High-Dysplastic Spondylolisthesis With Associated Severe Scoliosis: Treatment Principles and Surgical Technique

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Introduction

High-dysplastic developmental spondylolisthesis (HDDS) is a rare and complex spinal deformity first described by Marchetti and Bartolozzi in 1982 as a subset of ontogenetic spondylolisthesis. HDDS is characterized by lysis or elongation of the pars interarticularis, with consequent slippage of the L5 vertebral body, which is progressively deformed under the action of gravity, resulting in a trapezoidal L5 body and a rounded sacral dome. The progressive deformation of osseous and ligamentous structures promotes slippage and leads to a localized kyphotic deformity of the lumbosacral junction. Lumbosacral kyphosis leads to compensatory mechanisms to maintain adequate sagittal balance, such as increased lumbar lordosis, decreased thoracic kyphosis and cervical lordosis, and pelvic retroversion.

An scoliotic deformity is reported in 18% to 48% of adolescents with spondylolisthesis. Three scoliosis and spondylolisthesis associations are described: sciatic, olisthetic, and unrelated type. The first two types of scoliosis likely will partially or completely resolve via reduction of spondylolisthesis. Conversely, the third type requires separate correction.

In approaching HDDS associated with scoliosis, staged surgery is preferable, correcting spondylolisthesis during the first stage. This reduces any possible olisthetic or sciatic component in the scoliotic curve and eliminates any compensatory mechanism on the sagittal plane, which would alter planning of the scoliosis corrective maneuver.

This video presents two-stage surgical correction of HDDS and associated severe thoracic scoliosis.

Materials and Methods

The authors of this video performed a retrospective case-series. All the patients who underwent two-stage correction for HDDS and associated severe thoracic scoliosis at the authors' institution between January 2016 and June 2020 were included. In the first stage, HDDS was managed via reduction and circumferential fusion with the posterior-only approach; bicortical screws were placed at L5 (reduction screws) and S1 (monoaxial screws). A wide laminectomy was performed, removing the Gill fragment to allow for complete isolation of the L5 roots. The second stage was performed 90 to 120 days after the first stage. Scoliosis was managed via the Hi-PoAD technique (high-density pedicle screws, Ponte osteotomies, asymmetric rod contouring, direct vertebral rotation). All radiographic data was retrieved. Deformity characteristics and correction were assessed. All measures were obtained by two experienced spine surgeons.

Results

Five patients (three females, two males) were included, with a mean patient age of 15.2 years (range 12 to 18 years) and a mean follow-up of 47.6 months (range 25 to 71 months). The mean slip angle, lumbosacral angle, and slip percentage improved from 37.8° to 6.2°, 55.2° to 91.2°, and 84.4% to 7.4%, respectively. After the first stage (spondylolisthesis surgery), mean thoracic kyphosis improved from 9.4° to 13.8°, mean lumbar lordosis decreased from 33.8° to 24.6°, and the mean Cobb angle of the main curve decreased from 93.2° to 91°.

After the second stage (scoliosis surgery), the mean major curve Cobb angle decreased from 91° to 31.6°, mean thoracic kyphosis improved from 13.8° to 18.4°, and mean lumbar lordosis improved from 24.6° to 27.2°.

Major intraoperative and postoperative complications were not reported. No L5 radiculopathy was observed.

Discussion

The highest occurrence of scoliosis associated with spondylolisthesis is at lumbar level. These curves show low angular and rotational values. Conversely, in the rare association between spondylolisthesis and thoracic scoliosis, the major curve Cobb angle often is severe, and both deformities require surgical management.

The presented technique allows for correction of both deformities, restoring correct triplanar alignment of the spine. Particularly, the two-stage approach allows for planning of the scoliosis fusion area and the corrective maneuver after removing any spondylolisthesis-related compensatory mechanisms on the sagittal plane.

Conclusions

The association between HDDS and severe scoliosis can be successfully managed via a two-stage approach, with all-posterior reduction and fusion of HDDS performed first, followed by subsequent scoliosis correction.