Use of Mineral Oil Aids Scoliosis Correction by Decreasing Implant Friction

Daniel G. Hoernschemeyer, MD, David L. Skaggs, MD, and Mark Sucher, MD

Abstract

Adolescent idiopathic scoliosis is commonly corrected through posterior spinal fusion and instrumentation using pedicle screws. One difficulty in performing the correction with this method is the potential for friction at the interface between the rod and each individual point of fixation. The authors have found that the application of mineral oil at these points of contact serves to reduce friction, reducing the need for undue force and increasing the likelihood of effective fixation. The lubrication afforded by the mineral oil is particularly helpful when performing scoliosis correction using the classic derotation of the rod and direct vertebral rotation.

Posterior spinal fusion with instrumentation has gained acclaim as the "workhorse" in correction of adolescent idiopathic scoliosis. Initially, fixation was obtained by using sublaminar wires or hooks. Today, pedicle screw constructs are more commonly preferred because of their increased pullout strength and increased control in the sagittal, coronal, and rotational planes,[1] as well as their lower rates of reoperation for loss of fixation.

As for the correction maneuvers, various options can be used individually or in conjunction with one another. The classic rod rotation described by Cotrel and Dubousset[2] works well for a typical lordotic or hypokyphotic thoracic curve. In this maneuver, the correction rod is rotated, changing the coronal plane deformity into normal sagittal alignment. Compression and distraction also can be used as a primary reduction maneuver, or may be attempted to fine-tune a reduction after both rods are in place and contouring has occurred. Direct vertebral rotation (DVR) with use of pedicle screws, as described by Suk and colleagues,[3] has grown in popularity and has become very effective in restoring the axial plane alignment and improving the rib deformity. Other techniques can be used to manipulate the spine to try to correct the deformity. These techniques include in situ contouring and cantilever techniques designed to correct the spinal deformity.

One potential difficulty in using instrumentation methods to correct scoliosis is friction at the interface between the rod and each fixation point. This friction can be substantial enough to limit correction and apply undue force to the system, which could compromise fixation. We now describe use of mineral oil in reducing the friction at these contact points.

Technique

After the spine is exposed with a posterior approach, the hooks and screws of the planned construct are placed at the appropriate levels. Attention then shifts to the correction rod. Fill a 10-mL syringe with sterile mineral oil and place a few drops of mineral oil at each fixation point before engaging the rod with each set screw (Figure 1). Apply mineral oil along the rod, avoiding areas where vise grips will be used to derotate the rod (Figure 2). Placement of mineral oil allows for frictionless rotation of the rod once it is captured by the set screw at each hook or screw. This is par-

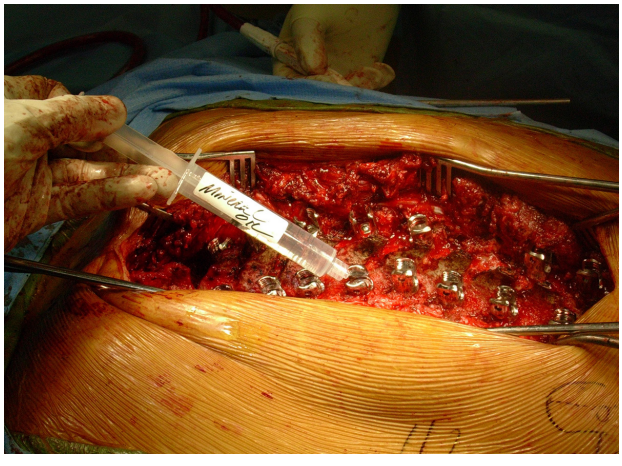

Figure 1. Initially, less than 1 mL of mineral oil is placed at each fixation point.

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Figure 2. Mineral oil also may be placed along correction rod.

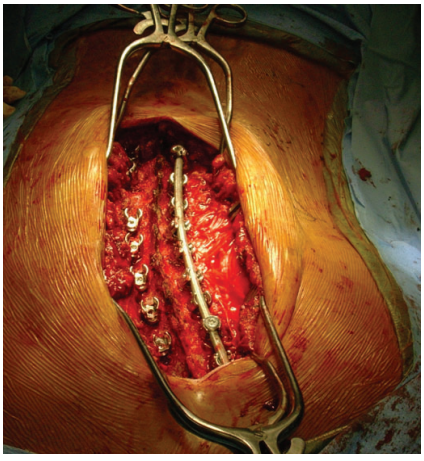

Figure 3. Correction rod is inserted on concave side of thoracic curve.

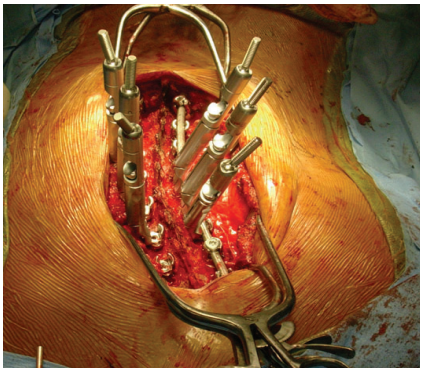

Figure 4. Direct vertebral rotation clamps are then attached to multiple fixation levels.

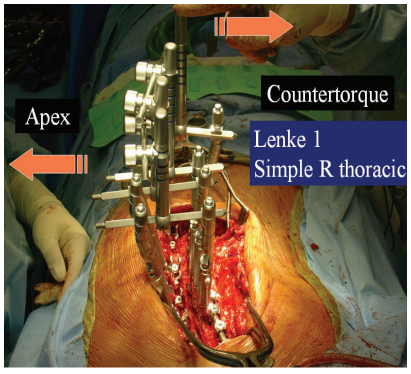

Figure 5. Surgeon derotates thoracic curve while countertorque is applied to L1 vertebra at base of construct.

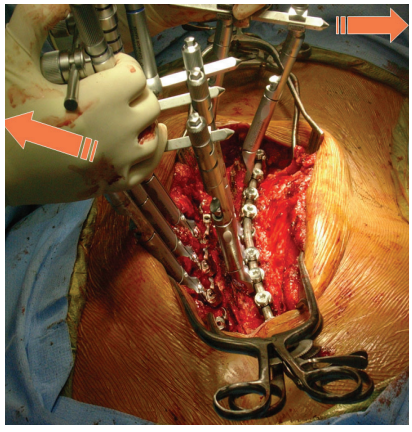

Figure 6. En bloc direct vertebral rotation techniques performed manually.

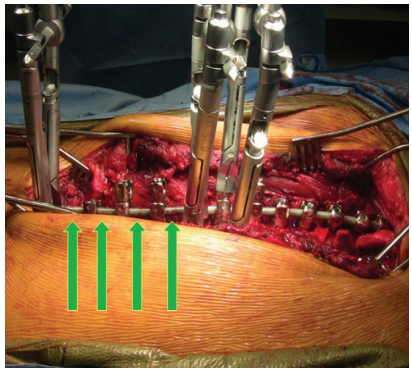

Figure 7. Derotation occurs through open disks.

ticularly helpful when performing scoliosis correction using the classic derotation of the rod and DVR. After the surgery and before decortication and bone grafting of the posterior spine, the wound is irrigated and suctioned.

As already mentioned, specific correction maneuvers can be used independently or in conjunction with one another for the overall correction of the spinal deformity. In the classic rod rotation maneuver, this frictionless environment allows for easier rotation (using vice grips) of the correction rod into its final sagittal alignment. Segmental and en bloc techniques can be used with DVR. When using segmental direct vertebral rotation, the deformity is corrected at each individual level in the axial plane. The rod is placed in its final sagittal alignment and locked at one end of the curve, with the expectation that the spine will lengthen during curve correction. An en bloc derotation technique also may be used. Our example demonstrates correction of a Lenke I right thoracic curve (Figures 3–11). The left rod is placed and bent to slightly more kyphosis than necessary at the end, as the rod can be expected to flatten a bit during rod rotation. The left rod is placed within the pedicle screws, with the bend matching the right thoracic curve. Screw caps are loosely attached to hold the rod to the screws but allow movement. Pedicle screws at the apex of the curve are attached to derotation devices, which are available from many manufacturers. The derotation devices are pushed to the right side at the apex of the curve. Optional devices at the top and bottom of the construct may be pushed to the left to add to the amount of derotation. With the derotators actively held in position, the rod is then rotated to the left side, turning the scoliosis into kyphosis. Screw caps may be tightened now, with distraction between screws as needed.

After the rod is placed, the screws may be loosened, and the deformity may be further derotated at each level. Here, again, mineral oil facilitates rotation of the screws at the apex. The compression-distraction technique implements distraction on the concave rod and compression on the convex side of the deformity to decrease the amount of scoliosis. The compression-distraction techniques, which may also affect correction of sagittal plane thoracic deformities, benefit from the decreased friction as well. Although other techniques, such as in situ contouring, are important in fine-tuning the correction, the correction that they provide does not depend on a reduced-friction interface.

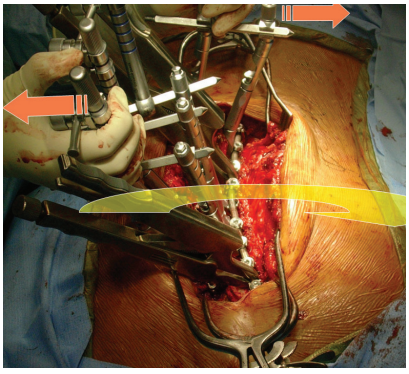

Figure 8. Yellow arrow denotes rod rotation on concavity of curve. Opposing orange arrows demonstrate direct vertebral body rotation and countertorque being applied at base of construct.

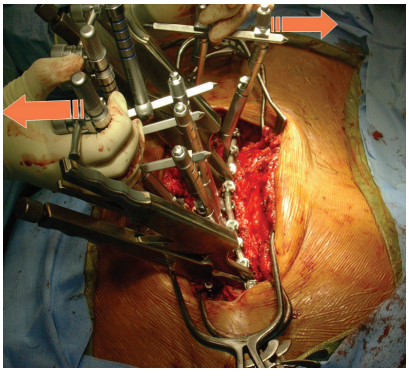

Figure 9. Further segmental derotation can be performed at proximal and distal ends of construct.

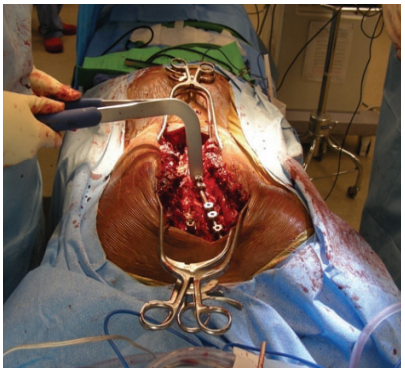

Figure 10. In situ bending can be performed to gain further correction after direct vertebral rotation.

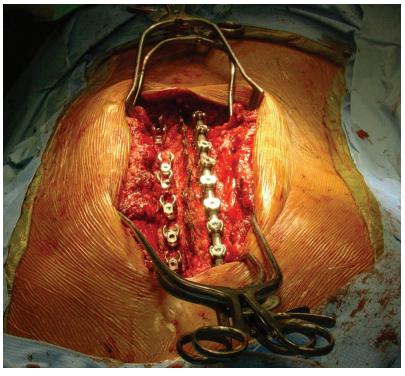

Figure 11. On completion of procedure, scoliosis is fully corrected.

In rare cases, particularly with smooth titanium implants, forceful distraction or compression cannot be held by lubricated set screws. Wiping the mineral oil off them generally solves this problem.

When instrumentation is complete, irrigate with 3 L of jet lavage dilute soap solution (10 mL of liquid pink soap with 5 L of fluid).

Discussion

Mineral oil, a lubricating liquid obtained from the distillation of petroleum, is clear, colorless, and nearly odorless, and has been safely used in medicine for many years. In 1913, its use was documented in the medical literature for the first time; Sir W. Arbuthnot Lane used mineral oil to treat chronic constipation.[4] Since then, its use has grown, particularly in the pediatric population. Recent studies have shown mineral oil to be both effective and safe when used orally. The North American Society for Pediatric Gastroenterology and Nutrition identified mineral oil as a first-line treatment for pediatric constipation.[5]

Mineral oil recently has gained popularity in plastic surgery. It is being used as a lubricating agent in the harvesting of split-thickness skin grafts. Before grafting is performed, mineral oil is spread over the surface of the harvest site to prevent the graft from adhering to the dermatome.[6]

To our knowledge, the present article is the first to describe use of mineral oil specifically for its advantages in the corrective maneuvers used in pediatric spinal deformities. Dr. Hoernschemeyer and Dr. Skaggs have used mineral oil in more than 300 scoliosis cases, without any postoperative infections occurring. We believe that use of mineral oil is safe and aids scoliosis correction by decreasing implant friction.

Authors' Disclosure Statement

The authors report no actual or potential conflict of interest in relation to this article.

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