Spine

SPINE Volume 44, Number 4, pp E252–E257

CASE REPORT

Posterior Spinal Fusion in a Scoliotic Patient With Congenital Heart Block Treated With Pacemaker

An Intraoperative Technical Difficulty

Tat Seng Wong, MBBS,* Jaseemuddeen Abu Bakar, MBBS, MMed Anaes,† Kok Han Chee, MBBS, MMed,‡ Mohd Shahnaz Hasan, MBBS, MAnes,† Weng Hong Chung, MD, MSOrth,* Chee Kidd Chiu, MBBS, MSOrth,* Chris Yin Wei Chan, MD, MSOrth,* and Mun Keong Kwan, MBBS, MSOrth*

Study Design. Case report.

Objective. To describe the technical difficulties on performing posterior spinal fusion (PSF) on a pacemaker-dependent patient with complete congenital heart block and right thoracic scoliosis.

Summary of Background Data. Congenital complete heart block requires pacemaker implantation at birth through thoracotomy, which can result in scoliosis. Corrective surgery in this patient was challenging. Height gain after corrective surgery may potentially cause lead dislodgement. The usage of monopolar electrocautery may interfere with the function of the implanted cardiac device.

Methods. A 17-year-old boy was referred to our institution for the treatment of right thoracic scoliosis of 70°. He had underlying complete congenital heart block secondary to maternal systemic lupus erythematosus. Pacemaker was implanted through thoracotomy since birth and later changed for four times. PSF was performed by two attending surgeons with a temporary pacing inserted before the surgery. The monopolar electrocautery device was used throughout the surgery.

Results. The PSF was successfully performed without any technical issues and complications. Postoperatively, his permanent pacemaker was functioning normally. Three days later, he was recovering well and was discharged home from hospital.

Conclusion. This case indicates that PSF can be performed successfully with thoughtful anticipation of technical difficulties on a pacemaker-dependent patient with underlying congenital heart block.

Key words: adolescent, congenital complete heart block, electrocautery/electrosurgery, grounding pads, pacemaker, posterior spinal fusion, scoliosis, temporary pacing, thoracotomy.

Level of Evidence: 5

Spine 2019;44:E252–E257

Congenital heart block has a prevalence of 1% to 2% in pregnant ladies with anti-Sjögren's-syndrome-related antigen A antibodies. It carries substantial mortality during neonatal period and requires pacing.[1] Thoracotomy, which can result in scoliosis,[2] is the standard surgical approach for pacemaker implantation in infants with congenital heart block.

To prevent worsening of the scoliosis, posterior spinal fusion (PSF) is recommended in this group of postpubertal patients. The use of monopolar electrocautery in PSF, which introduce electromagnetic interference (EMI) can cause alteration and damage to the pacemaker. Instant height gain during surgical correction may also cause lead dislodgement. Therefore, we would like to report a case of a pacemaker-dependent patient with congenital heart block presented with a right thoracic scoliosis, who successfully underwent a PSF.

CASE PRESENTATION

A 17-year-old boy with underlying glucose-6-phosphate dehydrogenase deficiency and congenital heart block on pacemaker, was referred to our institution for surgical correction of right thoracic scoliosis of 70°.

He was diagnosed with complete congenital heart block and had an epicardial pacemaker implantation *via* a left thoracotomy at birth. Family history revealed that his mother had systemic lupus erythematosus. During cardiology follow-up, he had his pacemaker replaced for four times. The current dual chamber pacemaker (Accent DR, St. Jude Medical, Little

From the *Department of Orthopaedic Surgery (NOCERAL), Faculty of Medicine, University of Malaya, Kuala Lumpur, Malaysia; †Department of Anaesthesiology, Faculty of Medicine, University of Malaya, Kuala Lumpur, Malaysia; and ‡Department of Medicine, Faculty of Medicine, University of Malaya, Kuala Lumpur, Malaysia.

Acknowledgment date: June 14, 2018. First revision date: July 13, 2018. Acceptance date: July 16, 2018.

The manuscript submitted does not contain information about medical device(s)/drug(s).

No funds were received in support of this work.

No relevant financial activities outside the submitted work.

Address correspondence and reprint requests to Mun Keong Kwan, MBBS, MSOrth, Department of Orthopaedic Surgery, National Orthopaedic Centre of Excellence for Research and Learning (NOCERAL), Faculty of Medicine, University of Malaya, 50603 Kuala Lumpur, Malaysia;
E-mail: munkeong42@hotmail.com

DOI: 10.1097/BRS.0000000000002828

Figure 1. Preoperative clinical photographs from the front (**A**) and back (**B**) showed a thoracic scoliosis and a left thoracotomy scar. Postoperative clinical photograph (**C** and **D**) showed correction of the scoliosis with balanced shoulders postoperatively.

Canada, Minnesota) was inserted 2 years before the scoliosis surgery with remaining battery longevity of 8 years.

On clinical examination, left thoracotomy scar was noted. He had right thoracic scoliosis with a marked prominence of the right rib cage, waistline asymmetry, lateral shoulder imbalance, and C7-plumb line was 10 mm to the right (Figure 1A and B). Other examinations were unremarkable.

The Cobb angle measurements were 38° (T1-T5) and 70° (T6-T12). Risser sign was grade 5 (Figure 2A–C). MRI of

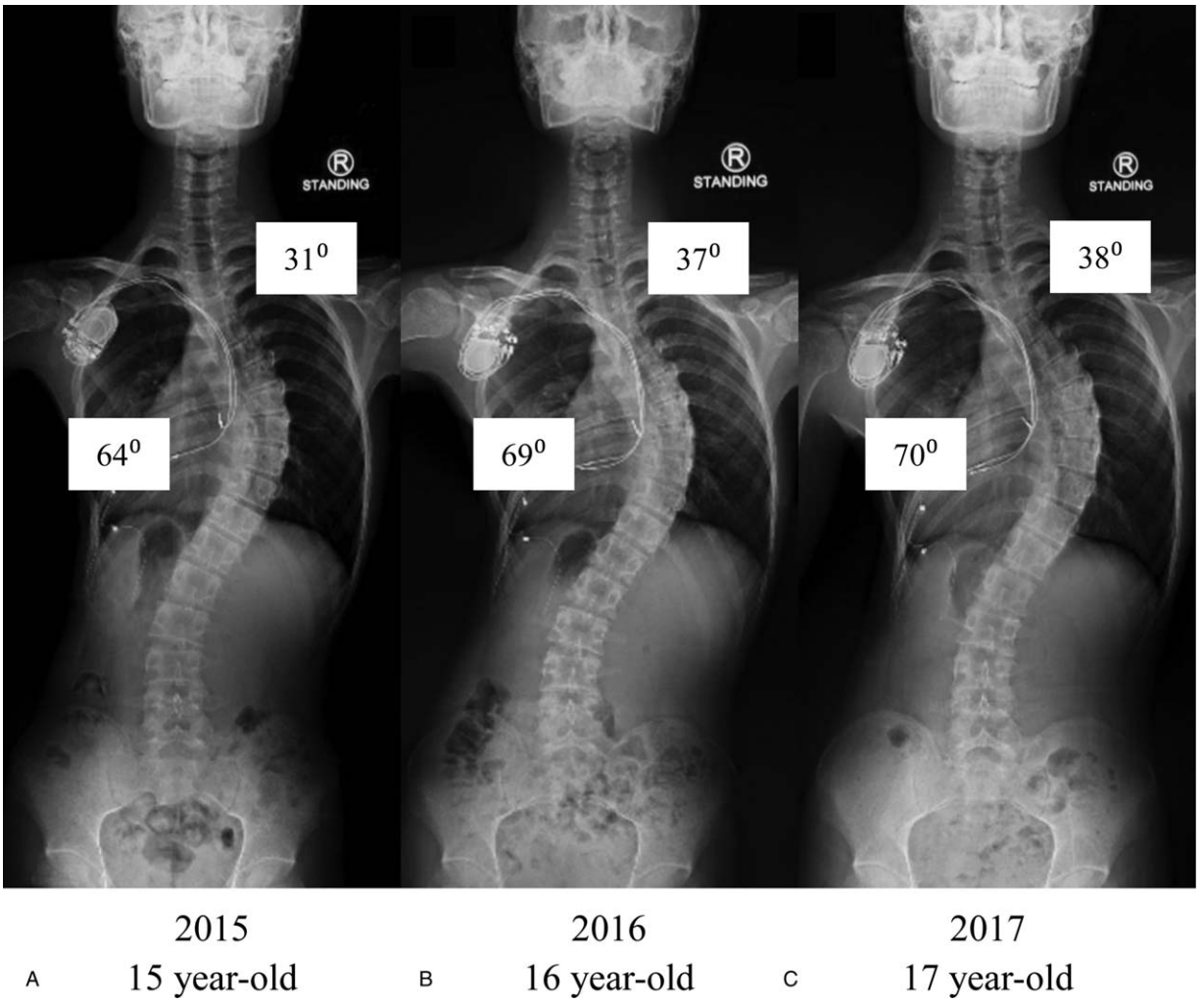

Figure 2. Posteroanterior (PA) standing radiographs demonstrated worsening of scoliosis curve in 2015 (**A**), 2016 (**B**), and 2017 (**C**).

the whole spine was normal. Blood tests were normal except polycythemia. The cardiology evaluation showed good cardiac function on 100% ventricular pacing and 20% atrial pacing. Chest x-ray revealed minimal redundancy of pacemaker leads (Figure 3A and B).

Before the surgery, temporary pacemaker was inserted as a pre-emptive measure for intraoperative pacemaker lead dislodgement (Figure 4A–C). By using a magnet applied onto the chest, the permanent pacemaker was changed to asynchronous mode with a constant pacing at 80 per minute. The temporary pacemaker was set at 60 per minute (backup pacing). The surgery was performed by two senior attending surgeons with monopolar electrocautery device (Arc 303, BOWA-electronic GmbH & Co. KG, Gomaringen, Germany) with setting at 35 and grounding pads applied on the thighs. Somatosensory-evoked potential monitoring was used throughout the surgery. Transcranial monitoring was not used in this case. There was 15% blood pressure drop with 1654 mL blood loss after surgical correction, but it responded well to fluid and bolus of phenylephrine. He had successfully undergone a PSF from T2 to L2 with intact permanent pacemaker (Figure 3C and D). All the pacemaker and leads' parameters were normal. The temporary pacemaker was then removed 24 hours later after close observation in intensive care unit. Relevant height gain was measured clinically and radiologically. Both clinical and radiological (T1 to S1) height gain were 3.6 cm. He was discharged home 3 days later with no complications. Postoperatively, he had balanced shoulder, more symmetrical waist line, and less rib hump (Figure 1C and D).

DISCUSSION

Congenital complete atrioventricular heart block has incidence of 1 in 15,000 to 20,000 live births[3] and carries fetal mortality rate of 20%.[4] Pacemaker implantation *via* thoracotomy is the standard approach in infants. There are some literatures reported postoperative scoliosis after thoracotomy.[5,6]

Some essential factors in perioperative management of pacemaker-dependent patients include its indications, model, programming, battery longevity, leads type, and

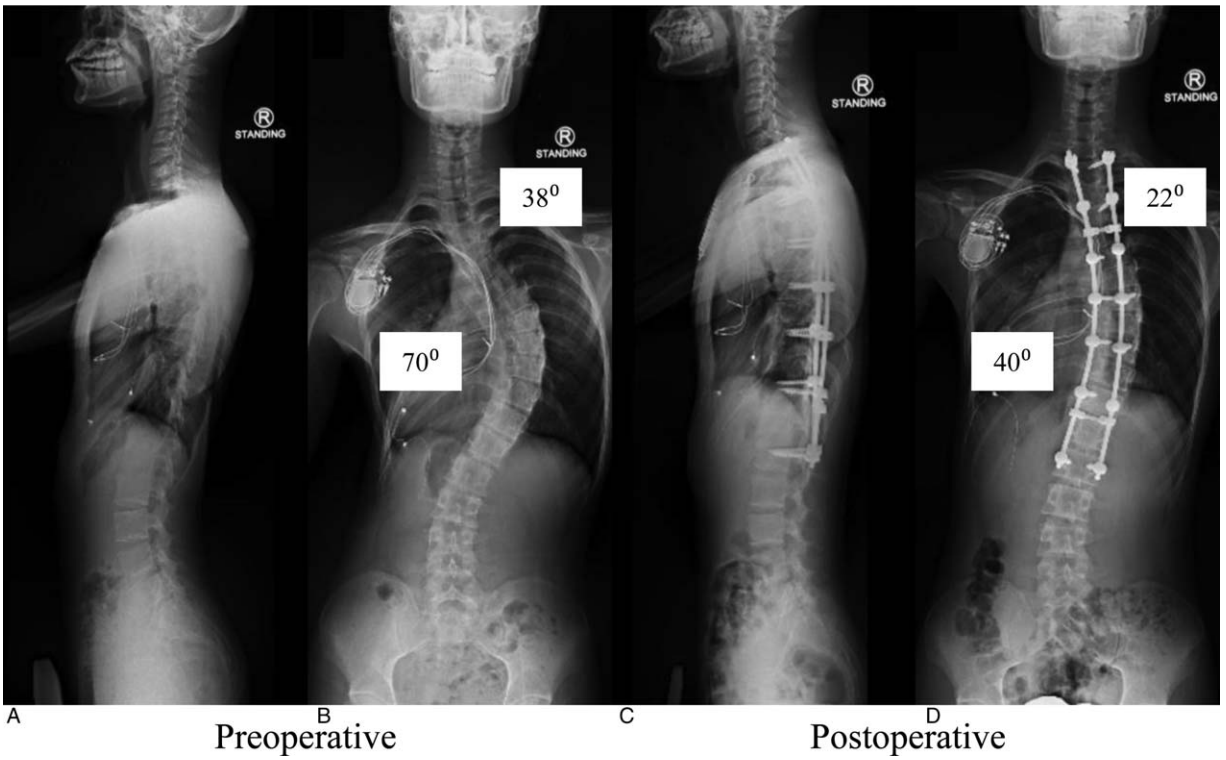

Figure 3. Preoperative lateral (**A**) and posteroanterior (**B**) standing radiographs of the spine showed a right thoracic scoliosis with an indwelling cardiac pacemaker. Postoperative lateral (**C**) and posteroanterior (**D**) radiographs revealed correction of the scoliotic curve of 42.8% with 3.6 cm height gain. There is minimal movement of the pacemaker leads after the surgery.

functionality.[7] Introduction of EMI, that is, monopolar electrocautery to pacemaker can result in pacemaker inhibition, oversensing problem, and damage to pulse generator.[7] Bales *et al*[8] reported the use of monopolar electrocautery-induced asystole in a pacemaker-dependent patient during scoliosis surgery. As such, bipolar electrocautery, minimum electrocautery power settings, and strategic positioning of the current electrode are recommended to make sure the current path more than 6 inches away from the pulse generator and lead.[7] One way to minimize pacemaker inhibition is by placing a magnet over the pulse generator to achieve asynchronous state. Hence access to pulse generator must be checked when in prone position. If central venous line is required using Seldinger technique, caution should be exercised to avoid lead dislodgement.[7] Intraoperative neurophysiological monitoring using somatosensory-evoked potential is safe but transcranial electrical stimulation in motor-evoked potential may cause interference to pacemaker.[9] Pacemaker should be evaluated for functionality postoperatively.

Growth-related lead problem has always been a concern in pacemaker implantation with endocardial approach. In patients undergoing scoliosis surgery, substantial height gain can be achieved in relation to the magnitude of surgical correction, the number of levels fused, and preoperative stature.[10] In view of the instant height gain after surgery, there is a possibility of lead dislodgement due to inadequate redundancy of pacemaker electrode. Watanabe *et al*[11] proposed that height increment equals to correction of the Cobb angle $\times$ 0.77. Therefore, undercorrection of the Cobb angle by usage of polyaxial screws, reduced screw density, and ''letting go'' the rod bending can limit excessive height gain after scoliosis correction surgery. Temporary pacing should be prepared before the surgery to avoid intraoperative lead(s) dislodgement as a result of spinal height gain.

Hemodynamics could change due to the blood loss during surgery. Patient's permanent pacemaker base rate was set at 80 per minute, which is 20 per minute higher than his baseline to compensate for blood loss and minimize hemodynamic changes. The blood loss (1654 mL) in this patient was higher as the mean total blood loss in our series of patients was 951.0 ± 454.0 mL.[12] Bipolar cautery was an ineffective method for surgical dissection. Therefore, the surgical dissection was performed using monopolar cautery throughout the surgery. Furthermore, a two-attending surgeon approach can be used to significantly reduce operative time and blood loss.[13]

CONCLUSION

With fastidious perioperative evaluation, meticulous intraoperative management, and postoperative care, scoliosis surgery *via* PSF can be safely performed in pacemaker-dependent patients.

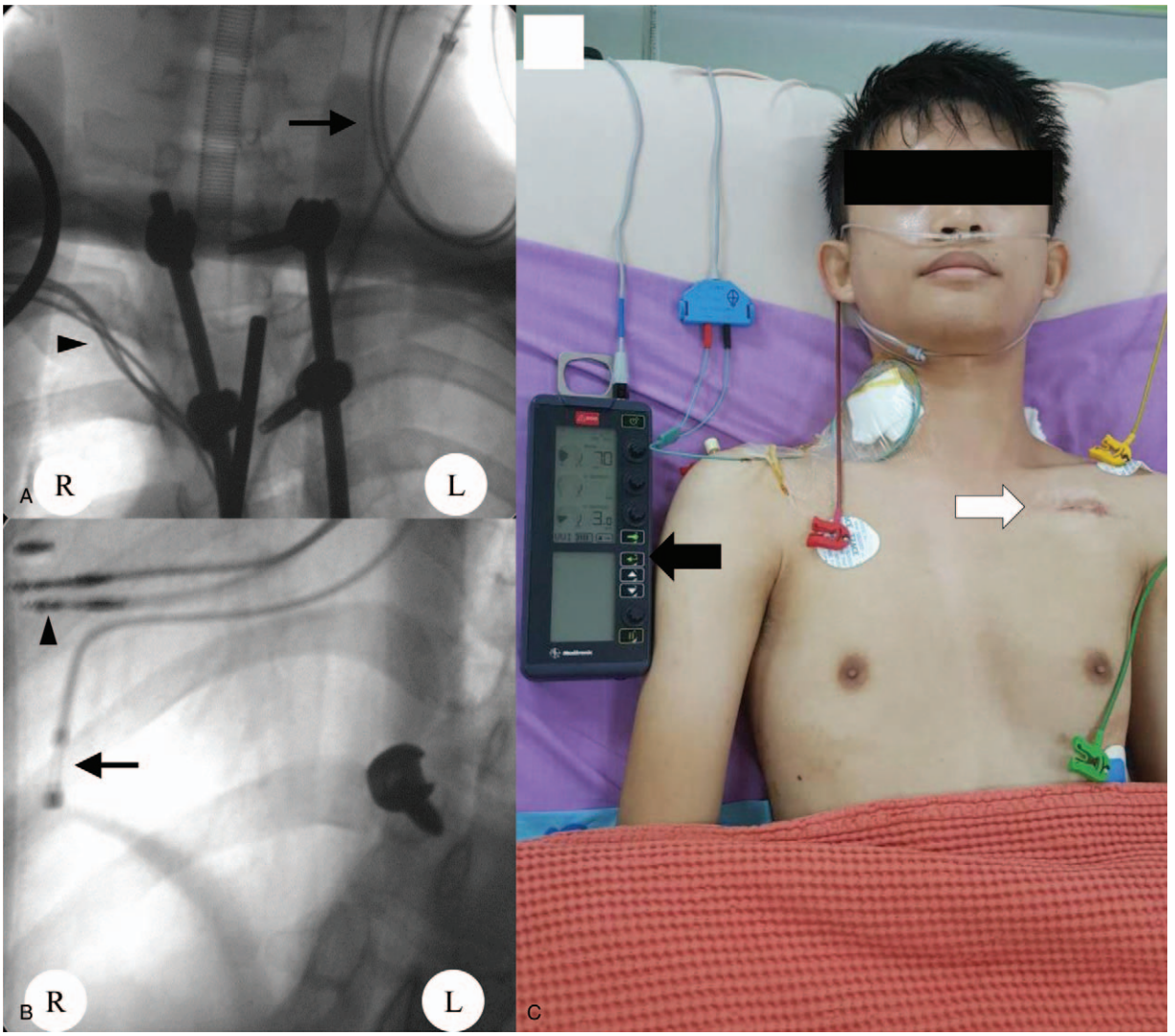

Figure 4. Intraoperative radiographs (**A** and **B**) showed the lead placement of permanent pacemaker (arrowhead) and temporary venous pacemaker (arrow) during the surgery. Clinical photo (**C**) showed the placement of the temporary cardiac pacemaker (black arrow) and permanent cardiac pacemaker (white arrow).

Key Points

- There are technical difficulties in performing PSF on a pacemaker-dependent patient with congenital heart block.
- Introduction of EMI by monopolar electrocautery device causing pacemaker inhibition and damage to pulse generator can be prevented by meticulous preoperative and intraoperative planning.
- Complications of pacemaker lead dislodgement following instant height gain during surgery can be avoided by undercorrection of the Cobb angle and insertion of a temporary pacemaker.
- A dual attending surgeon strategy is recommended to reduce operative duration and blood loss hence minimizes hemodynamic changes in this pacemaker-dependent patient.

References

1. Buyon JP, Hiebert R, Copel J, et al. Autoimmune-associated congenital heart block: demographics, mortality, morbidity and recurrence rates obtained from a national neonatal lupus registry. *J Am Coll Cardiol* 1998;31:1658–66.
2. Bal S, Elshershari H, Çeliker R, et al. Thoracic sequels after thoracotomies in children with congenital cardiac disease. *Cardiol Young* 2005;13:264–7.
3. Issa Z, Miller JM, Zipes DP. *Clinical Arrhythmology and Electrophysiology: A Companion to Braunwald's Heart Disease E-Book: Expert Consult: Online and Printed*. Philadelphia, PA: Elsevier Health Sciences; 2012.
4. Friedman DM, Rupel A, Glickstein J, et al. Congenital heart block in neonatal lupus: the pediatric cardiologist's perspective. *Indian J Pediatr* 2002;69:517–22.

5. Van Biezen FC, Bakx PAGM, De Villeneuve VH, et al. Scoliosis in children after thoracotomy for aortic coarctation. *JBJS* 1993;75:514–8.
6. Gilsanz V, Boechat IM, Birnberg FA, et al. Scoliosis after thoracotomy for esophageal atresia. *AJR Am J Roentgenol* 1983;141: 457–60.
7. Crossley GH, Poole JE, Rozner MA, et al. The Heart Rhythm Society (HRS)/American Society of Anesthesiologists (ASA) Expert Consensus Statement on the perioperative management of patients with implantable defibrillators, pacemakers and arrhythmia monitors: facilities and patient management this document was developed as a joint project with the American Society of Anesthesiologists (ASA), and in collaboration with the American Heart Association (AHA), and the Society of Thoracic Surgeons (STS). *Heart Rhythm* 2011;8:1114–54.
8. Bales JG, Colon J, Ramadhyani U, et al. Electrocautery-induced asystole in a scoliosis patient with a pacemaker. *J Pediatr Orthop B* 2007;16:19–22.
9. MacDonald DB. Safety of intraoperative transcranial electrical stimulation motor evoked potential monitoring. *J Clin Neurophysiol* 2002;19:416–29.
10. Spencer H, Gold M, Karlin LI, et al. Gain in spinal height from surgical correction of idiopathic ccoliosis. *J Bone Joint Surg Am* 2014;96:59–65.
11. Watanabe K, Hosogane N, Kawakami N, et al. Increase in spinal longitudinal length by correction surgery for adolescent idiopathic scoliosis. *Eur Spine J* 2012;21:1920–5.
12. Chiu CK, Chan CY, Aziz I, et al. Assessment of intraoperative blood loss at different surgical stages during posterior spinal fusion surgery in the treatment of adolescent idiopathic scoliosis. *Spine (Phila Pa 1976)* 2016;41:E566–73.
13. Kwan MK, Chiu CK, Chan CY. Single vs two attending senior surgeons: assessment of intra-operative blood loss at different surgical stages of posterior spinal fusion surgery in Lenke 1 and 2 adolescent idiopathic scoliosis. *Eur Spine J* 2017;26:155–61.