Posterior Spinal Fusion for Adolescent Idiopathic scoliosis via HIPOAD technique: correction maneuvers based on simplified curve patterns

Cesare Faldini[1], Giovanni Viroli, Matteo Traversari, Marco Manzetti[1], Marco Ialuna[2], Zayed Almadidy[3], Sergey Neckrysh, Isabella Sofia Giannini[4], Alberto Ruffilli
[1]Istituto Ortopedico Rizzoli, [2]IOR, [3]Department of Neurosurgery, University of Chicago, Illinois, [4]First Orthopaedic and traumatologic clinic, Istituto Ortopedico Rizzoli

Introduction:

Adolescent idiopathic scoliosis is the most common type of scoliosis, with a reported prevalence of 3 to 5%. It is characterized by a tridimensional spinal deformity with typical patho-anatomical features such as inclination, rotation and wedge deformity of the vertebral bodies. Patients with severe Adolescent Idiopathic Scoliosis curves, greater than 40° of Cobb angle, are candidates for surgical correction. The gold standard for surgical correction of adolescent idiopathic scoliosis is posterior spinal fusion.

In 2001 Lawrence Lenke described a novel classification system that defined spinal fusion area including only the structural curves. However, Lenke classification involved also lumbar and sagittal modifiers, resulting in over 40 different curve patterns.

While this complex system can be an invaluable tool in choosing the fusion area, the corrective maneuver choice can rely on a more simplified classification system, since many different Lenke patterns share common correction strategies. The aim of the present work is to offer a manouvre-based treatment algorithm for adolescent idiopathic scoliosis via HIPOAD technique.

Materials and Methods:

This was a retrospective study. We included all the patients who underwent posterior spinal fusion for AIS treated in our institution between January 2019 and June 2022. All patients received one-stage posterior spinal fusion via HiPoAD technique that implies high density pedicle screws, peri-apical Ponte osteotomies and/or Smith-Petersen osteotomies. All patients received pre-operative radiographical evaluation with full spine standing x-rays in postero-anterior view and lateral view and full spine supine lateral bending x-rays. The fusion area was selected according to the Lenke classification and the corrective manouvre was selected according to the present algorithm. Sensory and Motor evoked potentials were monitored. All the procedures were performed by a team of two experienced spine surgeons. All the patients received a post-operative full spine standing x-ray in postero-anterior and lateral view in order to evaluate post-operative radiographical outcomes. All of the radiographic measurements, aimed to assess the deformity correction, sagittal and coronal alignment, were obtained by the same experienced surgeons who performed the surgeries.

SRS-22 questionnaire was submitted pre-operatively and at the last follow-up, in order to detect the satisfaction of the patients with the surgical treatment.

Results:

A total of 114 patients (96 females, 18 males) were included, with a mean age of 15.2 years (range 11-18 years, sd: 4.1 years) and a mean follow-up of 33.8 months (range 24-46 months). The included patient could be classified: 48 as single thoracic curves, 10 as double thoracic curves, 21 as thoracolumbar/lumbar curves, 27 as double curves, 8 as triple curves.

Estimated blood loss, surgical time and length of stay were 1045 ± 555.4 mL, 283.8 ± 54.3 minutes and 7.1 ± 3.2 days, respectively. Main curve coronal Cobb angle, T5-T12 Thoracic Kyphosis and C2-C7 cervical lordosis improved from 67.3° to 24.3°, from 15.7° to 20.9°, from 11.7° to -5.1°, respectively.

Apical Vertebral Rotation (Nash and Moe) improved from 2.4 to 0.8.

Six post-operative complications were reported, 5 superficial wound infections treated with surgical debridement, antibiotics and implant retention, 1 superior mesenteric artery syndrome treated conservatively.

Discussion and Conclusions:

The present manouvre-based treatment algorithm aims to guide spine surgeons in choosing the right corrective maneuvre based mainly on full spine standing coronal X-ray and subsequent evaluation of full spine standing sagittal X-ray and full spine supine bending X-ray. Each of the five patterns was addressed with a specific corrective maneuver. In particular, Single Thoracic curves were treated with a simultaneous deroto-translation with a successful restoration of sagittal alignment. Double thoracic curves required specific attention to achieve a balanced correction between the two thoracic cures, via a proper derototranslation in both curves and in-situ proximal thoracic compression-distraction forces. Thoraco-lumbar/Lumbar curves required specific strategies to achieve a restoration of lumbar lordosis and thoracolumbar junction neutrality. Double Curves were addressed with an hybrid strategy based on a combination of lumbar rod rotation and

derototranslation. Finally, Triple curves were approached with a combination of Double Thoracic and Double Curves correction strategies. The algorithm can be a useful tool in the selection of the most appropriate correction strategy for each AIS curve.