Idiopathic Scoliosis: Anterior Approach and Fixation from the Concavity

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ABSTRACT
Surgical treatment of idiopathic scoliosis is recommended in curves of 45°, requiring reduction and transpedicular fixation. In 2007, we published our experience in the management of scoliosis using four screws in the construct base, two compression screws at the convexity apex, two cross-links and proximal hooks and sublaminar wires, and we reported satisfactory results. Since 2008, we used pedicle screw in the curve with better correction, balance, and rate of arthrodesis consolidation than the technique we performed before; however, this increased the cost, making the surgery inaccessible for our patients.

This is the reason we use new constructions with a lower number of fused levels and with reduction in the number of implants to improve cost. The anterior approach with reduction and fixation has good clinical results and lower cost. We include patients with curves under 70° with the concavity to the left, performing anterior approach, reduction, and fixation. Ten patients with a 5-year follow-up were without loss of reduction or pseudoarthrosis, conserving sagittal and coronal balance.

Keywords: Anterior approach, Idiopathic scoliosis, Pedicle screws, Spinal fusion, Treatment outcome.

INTRODUCTION
Surgical treatment of scoliosis with curves of 40 to 50° is controversial from the treatment point of view because it depends on different factors, such as age, curve flexibility, and the possibility of spine growth. In strict compliance with the established procedures, scoliosis surgery can be performed in a 45° scoliosis and requires reduction and transpedicular fixation that includes all the curves which in the high thoracic area do not interfere with the low thoracic, transitional, and lumbar region; functional impact is important and although we leave complete corrections, even with balance, mobility is affected. In 2007 we published, for the second time, our experience in management of scoliosis, concluding that in 70° scoliosis, we used four screws in the construct base, two compression screws at the convexity apex, concavity hooks at the proximal end of the curve and sublaminar wires, segment to segment, with two cross-links, and we obtained satisfactory results with more than 70% correction, coronal and sagittal balance with an arthrodesis rate of 93%.

Since 2008, we have initiated pedicle screw placement in the curve with satisfactory results, better correction, balance, and rate of arthrodesis consolidation. However, the cost increased 500%, which is often inaccessible to our patients.

For this reason, we decided to try new combinations that would have the same effectiveness, lower cost, and did, for example, the construction of “zig zag” screws, placing one screw per segment, complementing with sublaminar wire in the nonfixed segments, placing cross bars to distribute loads, achieving equally satisfactory results.

In the literature, we can find that reduction pedicle screws vs reduction and corporal fixation in the convexity have similar results, with greater morbidity but with lower number of implants, which lowers costs especially seen from economy of the developing country’s point of view, like mine. We also consider that anterior in 70 to 100° curves is only required if fixation and reduction are performed with a hybrid instrumentation, but not with pedicle fixation.

The anterior thoracoabdominal approach for thoracic scoliosis facilitates excellent clinical and radiographic outcomes, minimal loss of blood, correction of the powerful apical trunk rotation, maintenance of lordosis, relatively short fusion constructs, and better SRS-22 performance (of SRS-22) without significant deterioration of lung function in 2 years. It is still an effective treatment for thoracic scoliosis.

Anterior instrumentation by thoracoscopy in teenagers with idiopathic scoliosis is a surgical option; the outcomes are the same as those obtained with the open technique described in the literature.
The technical challenges of this surgery are obvious, especially for the learning curve; however, the beneficial effect has been demonstrated with satisfactory outcomes, especially in a less rigid fixation and thereby lower failure rate and pullout of fixation. From the point of view of pulmonary function, we know pulmonary function is affected after the anterior approach with up to 2 years recovery; this can be drastically reduced if we performed minimal incision portals with almost no impact on pulmonary function.

The goal of idiopathic scoliosis treatment is progression, to maintain the deformity correction on three dimensions, improving the thoracic appearance, reducing short- and long-term complications, and there is evidence that fixation with double bars by posterior approach achieves good results in these patients, now we should try to obtain the same results but with a lower number of fused levels and with a reduction in the number of implants to improve costs, which nowadays are higher.

For this reason, the anterior approach with reduction and fixation not only has demonstrated these good clinical results but is showing that the number of levels fused and number of implants used are lower, reducing the total costs of surgery.5

The correction of the rotation is better performed in the flexible curves where the maneuver and fixation are posterior with pedicle screw especially in the concavity at the vertex of the curve. It is not so when the fixation and correction are with wires and/or hooks.7

Regarding the pulmonary effect in the anterior approach, it is known that the only difference between a healthy patient and a sick patient is the recovery time, so the condition of vital capacity and lung function should not be a contraindication for surgery, only that care and rehabilitation after surgery must be increased and managed to improve recovery and prevent subsequent complications secondary to poor postoperative care.8

If we need to perform an anterior approach in scoliosis, we think in a divergent approach and therefore, necessarily a wider incision to view more disk spaces and vertebral levels, if we performed it by endoscopy, we need to make more incisions, almost one per level (Figs 1 and 2).

However, if our goals are to reduce incision, limit arthrodesis, increase flexibility of the vertex of the curve, reduce the instrumented levels, avoid the crankshaft phenomenon, and decrease the failure of fixation, thinking of an approach by the concavity necessarily makes us imagine the vision in a convergent form, so the incision is smaller, the release of the curve is easily achieved, and automatically no crankshaft phenomenon, and if the implants are used in the form of compression it is harder to suffer traction effect/effect of traction and failure of the fixation (Fig. 2). To achieve less number of levels is something that has been seen when performing anterior approach in which arthrodesis happens in fewer levels.

In the beginning, we only make the release of curves. Initially, we performed the release of the curves by this method and using only this procedure we obtained 50% of reduction, making the curve more flexible and therefore, the correction by posterior approach with hybrid systems was easier with a high rate of correction of the rotation curves. Therefore, we began with shorter fixations, however, still without a noticeable decrease.

With this background, we think that we could achieve release, reduction, and fixation of the curves, reducing the number of levels and keeping reduction without loss since the construct is under compression loads instead of distraction loads in which screws do not have the effect of traction and placing graft in the intersomatic space, it would achieve a faster consolidation of the segments.

Until now, we only have 10 cases with a 5-year follow-up without loss of reduction, without pseudoarthrosis, sagittal and coronal balance, no alterations, and rupture of fixation material.

We require more time and volume that we are about to start because in the 10 cases, we observed substantial improvement, even in the number of levels and implants, which means a great achievement in my country.

![Fig. 1: Divergent approach](image1.png)

![Fig. 2: Concavity approach](image2.png)
INDICATIONS

We consider that indications so far are curves under 70° preferably with the concavity to the left, having acceptable indication for anterior approach without lung condition that contraindicates the surgery.

SURGICAL TECHNIQUE

Under general anesthesia in lateral decubitus position, lying on the convex side of the curve to cause the reduction of the curvature (Figs 3 and 4).

The incision is performed on the rib of apex, starting in the posterior axillary line, toward the zone of the spiny apophysis, reaching up to 3 cm, the approximated incision is 8 cm. The conventional approach is to perform, with periostomy of the rib, location of the pleura, and dissection to enter retropleural without affecting cavity located vertebrae, three superior and three inferior to the vertex vertebrae.

Discoipectomy/disectomy and total release of (the) selected levels is performed – we place the screws in the central part of the vertebrae in a perpendicular way and following the direction of the platforms until the opposite is cortical.

Once the screws are placed, the bar is inserted in the shape of the convexity, fixing it to all the screws, we proceed to derotate through the bar leaving the curve in the form of kyphosis, cancel out the screws one by one to promote distraction in the central segments to improve the reduction of scoliosis.

We close leaving a 24-hour drainage.

CLINICAL CASE

A 13-year-old patient, menarche at age 11, was evaluated for the first time at 11 years because of a thoracic deformity.

In 2007, a 48° right thoracic curve was detected, with a 1 cm drop of the right shoulder, with distal onset in L1 and proximal in T3, rotation of second degree, vertex in T9 (Fig. 5).

In 2008, the curve increased to 58°, so surgery was scheduled.

Satisfactory postsurgery evolution and observing reduction of the curve to 14 and 18° of kyphosis were noted (Fig. 6).

Her evolution until 2011 is in conformity with the displayed X-rays history (Fig. 7).

We observe a clinical evolution in the images (Figs 8 and 9).

DISCUSSION

The primary goals of the surgical treatment of the idiopathic scoliosis are to stop the progression in the curve through a solid fusion of the affected segment, offer a permanent deformity correction, and improve appearance, physical functionality, psychosocial, and cosmetic health. The anterior approach reduces late complications, such as low back pain, degenerative changes, systemic functional failure, and cardiopulmonary compromise in adulthood.\(^9\)

The current techniques are related to four fundamental concepts: segmental instrumentation, coronal reduction with permanent arthrodesis, and derotation to avoid loss of reduction.

Nowadays, there are many surgeries but the most widely accepted today are four, divided into two types of approach: anterior and posterior. The first one would be the anterior approach with screw fixation in the convexity. The remaining are basically considered as two hybrids, one is the universal system with hook and screws and the other one with sublaminar wires in a supported structure with pedicle screws in the base.\(^8\)
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We are implementing the treatment in this type of curve with anterior approach with reduction and fixation of the deformity through the concavity of the curve in which we facilitate the technique. As we observe the curve in a convergent shape, we can make a smaller incision and also consider that we reduce the number of fixation levels allowing better mobility of the rest of the spine, having the fixation screws in compression to prevent complication and failure of treatment.

We have to understand that the excessive use of implants (without measure) increases costs and in many cases the results are not as favorable as expected. Short- and long-term follow-up between new pedicle screws and the less expensive hybrid is almost the same.10
If we evaluate the case that we present, the patient should have been instrumented from T2 to L1 to achieve satisfactory correction of the curve, requiring a longer surgery with a greater morbidity and complications. With increased morbidity complications and specially with 12 levels instrumented, the implications of the pulmonary functional impact and dynamic implications are greater. For this reason to reduce the number of levels down to 6 or 7, with satisfactory results in less than 70° curves, lowering the costs and risks for the patient seems an option to take into account.8

REFERENCES