

5. Force Control techniques and technologies applied in complex deformity corrections

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Background

The concept of controlled fixation can be used for complex deformity correction. Four controlled reduction maneuvers are to be considered for different types of deformity: 1. Cantilever technique for flexible kyphosis, 2. Translation technique for flexible idiopathic scoliosis, 3. Bloc reduction for neuromuscular flexible scoliosis and 4. Pedicle Substraction Osteotomy (PSO) with Domino compression for rigid kyphosis.

Cantilever Controlled Reduction

The first case shows a L4-S1 lordosis reduction. Here, the initial key aspect is precise rod bending and stress-free placement between iliac fixation and the S1 screw. Further checks should follow up to the most cranial level to control the reduction performed, using the towers as a reference. Another case shows a 70 years old male with Parkinson disease. The patient had prior surgery for lumbar stenosis with progressive spinal deformity, proximal and distal junctional kyphosis and pseudarthrosis. He had standing and walking difficulties, but no leg pain and no deficit. The patient was treated in staged surgery. Step 1: T2 to Ilium posterior fusion without osteotomy by Wiltse approach, posterior instrumentation and Domino correction procedure. Step 2, 3 weeks later: L4-L5 and L5-S1 anterior graft by ALIF procedure. Three months postoperatively, radiographs show good correction of global alignment.

Translation Controlled Reduction

The next case shows how the Neo system can be used for the correction of idiopathic scoliosis in controlled translation technique. This technique has demonstrated superiority, especially in restoring thoracic kyphosis¹. After standard screw insertion, the towers of the monoaxial screws exactly follow the curved spine. Inserting the rod should be easy. Then all set screws can be screwed in until they touch the rod and then tightened. This generates major correction forces. These forces cannot be avoided, but Neo supports to share these loads well in a controlled way.

Bloc Controlled Reduction

In neuromuscular flexible scoliosis, bloc reduction is the treatment of choice with the Baker technique. It aims to fix the spine from the bottom up. Due to the strong fixation in the lower part, it is possible to achieve distraction by passing long rods under the skin and under the fascia to the upper part of the instrumentation. This allows good correction with a relatively simple and less aggressive operation. In 7 years of experience with about 60 cases, no rod breakage has occurred so far.

PSO Controlled Reduction with Domino Compression

PSO is the most difficult procedure in deformity correction surgery, and performing it with proper tower management is challenging. To achieve a force-controlled reduction, the caudal and cranial parts of the fixation are performed separately in stress-free cantilever technique, which can be controlled by the Neo towers. The upper and the lower blocs are then reduced in Domino technique and fixed to each other without avoidable pull-out stress. With this technique, the forces required for correction are applied in a controlled manner, i.e. only the load that is absolutely necessary is exerted where it is needed.

Conclusions

All types of deformities can be treated with the Neo system in a controlled fixation technique with only a few instruments. The main issues are the optimal placement of the screws, the precise bending of the rods and the flexibility of the spine.

1. Pesenti S, Clément JL, Ilharreborde B, Morin C, Charles YP, Parent HF, Violas P, Szadkowski M, Boissière L, Jouve JL, Solla F. Comparison of four correction techniques for posterior spinal fusion in adolescent idiopathic scoliosis. *Eur Spine J*. 2022 Apr;31(4):1028-1035. doi: 10.1007/s00586-022-07145-7. Epub 2022 Feb 28. PMID: 35224673.