

Idiopathic Scoliosis— the State of the Art

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Idiopathic scoliosis, in which the cause is unknown, affects approximately two percent of the population, although only a small number of those with scoliosis require treatment. Treatment of scoliosis is indicated for those who have progressive spinal deformity, with progression defined as a curve of 20 degrees or more in which an increase in frontal plane curvature of more than 10 degrees has occurred, or a curve which is greater than 30 degrees upon presentation. Electrical muscle stimulation, exercise programs and manipulation have not been found to be effective treatments for scoliosis.

Historically, these patients were treated with metal and leather braces such as the Milwaukee Brace, which was both uncomfortable and unsightly. Advances in the craft of orthotics and prosthetics have led to much more comfortable and lighter weight polypropylene plastic braces which can be worn beneath clothing, hopefully increasing compliance with the bracing regimen. Additionally, besides the body jacket-type TLSO of the Boston, Wilmington, or Miami variety, nighttime-only braces such as the Charleston Bending Brace or the Providence Brace have been shown to be just as effective for certain patterns of scoliosis, principally the thoracolumbar and lumbar curves. Investigation continues to determine the effectiveness of these newer braces in preventing progression of scoliosis. Unfortunately, to date, no brace has been shown to actually improve scoliosis by permanently decreasing the magnitude of deformity. That desired outcome is only available via surgical treatment.

The surgical treatment of idiopathic scoliosis is usually reserved for curves that have progressed beyond 40 or 45 degrees. If left untreated, continued progression of these curves may lead to chronic severe pain, deformity, psychosocial disability and pulmonary dysfunction. Advances in

surgical technology have led to highly effective and safe surgical procedures resulting in excellent results as measured by patient satisfaction surveys as well as by standard radiographic measurements.

Until recently, most scoliosis surgery for children with significant remaining growth has consisted of posterior spinal fusion with instrumentation as well as adjunctive anterior spinal fusion to prevent recurrent deformity known as the “crankshaft phenomenon.” In the last few years, many of these anterior fusions have been performed thoracoscopically, dispensing with the need to perform a larger thoracotomy. This lessened patient morbidity with smaller scars, less postoperative pain and more rapid recovery. However, the advent of pedicle screw fixation, commonly used in posterior lumbar spine surgery in adults, has led to the ability to dispense with the anterior procedure completely. The placement of these pedicle screws is significantly more challenging in the three-dimensionally deformed spine, which is not only curved in the frontal and sagittal planes, but rotated along the axis of the spine as well. Use of CT-based, intraoperative image guidance has facilitated placement of these screws.

CT-based, intraoperative image guidance allows the surgeon to navigate the spine with “smart tools” by merging the data from a preoperatively acquired CT scan of the spine with in vivo registration of anatomical reference points that have been determined from the 3D, axial and sagittal CT images. This has facilitated rapid and accurate placement of pedicle screws for which there is virtually no tolerance for inaccurate placement due to the aorta, spinal cord and lung being immediately adjacent to the trajectory of the screws. This technology also enables more precise sizing of the screws within the pedicles and the vertebral body, lessening the chances of loosening. Where 50 percent correction of frontal plane deformity was

seen with the use of hook and rod constructs utilized from the late 1980s until now, pedicle screw and rod fixation has resulted in scoliosis correction of 75 to 80 percent, normalization of sagittal plane profile, and better derotation of the spine.

Scoliosis surgery requires both spinal stabilization with anchored implants as well as bone grafting to obtain the desired result: a solid fusion. Traditionally, bone graft has been harvested from the patient's iliac crest or ribs, lengthening surgical time by about 30 minutes and increasing postoperative pain. To further decrease morbidity, modern spinal deformity surgeons are incorporating the use of “osteobiologics.” The patient's bone marrow and allograft demineralized bone matrix can be substituted for autogenous bone graft and result in a solid fusion. Other osteobiologic compounds without allograft are being developed which hold great promise for the future.

The combination of advanced computer technology, precisely engineered metallic implants, and cutting-edge bioactive chemistry has led to the current state of the art in scoliosis and spinal deformity surgery. With continued basic science research and clinical investigation, even more exciting advances will be seen in the future.

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