondylolisthesis; Spondylolisthesis; Trans-sacral screw; Pelvic balance; Spinopelvic imbalance

**Core tip:** The choice of treatment in L5-S1 ontogenetic spondylolithesis is related to a correct clinical and diagnostic planning (X-ray, computer tomography, magnetic resonance imaging, measurement). In particular, the severity index and the square of unstable zone, and the standard measurements already described in the literature, are important to understand and to plane the correct surgical strategy, that require, in most of the times, fusion and interbody artrodesis.

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## INTRODUCTION

Marchetti and Bartolozzi's classification[1,2] is the most complete one regarding the prognosis and treatment of ontogenetic spondylolisthesis, including the description of the high or low dysplastic forms. Unfortunately, however, does not provide specific criteria to differentiate these two subgroups. In particular, it is accepted that the treatment of choice for both high-dysplastic developmental spondylolisthesis (HDDS) is surgical procedure, but it is unclear which is the best surgical strategy. A correct preoperative planning based on meticulous radiological examinations is crucial for the choice of the correct surgical treatment to be undertaken which is, when possible, a stabilization with interbody fusion.

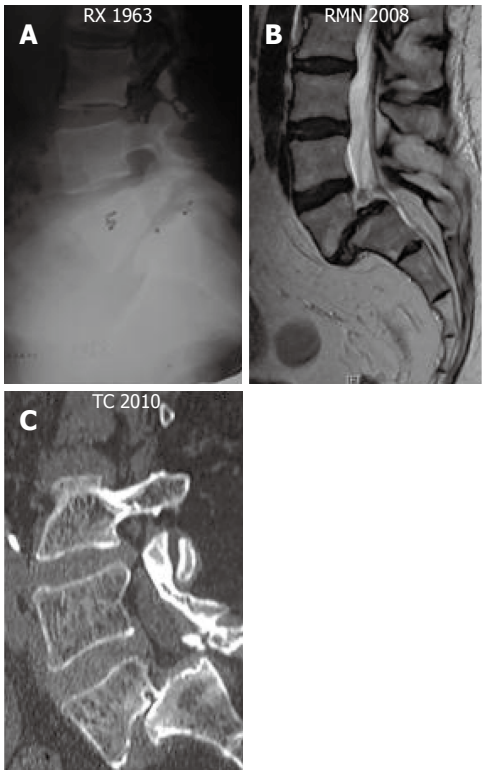


**Figure 1 Seriated radiological exams showing the progression of the spondylolisthesis from grade Ⅰ in 1963, to grade Ⅲ in 2010.**

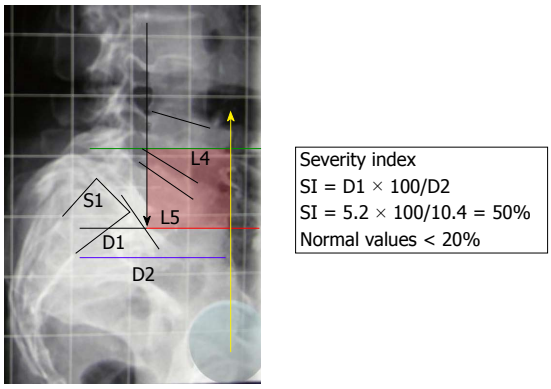


**Figure 2 Analysis of the severity index and of the square of unstable zone.** It's described by Lamartina[14]. SI: Severity index.

**Table 1 Measurements and indexes performed for the operative planning**

| | Test | Our case | NR |
|---|---|---|---|
| Slipping | | 63% | |
| Sacro lumbar indexes | Lumbar index | 45% | > 50% |
| | Pelvic incidence | 86.2° | 50°-60° |
| | Sagittal pelvic tilt index | 0.52 | > 0.70 |
| Pelvic nutation indexes | Sacral slope | 39.9° | 32°-49° |
| | Pelvic tilt | 40.6° | 7.2°-7.9° |
| | Sacral inclination | 45° | |
| Sacro-lumbar ratio | Slip angle | 77.3° | |
| | Sacral kyphosis angle | 25.8° | |

## CASE REPORT

We describe the case of a 67-year-old woman with L5-S1 ontogenetic spondylolisthesis known since 30 years before. The patients complained recurrence of 15-d lumbar back pain episodes that improved after medical therapy. She referred difficulty in walking and in the upright position because of the presence of low back pain and right sciatica from 2 years. The patient brought seriated radiological examinations. The first one performed 30 years earlier showing a progression of the spondylolisthesis that from Meyerding grade I currently has become Meyerding grade Ⅲ, with development of an important sacral dysmorphia giving a profile of an high dysplastic spondylolisthesis HDDS (Figure 1). Neurologically the patient presents a sacral kyphosis attitude, semi flexion of knees and hips in an upright position to compensate the pelvic imbalance, moderate weakness to the right lower limb at the dorsal flexion of the foot, sensitive disturbances in L5 territory to the right lower limb, neurogenic claudication at 100 m. According to the literature it was performed an orthostatic X-ray to visualizes the femoral heads and to calculate the dysplasia indexes in order to plan a correct surgical strategy. We have calculated: slip percentage (63%), the sacral-lumbar indexes (lumbar index 45%, pelvic incidence 86.2°, sagittal pelvic tilt index 0.52), the pelvic nutation indexes (sacral slope 39.9°, pelvic tilt 40.6°, sacral inclination 45°) and the sacro-lumbar ratio (77.3° slip angle, sacral kyphosis angle 25.8°). In relation to the measurements, the diagnosis of HDDS was confirmed (Table 1). The surgical planning requested the evaluation of the severity index and of the square of unstable zone (Figure 2)[3,4]. All the indexes suggested us the indication for L4-L5-S1 fusion and L5-S1 interbody fusion to be executed with an anterior support. It was decided to proceed with pedicle screw fixation associated with interbody fusion performed with S1-L5 trans-sacral screwing according to the Bartolozzi's technique[1,2]. The procedure was followed by a wide decompressive laminectomy (Figure 3). The patient had a progressive improvement of the symptoms which gradually disappeared in 12 mo. The radiograph at 6 and 12 mo showed a complete bone fusion (Figure 4).

## DISCUSSION

The HDDS (Meyerding grade Ⅲ° and Ⅳ°), caused by isthmus lysis, are characterized by a specific aspect, the pelvic retroversion, which generates an L5 dimorphism with trapezoidal shape and a consequent S1 dysplasia and round shape of the sacral promontory. The combination of these deformities causes L5-S1 kyphosis and increases the incidence of the slipping of L5 on S1. Such deformities cause alteration of the posture of the subject; in particular the pelvic retroversion causes a compensatory flexion of the hips and knees, in an attempt to realign the sagittal balance, and the lumbosacral kyphosis causes compensatory hyperlordosis of the adjacent lumbar segment. This process cause a considerable torsional force

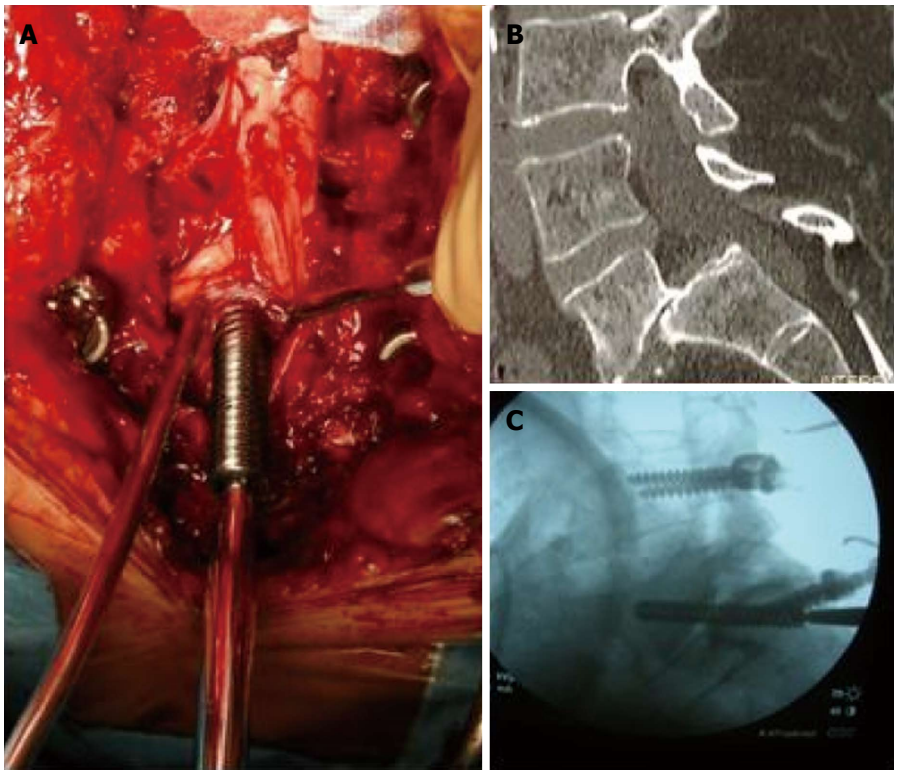


**Figure 3 Intraoperative picture that showed the insertion of the trans sacral screw.**

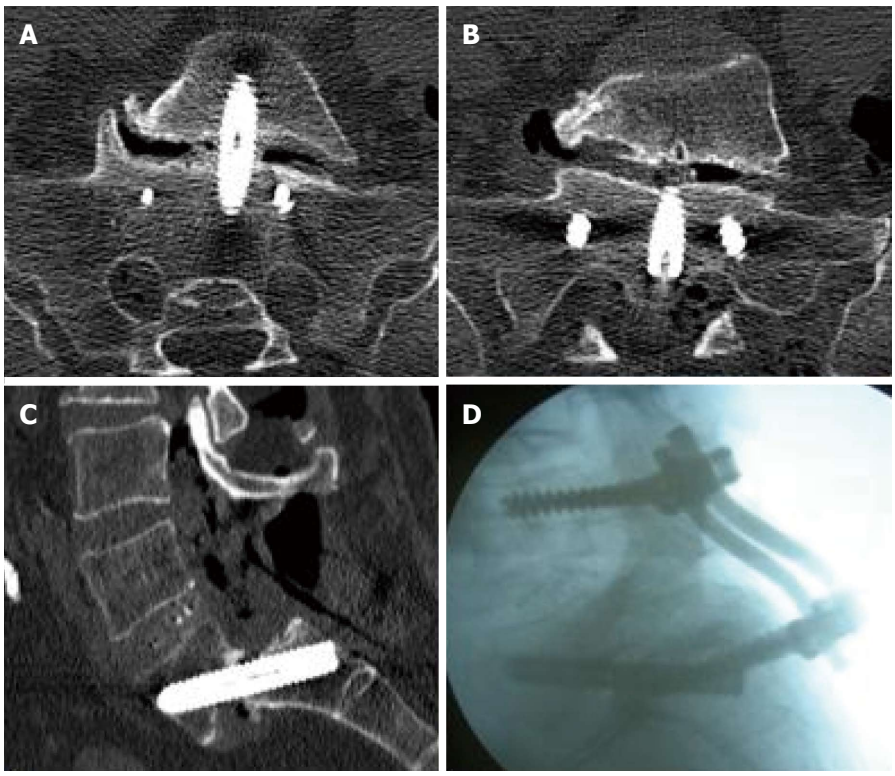


**Figure 4 Computer tomography scan at 12 mo follow-up that showed the correct positioning and fusion of the system.**

on the pelvis burdened by the L5-S1 disc orientation, which tends to be perpendicularly to the ground, in relation to the sacral inclination. This type of biomechanical alterations affects significantly the sagittal balance, generating shear forces that allows the vertebral body to slide ventrally causing a framework of spondyloptosis[5-11]. In

such cases, treatment of choice is surgical, and should be aimed to correct the sagittal loading, to decompress the interested tract and to fuse the mobile segment. In particular high dysplastic forms need anterior support before fusion in order to ensure a longer stability, since the only posterolateral or posterior interbody fusion (PLIF, TLIF) do not contract enough the foreword slipping of L5 on S1[1,10,12-14]. Pelvic indexes and severity index evaluation allow us to identify which HDDS have such shear forces that do not permit a L5-S1 short fixation, so that has to be involved L4 too. The extension to L4 vertebral body is essential in order to reduce the cutting forces and to avoid the breaking the system[3,4].

Low-grade HDDS (Meyerding I and Ⅱ) are treated *via* posterior approach with interbody fusion (PLIF, TLIF), or when this is not executable, with PLF, providing good results in terms of long term fusion. From a technical point of view, the interbody fusion with anterior approach is the key point for the choice of treatment; the technique of choice for anterior interbody fusion is certainly the ALIF, performed with retroperitoneal anterior approach[11]. The advantages of this approach are: the direct visualization of the L5-S1 disc, the possibility of insertion of the cage very anteriorly favoring arthrodesis, and the possibility of releasing the disc, increasing the mobility of L5 to S1 and favoring the maneuvers of reduction of the lysthesis that will be performed *via* posterior approach. The risks associated with the anterior approach are: peritoneal perforation, visceral lesions (ureters, bladder, intestines, *etc.*), vascular lesions (arteries and iliac veins), lesions of the hypogastric plexus (vaginal dryness in women and retrograde ejaculation in men) and the morbidity linked to the autologous bone graft donor site. In addition, the lack of familiarity to this approach puts the spinal surgeon in the position of having to have a general surgeon or a vascular surgeon to perform anterior approach. In the light of this, we decided to perform anterior arthrodesis with trans-sacral screw fixation described by Bartolozzi *et al*[1,2]. In our opinion, this technique has some advantages over ALIF. First of all, the risks related to the anterior approach and to the bone donor site morbidity are eliminated. The insertion of the screw is possible with the same surgical exposure of the *via* posterior approach, exposing the L5-S1 disc, the S1 back wall and the S1 lower limiting; this is achieved with a simple laminectomy. The exposure of the screw entry point is obtained by a slight pull of the dural sac medially, without any risk of neurological damage. Furthermore, as described in the literature, the possibility to insert two screws, one on the right site and one on the left site, reduces the manipulation on the dural sac. The inclination of the screw has to be almost perpendicular to the operating table, so there are no particular needs of inclination of the instrumentation. The screw are auto tapping and can be filled within autologous bone, allowing a good interbody fusion that offers excellent fusion. From a biomechanical point of view, the angle assumed by the screw respect the stabilization system, pointing from the bottom upwards, provides adequate support to L5 that in this way counteracts the forces of sliding downward arresting the progression of the slipping out of the HDDS.The choice of treatment in L5-S1 ontogenetic spondylolithesis is related to a correct clinical and diagnostic planning (X-ray, computer tomography, magnetic resonance imaging, measurement). In particular, the severity index and the square of unstable zone, and the standard measurements already described in the literature, are important to understand and to plane the correct surgical strategy that require, in most of the times, stabilization and interbody fusion. The choice of the technique depends on the surgeon and on the grade of fusion he wants to obtain: PLIF < TLIF < ALIF[11,12,14]. HDDS require anterior support (ALIF or trans-sacral fusion) since posterior fusion in long term stabilization have an high risk of failure. The choice to extend the fusion at L4-L5 cannot be left to chance, but has be carefully planned on the basis of the preoperative exams (square of unstable zone), since in cases where it is necessary, its contribution to the stability of the system is essential.

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