



Higher-than-anticipated reoperation after final fusion for early onset scoliosis patients treated with growing rods

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The preservation of spinal growth and prevention of pulmonary compromise in early onset scoliosis (EOS) pose particularly challenging problems for clinician and patients. Maintaining spinal and thoracic growth is critical for expansion of the thoracic cavity and the prevention of thoracic insufficiency syndrome. Nowadays, growing rod technique has been proven to be the optimal surgical treatment for this population, regardless of distraction-based or auto-growing instrumentation constructs.

In 2013, Flynn *et al.* (1) published their retrospective review of their case series of 99 patients who had completed treatment with growing rods and had had a final operative procedure. In this article, Flynn *et al.* (1) recommended the final fusion surgery to the patient with growing rod instrumentation if he or she reached skeletal maturity (usually 11 to 13 years), additional lengthening no longer yielded considerable benefit, annoying instrumentation failure or deep infection was encountered, or by the assessment there was not much spinal movement or growth remaining. Prior to the final fusion surgery, the patients had a mean duration of growing-rod treatment of 5 years. During the fusion surgery, additional correction was often possible after removal of the growing rod instrumentation, with the majority of patients experiencing 21% to 50% curve correction (1).

When the patient goes down to the anticipated last stage, final fusion is the common end goal with segmental spinal instrumentation. To optimize correction rate, pedicle screws are frequently placed, and anchor exchanges are made to the sites if they had pedicle screws previously placed. At

most time the proximal and distal foundations are the same as those spanned by the growing rods. If it is necessary, additional levels (most often one or two levels) to the final fusion construct at either end is included in final fusion.

Final fusion is often a much-anticipated and celebrated event for patients, their families and the surgical team, as it marks as the end of repeated lengthenings and potential risks for varied complications. But is this anticipated final fusion really final? In 2016, a multi-center study gave us the answer. This study reviewed the results of 100 children treated with growing rods with a minimum of 2 years of follow-up after final fusion (2). And the fact is that this might not be “final” for up to 20% of patients who required reoperations (2). The incidence of reoperation was much higher than that of fusion surgery for adolescent idiopathic scoliosis (3).

Infection was the most common cause for reoperation, accounting for 9%. As reported in previous studies (4,5), surgical site infection is one of the least desirable complications in any surgery, and specifically in growth-friendly procedures in the pediatric population. Over the lengthening period of many years, the spine and implant are exposed on multiple occasions through the same incision. The soft tissue in this area will become stiff and scarred, with a poor vascular supply, which aggravates overall risk for infection. Other causes of reoperations included failure of instrumentation, painful/prominent instrumentation, coronal or sagittal deformity, pseudarthrosis, and requirement of thoracoplasty for progressive crankshaft phenomena (2). As the authors noted in this paper, prior infection, poor soft

tissue from repeated surgical intervention and impaired nutrition, decreased bone quality, and continued overall growth would contribute to possible unplanned surgical intervention after final fusion in this population.

An important issue lies in risk factors for patients being liable to develop problems which require revision surgery after final surgery. However, the current study can not identify these risk factors, despite that it revealed that etiology of neuromuscular scoliosis had the greatest number of reoperations (2). For growing rod treatment, patients with neuromuscular scoliosis is always a perplexing condition as a result of their high risk for complications due to underlying comorbidities, such as decreased pulmonary function, inadequate nutritional status, decreased mobility, costo-pelvic impingement pain and cognitive impairment (6,7). Even though patients of this pathology received the final fusion, they are still burdened by a large number of complications.

The authors reported a mean reoperation timing of 2 years after final fusion (range, 11 days to 7.4 years) and a predominance of late complications (onset late than 3 months following final fusion) (2). These strongly suggested that patients need long-term follow-up after definitive fusion as an end of growing-rod treatment. Theoretically, the longer follow-up is, the higher reoperation rate will be.

Therefore, a higher-than-anticipated reoperation rate was reported by this multi-center study. Caution must be taken to counsel parents that the “final fusion” may not be the last surgical procedure necessary to completely and permanently correct the spinal deformity. After suffering from so many years of lengthening procedures, the EOS population has been shown to have notable complication rates due to their age, underlying diagnoses, cardiopulmonary compromise, and repeated interventions. These factors may play a role in the reoperation rate because of their poorer overall health status than that of unaffected children.

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