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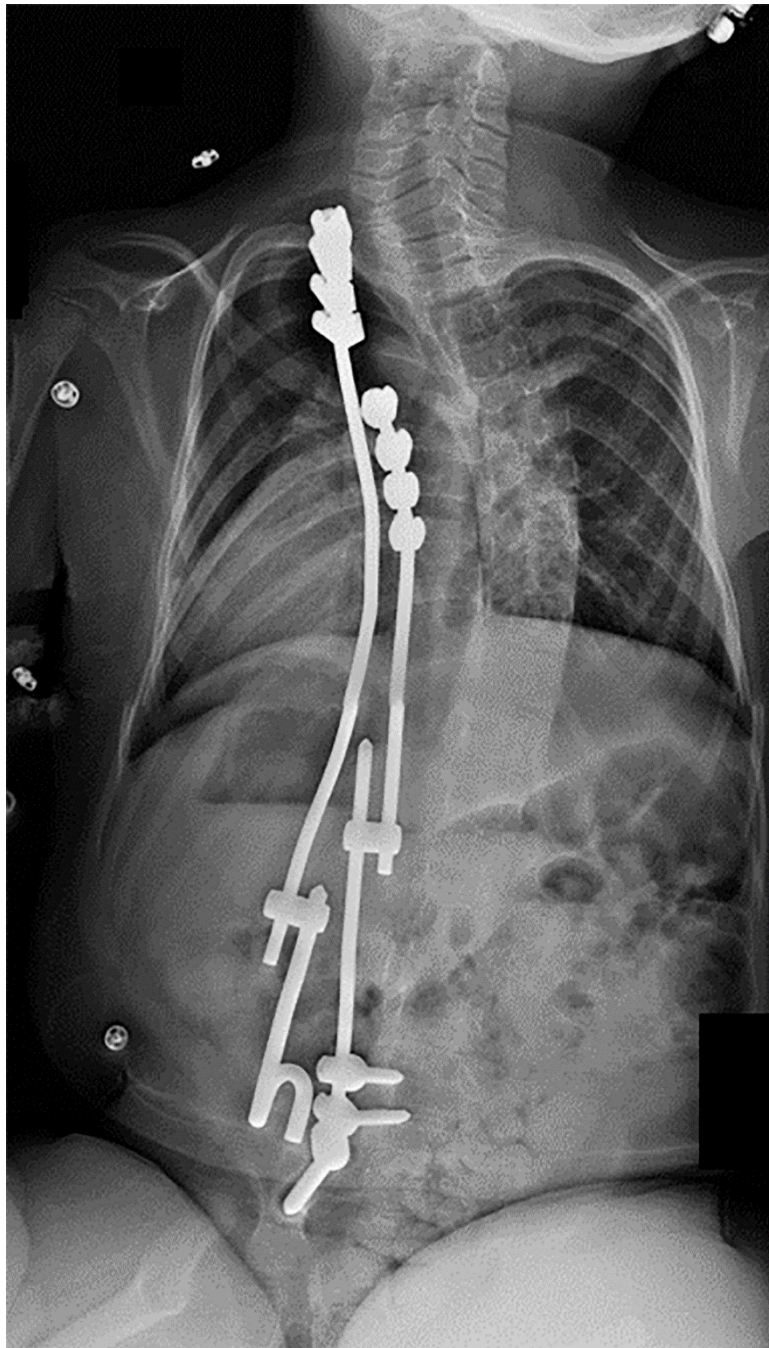
APPENDIX FIGURES - Growth-friendly spine instrumentation in AMC

Appendix Figures 1-3: Additional Images for Case 1

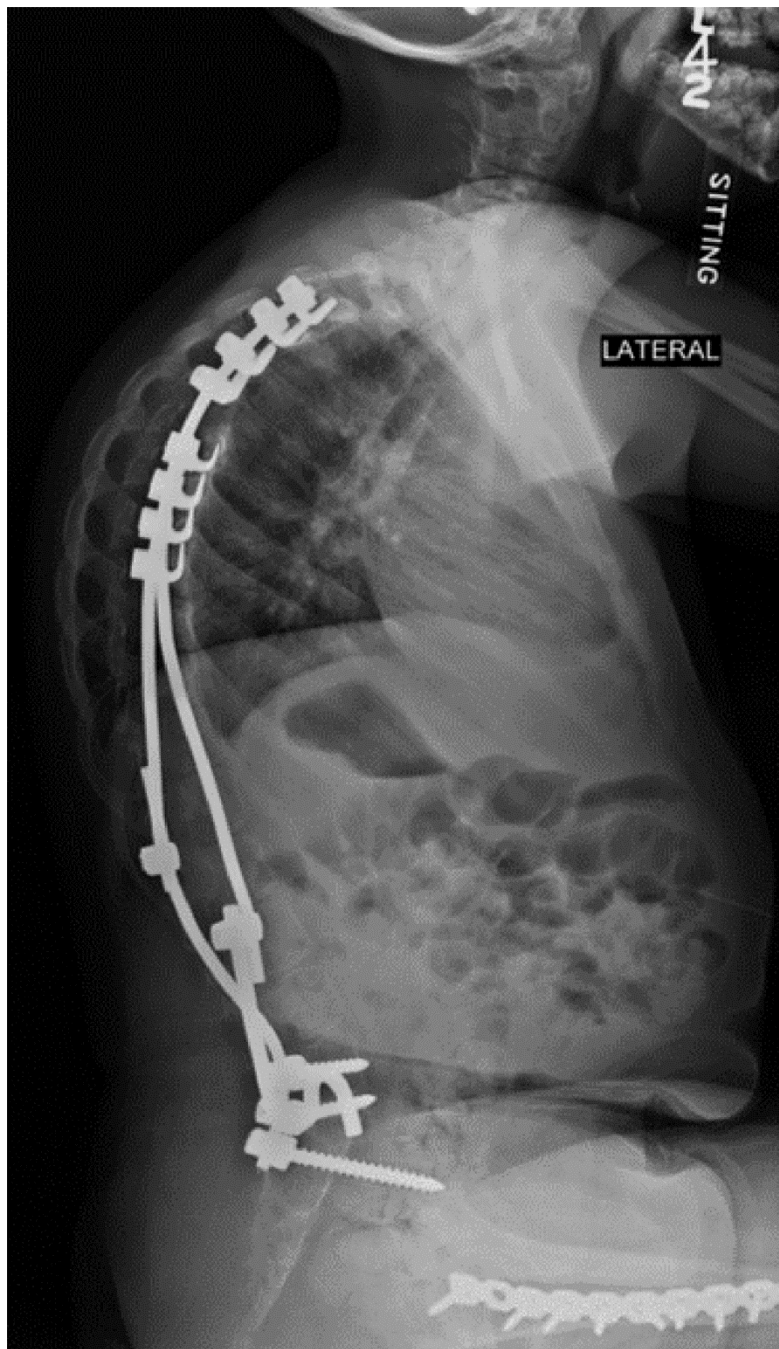
Appendix Figures 1 through 3 show additional images of Case 1, as shown in Figures 3, 4, 8, and 9 in the main paper. Case 1 was a 4.2-year-old boy with uncharacterized syndromic AMC demonstrating 84° right thoracolumbar scoliosis and severe 110° thoracolumbar kyphosis. Comorbidities included developmental delay, conductive hearing loss, bilateral hip dislocations, feeding difficulties, and thoracic insufficiency syndrome. The patient was nonambulatory (GMFCS V) and required nutritional support through a gastrostomy tube. An implant from a prior femoral osteotomy is evident on the right side. The patient underwent traditional growing rod treatment.

Preoperative sitting PA (**Fig. 1**) and sagittal (**Fig. 2**) radiographs after three years and five surgical distractions. A left proximal cervicothoracic 31° curve developed with stabilization of the right thoracolumbar 40° curve. Thoracic kyphosis deteriorated to 87° which resulted in anchor prominence and progressive skin erosion at the medial left connector. Conversion to dual magnetically controlled growing rods (MCGR) (proximal: bilateral pedicle screw fixation from T2-T4; distal: bilateral pedicle screw from L5-S1 and S2A1 fixation) was performed.

Sitting PA radiograph (**Fig. 3**) at the final GFI after approximately five years of GFI and six additional MCGR distractions (total 11 interventions). Excellent coronal deformity correction of the right thoracolumbar curve to 32° (62% correction) is noted with stabilization of the left proximal thoracic curve at 32°. During GFI, true T1-T12 length increased from 182mm to 223mm (0.67mm/month) and true T1-S1 length 269mm to 343mm (1.21mm/month). The skeletally immature patient was 9 years old at final follow-up and was actively being lengthened; recent sagittal radiographs were unavailable and further details on the evolution of thoracic kyphosis could not be provided.



Appendix Figure 1 Case 1: posteroanterior radiograph showing the preoperative conversion to MCGR.



Appendix Figure 2 Case 1: lateral radiograph showing preoperative conversion to MCGR.



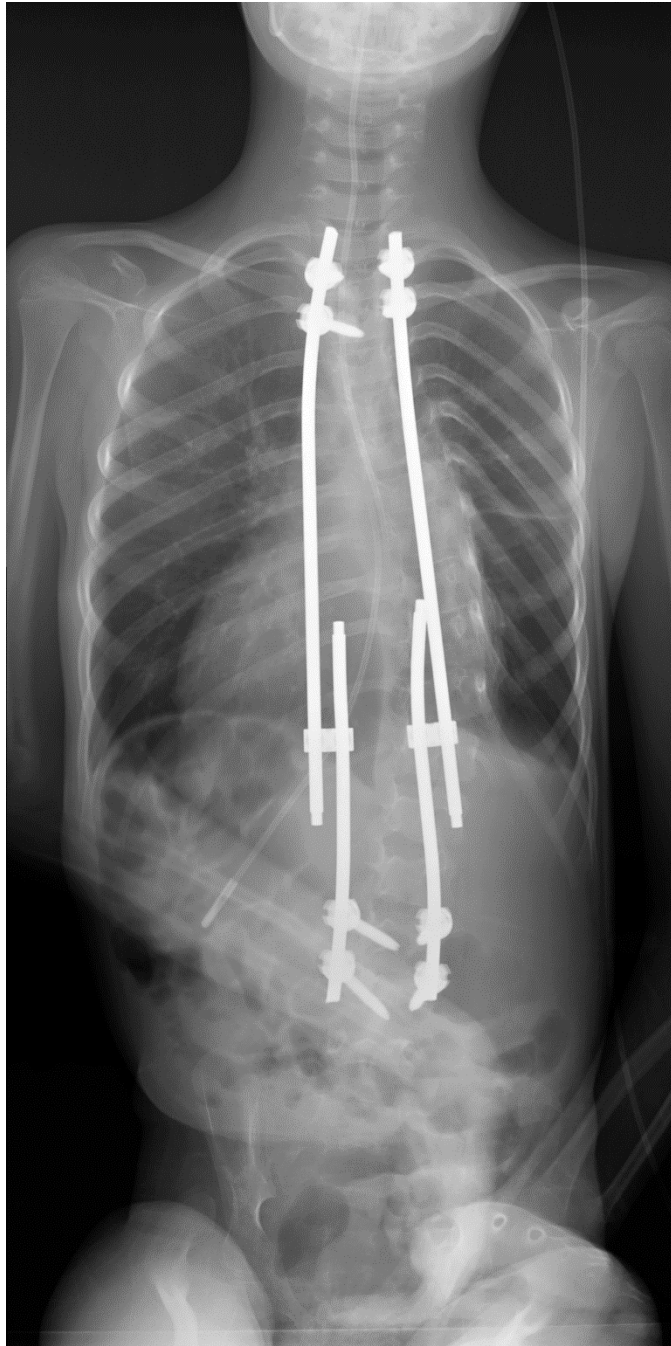
Appendix Figure 3 Case 1: posteroanterior radiograph showing postoperative conversion to MCGR.

Appendix Figures 4-7. Additional Images for Case 2

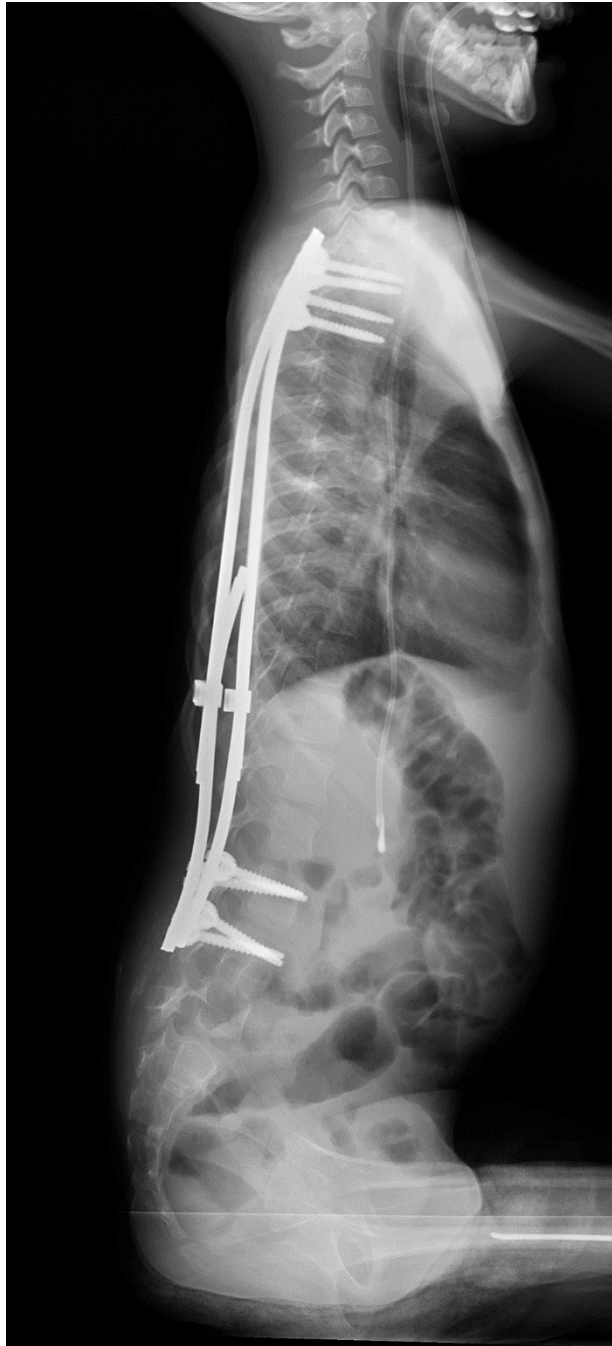
Appendix Figures 4 through 7 show additional images of Case 1, as shown in Figures 5 and 6 in the main paper. Case 2 was a 5.9-year-old girl with uncharacterized syndromic arthrogryposis demonstrating a 74° right thoracolumbar curve and a “flat” back. The patient was nonambulatory (GMFCS V) and the MRI was negative for intraspinal pathology. Curve progression occurred despite bracing using a thoracolumbar sacral orthosis. The patient was treated with a dual traditional growing-rod construct, which resulted in improvement of the scoliosis to 36° (51% correction) with minimal restoration of thoracic kyphosis (4°).

Postoperative index GFI sitting PA (**Fig. 4**) and sagittal (**Fig. 5**) radiographs after dual TGR insertion (bilateral pedicle screws at T2-T3 and L3-L4) demonstrating improvement of the right thoracolumbar curve to 36° (51% correction) with minimal restoration of thoracic kyphosis (4°). Post-index T1-T12 length was 194mm and T1-S1 length 295mm.

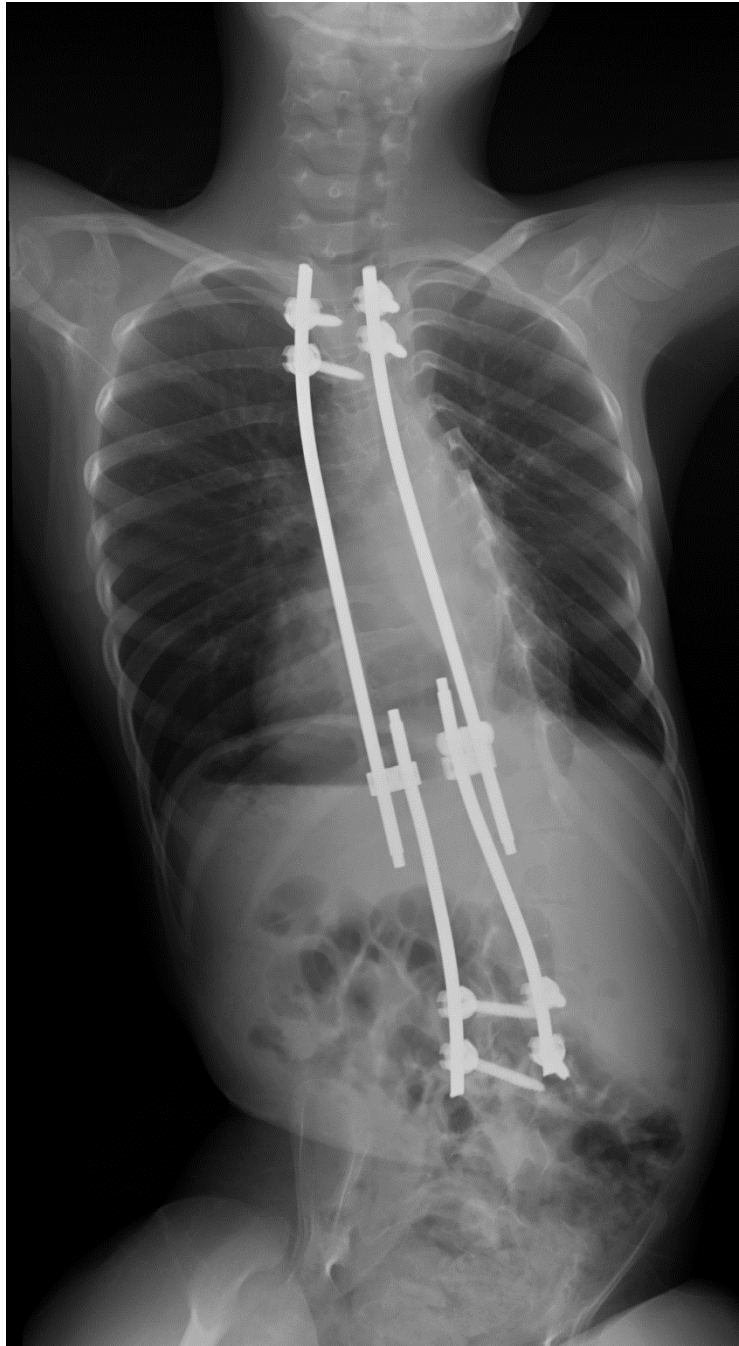
Sitting PA (**Fig. 6**) and sagittal (**Fig. 7**) radiographs at final GFI and follow-up after 26 months of GFI and five surgical distractions. Mild progression of the right thoracolumbar curve to 45° (maintained correction of 39%) and axial vertebral rotation are seen. True T1-T12 length increased to 207mm (0.50mm/month) and T1-S1 length to 312mm (0.65mm/month). The patient was actively undergoing GFI and further treatment details were unavailable.



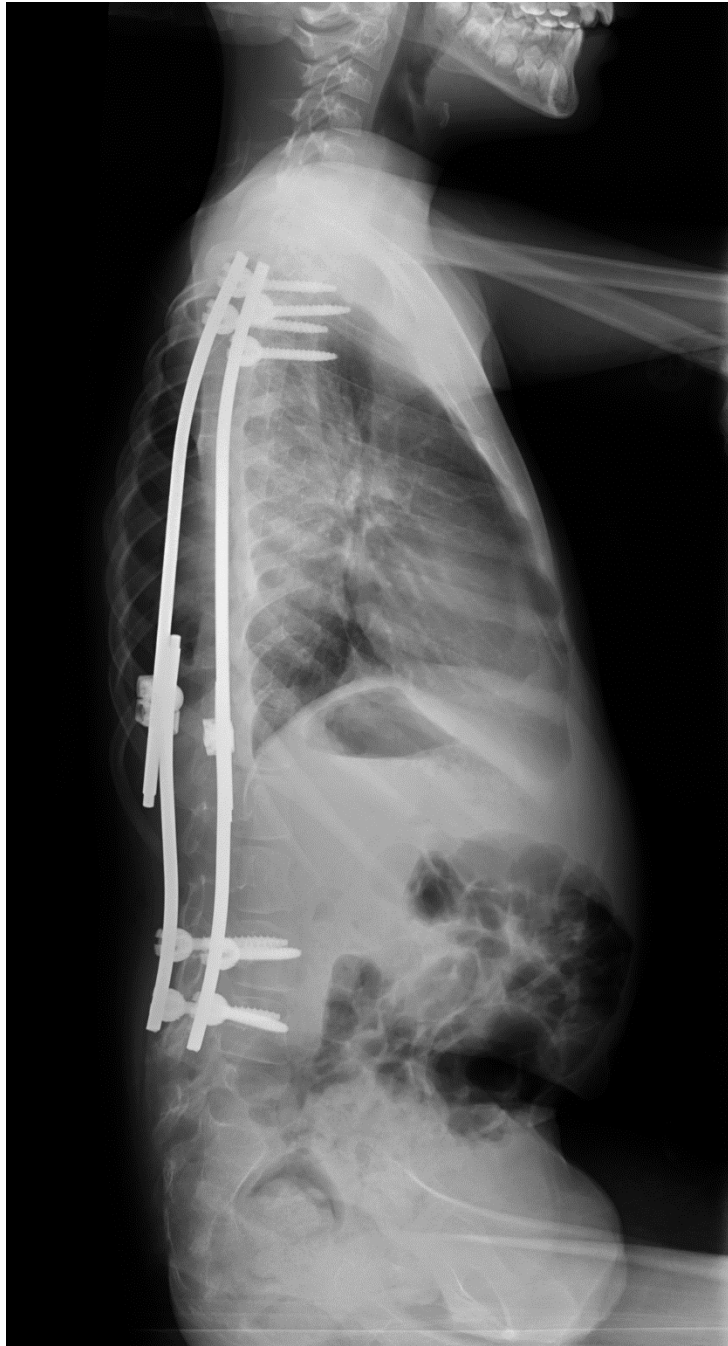
Appendix Figure 4 Case 2: posteroanterior sitting radiograph showing the spine post-index.



Appendix Figure 5 Case 2: lateral radiograph showing the spine post-index.



Appendix Figure 6 Case 2: posteroanterior radiograph showing the spine at the final GFI.



Appendix Figure 7 Case 2: lateral radiograph showing the spine at the final GFI.

Appendix Figures 8-15. Images for Case 3

Appendix Figures 8 through 15 show images of Case 3. Preoperative PA (**Fig. 8**) and sagittal (**Fig. 9**) radiographs demonstrating kyphoscoliosis in a 4-year-old girl with distal arthrogryposis type 4 (DA4). A double major curve (85° right thoracic and 75° left lumbar) and 54° thoracic kyphosis are visualized. Clinical examination at birth was significant for craniofacial abnormalities, plagiocephaly, torticollis, wrist flexion contractures, left hip dislocation, and a right clubfoot after C-section delivery at 36 weeks. Pavlik harness treatment and wrist splinting resulted in remarkable improvement by three months, with full passive range of motion of both upper extremities. Spinal deformity became evident by nine months and MRI revealed no intraspinal abnormalities. Despite temporary stabilization with a thoracolumbar sacral orthosis (18 hours/day), severe curve progression and recurrent upper respiratory infections occurred at age three.

Postoperative index GFI PA (**Fig. 10**) and sagittal (**Fig. 11**) radiographs demonstrating marked improvement in both the coronal and sagittal planes after dual TGR insertion (4.5mm rods). The right thoracic and left lumbar curves reduced to 47° (45% correction) and 49° (35% correction), respectively. Post-index thoracic height (T1-T12 length) was 173mm and total spine height (T1-S1 length) was 268mm. The patient was discharged uneventfully on postoperative day five.

Final GFI PA (**Fig. 12**) and sagittal (**Fig. 13**) radiographs after nine years of GFI (10 surgical distractions) demonstrating maintained deformity correction. Thoracic and total spinal growth rates during GFI were 0.3mm/month and 0.7mm/month, respectively. The patient was approaching skeletal maturity and GFI was discontinued.

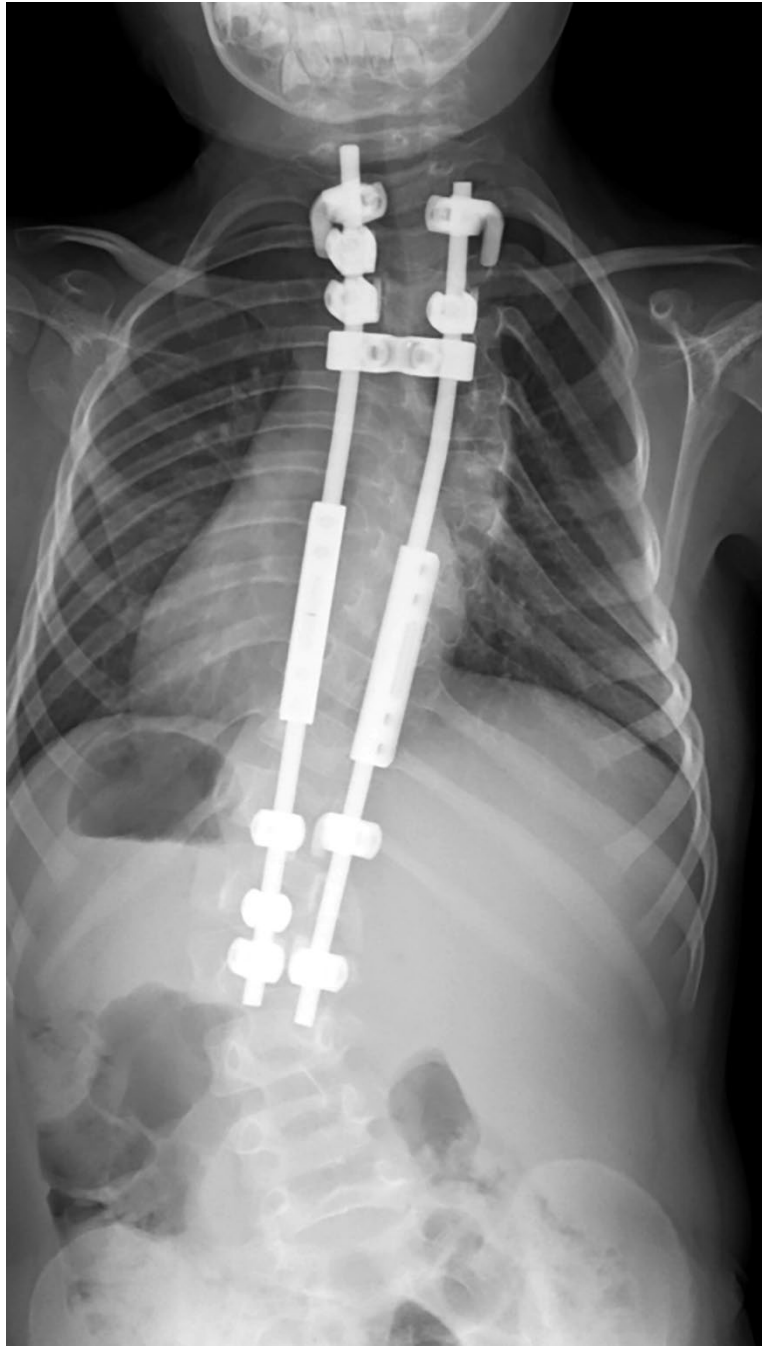
Last follow-up PA (**Fig. 14**) and sagittal (**Fig. 15**) radiographs taken two years after the final GFI showing excellent spinal alignment. No signs of mechanical failure, implant loosening, or junctional kyphosis are noted. The skeletally mature patient was 17-years old and definitive spinal fusion was deferred.



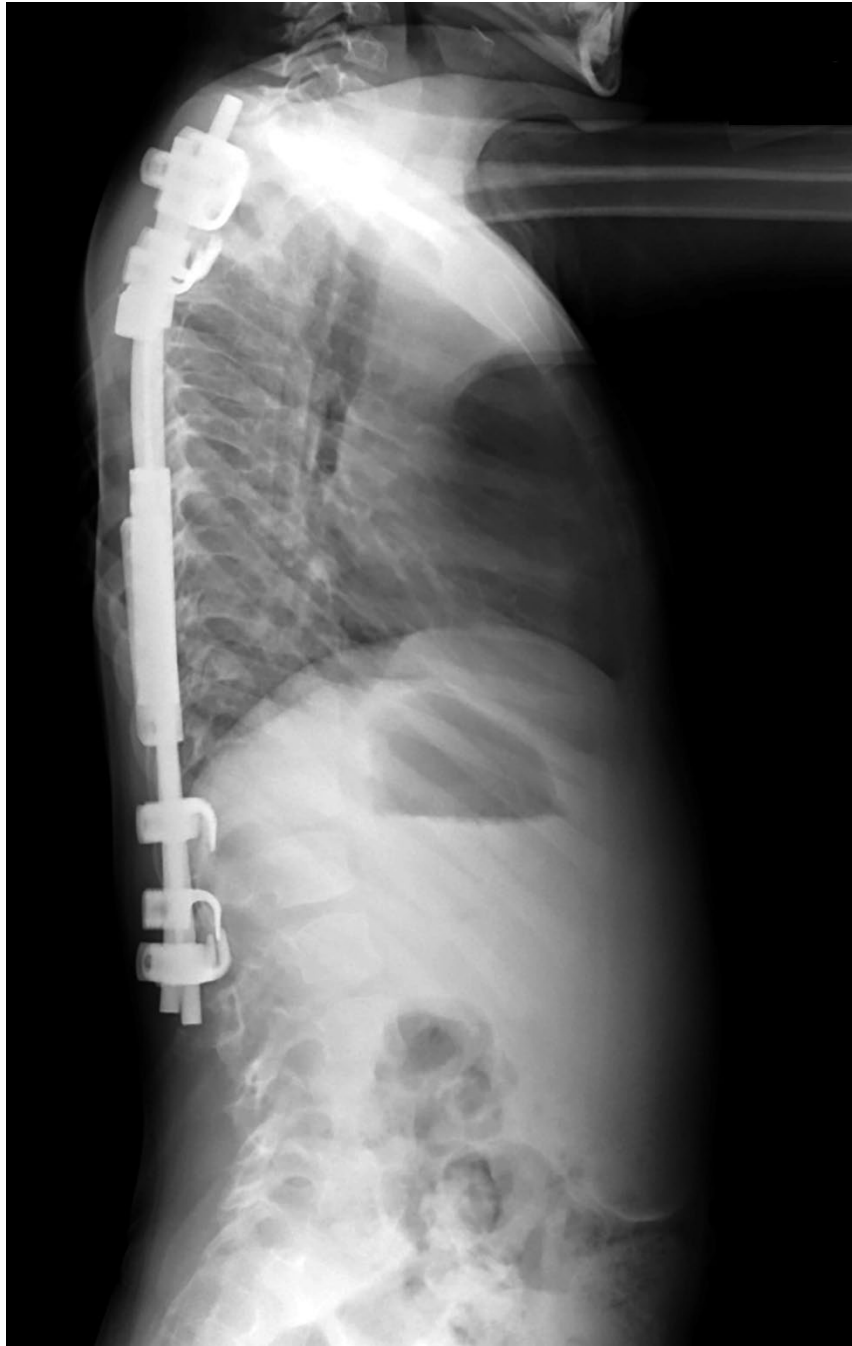
Appendix Figure 8 Case 3: preoperative posteroanterior radiograph showing a double major curve.



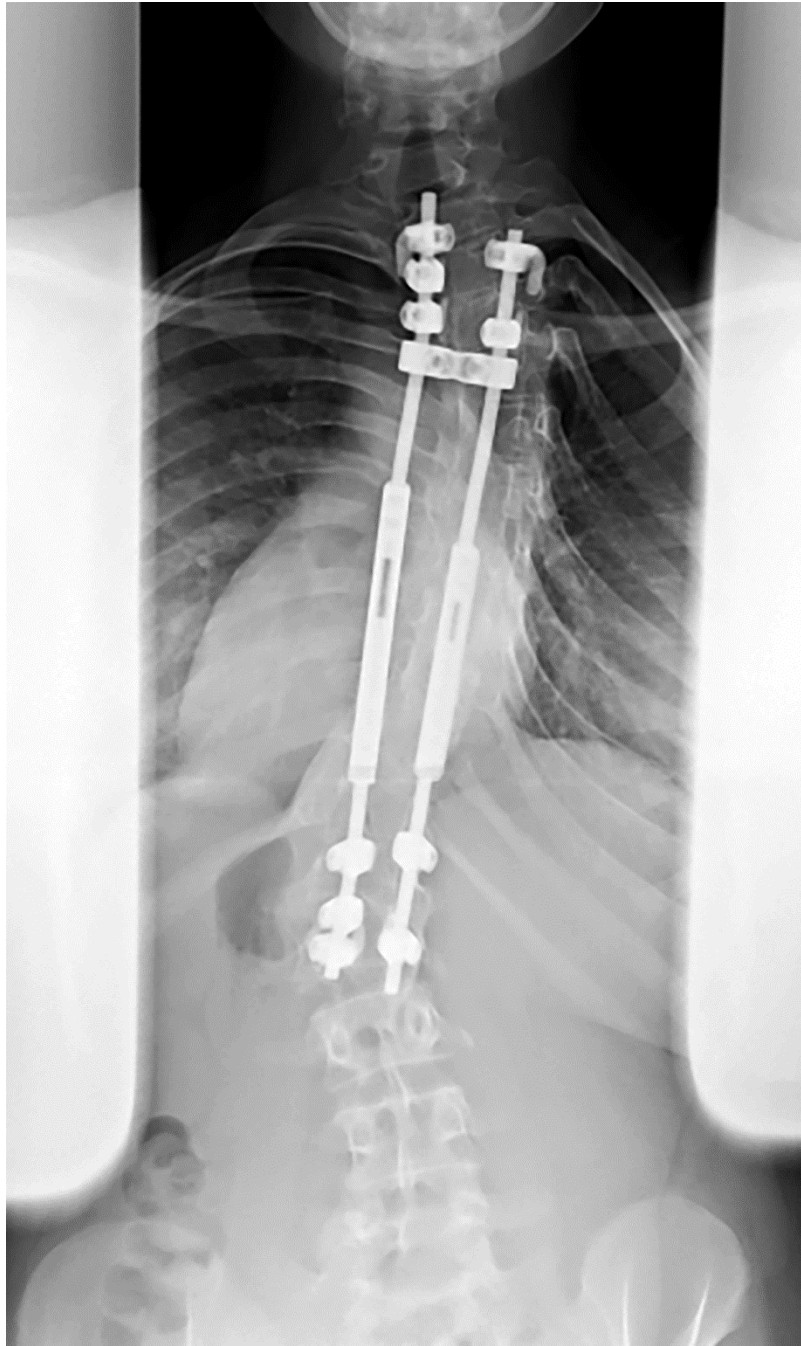
Appendix Figure 9 Case 3: preoperative sagittal radiograph showing thoracic kyphosis.



Appendix Figure 10 Case 3: postoperative index GFI posteroanterior radiograph demonstrating marked coronal curve improvement after dual TGR insertion (4.5-mm rods).



Appendix Figure 11 Case 3: postoperative index GFI lateral radiograph demonstrating reduced kyphosis after dual TGR insertion (4.5-mm rods).



Appendix Figure 12 Case 3: final GFI posteroanterior radiograph after 9 years of GFI (10 surgical distractions) demonstrating adequate coronal deformity correction.



Appendix Figure 13 Case 3: final GFI lateral radiograph after 9 years of GFI (10 surgical distractions) demonstrating excellent sagittal alignment.



Appendix Figure 14 Case 3: latest follow-up posteroanterior radiograph taken 2 years after the final GFI showing maintained coronal correction.



Appendix Figure 15 Case 3: latest follow-up lateral radiograph taken 2 years after the final GFI showing maintained sagittal correction.