Scoliosis circa 2000: radiologic imaging perspective

II. Treatment and follow-up

Abstract  Plain film imaging remains important for the diagnosis and surveillance of scoliosis, as well as for the detection of complications after surgery. New means of treating scoliosis have become established and should be understood by the radiologist. To the well-known postoperative complications, including pneumothorax, pneumonia, and gastrointestinal obstruction, are added new specific potential problems with the new surgical methodology.

Key words  Scoliosis · Imaging · Vertebral column · Spine abnormalities · Spine surgery · Diastematomyelia

Nonoperative treatment

Surveillance

Radiologic surveillance of subjects undergoing nonoperative treatment for scoliosis (i.e., no spinal surgery) has features intermediate between follow-up of an untreated subject and postoperative follow-up. The radiologist seeks, as in the untreated case, evidence of progression of curvature; while, as in the postoperative state, looking for evidence of complication.

Improvement, stability, or worsening is documented by careful comparison of curve angles with previous films, both at the previously measured curve margins and at any new curve margins that have become defined by the Cobb method on the new film. If the levels of greatest tilt from the horizontal change, comparison is made with the previous film at the newly selected levels. On lateral films, changes in kyphosis, lordosis, or spondylolisthesis are to be observed. Criteria for a change from nonoperative to operative treatment resemble those favoring operation in the untreated subject.

Complications

Documentation of desired improvement, or stability, validates a choice of nonoperative treatment. The finding of an unexpected lack of improvement or of worsening is a natural consequence of “trial and error” that is part of the dynamic nature of medical decision-making. Nonetheless, failure of success, even if due to noncompliance by the subject, is a complication of the selected nonoperative treatment, be it traction, cast, brace, or exercise (or the no longer favored electric stimulation of selected muscles).

Traction pins, either with a halo device in the calvarium or with femoral or iliac pins, are intended to reduce scoliosis, and other abnormal curvature, by stretching the vertebral column. Radiologic imaging can reveal or confirm such problems as pin loosening or pin infection, with CT used for suspected associated intracranial complications, and MRI for neurologic complaints that might arise from stretching of the spinal cord [1].

With casts, there are potential problems with pressure sores [1], which are principally a clinical diagnosis (by inspection) but could be revealed by MRI examination of the hidden soft tissue area. The historic term “cast syn-
drome” refers to the problems resulting from the narrowing of the abdomen in the midline when a cast is placed as therapy for spinal curvature (particularly when the lumbar column becomes relatively more lordotic). As discussed below, the same complication may occur after spinal surgery.

With brace treatment, compliance is an additional problem in children and adolescents. Loss of correction may also occur because of unrelenting progress of those factors responsible for the abnormal curvature. With both bracing and cast, any pressure applied to the mandible by the device may have adverse dental consequences.

Several neurologic complications are possible with the various forms of nonoperative treatment, particularly with methods that result in stretching of the spinal cord; they are similar to those after surgery.

The operation

Because of the careful preoperative determination of vertebral levels to be included in an operation, a precise intraoperative identification of the specific vertebral bodies encountered by the orthopedist is required. A portable radiograph with towel clips upon a spinous process (Fig. 1) is a straightforward solution (as long as the imager remembers that the spinous process tip generally projects over the subjacent vertebral body). One recent proposal of a preoperatively placed screw, with a marking wire through the skin [2], has the advantage of saving the anesthetic time required for the processing of the intraoperative towel clip radiograph; but the disadvantage of transporting a patient to and from a fluoroscopy suite. Intraoperative digital imaging may overcome the disadvantages of current radiographic systems.

The variety of possible techniques for operative correction (or stabilization) of scoliosis has expanded considerably in recent decades, each one seeking to avoid problems encountered with prior methods. The radiologist needs to understand the structural and functional appearances of devices used, the altered appearances of the vertebral column consequent to the operation, and the potential pitfalls and complications. While Harrington rods with hooks, both compressive and distractive, are still frequently employed, the new standard repertoire includes segmental wiring (Fig. 2), screws (Fig. 3), fusions within various articulations and disk spaces (Fig. 3), and anterior as well as posterior approaches [3, 4]. The familiar names for instrumentation systems include Luque, Cotrel-Dubousset, Texan Scottish Rite, Isola, Dwyer, and Zielke [3, 4] (Fig. 3). The reader is referred to two recent review articles that cover the specifics of these systems [3, 4]. Depending on the specific devices, hooks dislodge, wires break (Figs. 2, 3), screws may be improperly placed, and rods may not lie where expected.

When an anterior approach (to the thoracic spine) is deemed appropriate, major improvements in operative and postoperative care have been made more probable by the adoption of endoscopic techniques. This technically demanding approach is generally known under the acronym VATS [5, 6], i.e., Video-Assisted Thorascopic Surgery. Through small incisions, the operative team retracts the ipsilateral lung (which may be deliberately collapsed by the anesthesia team) sufficiently to visualize directly each surgical step and its site. The same VATS technique allows resection of portions of ribs (sparing peristostem as appropriate) as a direct approach to the thoracic deformity responsible for a cosmetically unattractive rib hump [5]. Those patients whose curves are severe enough to warrant anterior correction are exactly those with a higher chance of preoperative restrictive lung disease; and VATS aims to ameliorate pulmonary complications during and immediately after surgery in such vulnerable patients [7].

In classic osteopathic congenital scoliosis (scoliosis caused by a segmentation anomaly of the vertebral column) best results are obtained when curves that will relentlessly increase are aggressively managed early in life. An unbalanced hemivertebra (and certain other deformities) will continue to deform the trunk if the unbalanced growth potential on one side is not addressed during the scoliosis surgery. Surgical physeal arrest on the convex side of the curve has been advocated as one means to answer that challenge [8]; anterior thoracic level approaches