History of Spinal Deformity Surgery Part I: The Pre-modern Era

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Spinal deformity is one of the oldest known diseases that date back thousands of years in human history. It appears in fairy tales and mythologies in association with evil as its dramatic appearance in patients suffering from the disease easily lent itself to be thought of as a form of divine retribution. The history of spinal deformity dates back to prehistoric times. The early attempts to treat patients suffering from this disease started from Hippocrates age. Side traction or axial traction and cast immobilization were the only possible option prior to the discovery of anesthesia. The first surgical attempts to correct scoliosis occurred in the mid 19th century with percutaneous myotomies of the vertebral musculature followed by postoperative bracing, which outcomes were very quite horrifying. Hibbs' fusion operation had become a realistic treatment option to halt the progression of deformity in the early 20th century. Harrington’s introduction of the internal fixation device to treat paralytic scoliosis in 1960’s started revolution on deformity correction surgery. Luque developed a segmental spinal using sublaminar wiring technique in 1976 and Cotrel developed Cotrel-Dubousset (CD) instrumentation, which was a posterior segmental instrumentation system that used pedicle and laminar hooks on either thoracic or lumbar spine and pedicle screws on the lumbar spine.

Key Words: Spinal deformity - Hippocrates - Hibb - Harrington - Cotrel-Dubousset

INTRODUCTION

Spinal deformity is one of the oldest known diseases that date back thousands of years in human history. It appears in fairy tales and mythologies in association with evil as its dramatic appearance in patients suffering from the disease easily lent itself to be thought of as a form of divine retribution. The history of spinal deformity dates back to prehistoric times. The early attempts to treat patients suffering from this disease started from Hippocrates age. Side traction or axial traction and cast immobilization were the only possible option prior to the discovery of anesthesia. Hibbs’ fusion operation had become a realistic treatment option to halt the progression of deformity in the early 20th century. Harrington’s introduction of the internal fixation device to treat paralytic scoliosis in 1960’s started revolution on deformity correction surgery. Dwyer introduced anterior spinal instrumented fusion surgery era followed by Zielke, Moss-Miami, and Kaneda. Both Luque and CD segmental spinal instrumentation advanced the deformity correction surgery further by allowing three-dimensional correction of the deformity. Currently the role of genetics is being elicited for near future management for spinal deformity.

ANTiquity

Hippocrates (1460-1375 BC), who was born on the island of Cos during the Age of Peracles, is often credited as the person who introduced the philosophy of rationalism and separated medicine from mythology. He also described the anatomy, diseases, and deformities of the spine, along with treatments for these diseases, in his book, “De Articulationes” of the Corpus Hippocraticum. He wrote, “There are many varieties of curvature of the spine even in persons who are in good health, for it takes place from natural conformation and from habit, and the spine is liable to be bent from old age and from pains.” Hippocrates invented a “bench” for reduction of fractures and used this device for forcible spinal manipulation and traction as well. Although there is a lack of evidence demonstrating the effectiveness of Hippocrates’ traction techniques in treating spinal deformity, these methods
were widely used by many physicians until the 15th century.60 Galen (130-200 AD), who was born in Greece but later moved to Rome and became a physician to the Emperor Marcus Aurelius, is the next greatest physician of antiquity and is regarded as the father of experimental physiology and embryology.48 He was the first to use the terms scoliosis (meaning “curvature” in Greek), kyphosis, and lordosis and described the anatomy of the spine and spinal nerves in exquisite detail. Galen used axial traction and direct pressure to treat spinal deformities.14,61,63 Oribasius (325-400 AD) was another Greek physician who moved to Rome at the invitation of the Emperor Julian.67 He added a cross bar to Hippocrates’ traction device that could be used as a lever to apply a forward pressure on a gibbus to reduce the deformity, while maintaining a strong traction by turning the various cranks. Ibn Sena (980-1037 AD) from the Middle East also used axial traction to treat spinal deformity with less than satisfactory results and caused paraplegia in a significant number of patients.53

The Dark Ages followed the fall of the Roman Empire, and between the 5th and the 10th centuries, there was very little progress in treating spinal deformity.53 Racks were often used to correct the deformity, although Roland of Parma discarded Hippocrates’ traction device and recommended only manual manipulation in his famous Chirurgica.11

RENAISSANCE

Leonardo da Vinci (1452-1519) first described the anatomy as well as the biomechanics of the spine in meticulous detail.80 Andreas Vesalius (1514-1564), born in Brussels but worked mostly at Padua, Italy, inaugurated the real science of anatomy by publishing De Humani Corporis Fabrica Libri Septum in 1543. In the 16th century, Ambroise Pare (1510-1590), known as the father of French surgery, thought that poor posture was a probably a cause of scoliosis.68 He also recognized cord compression from the curvature as a cause of paraplegia. Pare designed and used an iron corset to correct scoliosis, thus antedating by several hundred years the development of bracing in Western Europe and the United States.40 Another major medical contribution of Pare was the introduction of ligating great vessels after amputations instead of cauterizing them with boiling oil.

There was a renewed interest in spinal deformity during the 17th and 18th centuries. Francis Glisson (1597-1677) of Britain introduced the Glisson’s sling that consisted of a bandage strapped from under the axillae, above the head, and under the chin to suspend the patient in the air to treat scoliosis by providing corrective force on the apex of the deformity.48 Giovanni Alfonso Borelli (1608-1679) wrote the first text on spinal biomechanics, De Motu Animalium.86 Nicholas Andry (1658-1742) published the first book on the musculoskeletal system, L’Orthopédie, and is credited with using the term orthopedics, meaning “straight child,” in 1741.5,28,52,74,83 Andry is also known for his illustration of a crooked tree strapped to a straight stake, an image intended to show backbone deformity, which has been adopted as a symbol of orthopedic surgery worldwide.68 Andry believed that spinal deformities were caused by an imbalance of the vertebral muscles and/or poor sitting posture.63

In 1768, Francois LeVacher introduced a device, called “Jurymast” brace, which consisted of a tight-fitting skull cap suspended from a posterior bar at the back of the brace through which axial distraction could be applied in the upright position.57,63 Percivel Pott of London is important to those who treat spinal disorders for his classic description of the deformity and sequelae of tuberculosis of the spine in 1769.72,73 Jean-Andre Venel (1740-1791), the “Father of Orthopedics,” founded the first orthopedic hospital for crippled children to treat scoliosis patients.82,85 He recognized the need to derotate the spine and demonstrated an appreciation for the three-dimensional nature of spinal deformity. Jacques Mathiew Delpech (1777-1832) of France published De l’orthomorphie, in which he emphasized the importance of muscle tone and balance in joint stability and posture and introduced the subcutaneous tenotomy in 1818.

THE 1800’s

The first surgical attempts to correct scoliosis occurred in the mid- to late 19th century. Jules Rene Guerin (1801-1886) of France introduced percutaneous myotomies of the vertebral musculature followed by postoperative bracing.22 Unfortunately, his surgical outcomes were very quite horrifying and ending in one of the most famous orthopedic lawsuits in history: Guerin vs. Malgaigne.35,69 In 1877, Lewis Albert Sayre (1820-1900) wrote Spinal Disease and Spinal Curvature: Their Treatment by Suspension and Use of Plaster of Paris Bandage, in which he described hanging the patient from a tripod by a rope and pulley connected to her head and hands to provide axial traction.87,88 A plaster of Paris cast was applied to the patient in the hanging position with appropriate lateral traction on the curve type, and the patient remained in the cast for several months afterwards. Sayre was the first person to use plaster of Paris casts,77, and the principles he developed were practiced until the early 20th century.84 Richard von Volkmann (1830-1889) of Germany performed the first bony surgical procedure by resecting the rib...
In 1891, Berthold Ernest Hadra used a silver wire between the spinous or transverse processes to correct spinal deformity in patients suffering from Port’s disease and fractures. In 1895, a French surgeon named Jean-Francois Calot became the first person to perform posterior arthrodesis with periosteal suture between the laminae and the transverse processes with some evidence of bony fusion. Calot also used plaster casts to correct kyphosis. However, he eventually abandoned the procedure as being unsuccessful. Dr. Yves Paul Cotrel started his career as an OB/Gyn surgeon and became a spinal deformity surgeon in Calot institute. Bradford and Brackett devised a horizontal distraction frame with a “localizer” attachment in 1895, very similar to that later used by Risser in 1952. Also, they first classified the scoliotic curve based on the flexibility of the spine and structural changes of the muscle and ligaments in their article, “Correction in Lateral Curvature,” in 1899. In this article, the authors suggested a different method than the one proposed by Sayre and recommended that the patient be placed in a recumbent position to relax the paraspinal muscles with pressure applied at four points on the prominences of the curves. The plaster of Paris cast was then fitted for the patient with padded aluminum plates as support. In the early 20th century, Fisher developed a suspension frame similar to the Glisson’s sling with purportedly less discomfort to the patient.

THE 1900’s

A revolution in medical science took place in the early 1900’s with the discovery of X-ray by William Conrad Roentgen (1845-1923), a physicist of German ancestry who was born in Holland, while he was working at the University of Würzburg. Now the surgeons were able to visualize the curved spine and objectively assess the bony deformity. For this discovery, Roentgen received a Nobel Prize in physics in 1901. In 1908, Arthur Steindler, an orthopedic surgeon from Iowa, performed a posterior fusion for scoliosis and proposed that “the proper way to deal with structural scoliosis is to follow the footsteps of nature and develop secondary compensating curves, rather than to persist in unsatisfactory attempts at correction.” He advocated realigning the spine by obtaining equal distribution of weight between the right and the left sides of the patient by shifting the body and the contra lateral hip on the concave side. By doing so, the lumbar curve was accentuated and the pelvis was tilted. The patients were trained to attain maximal degree of compensatory curve correction and to strengthen their muscles to maintain this new position. A plaster of Paris cast was then applied to fix the spine in this corrected position. Even after the operative treatment of spinal deformity was introduced, Steindler insisted on this treatment preoperatively for patients who needed subsequent operative intervention.

In 1911, Russel A. Hibbs (1869-1933) from New York Orthopedic Hospital (Orthopedic department in Columbia University Medical Center) performed the first true spinal fusion on a tuberculous spine by using autologous bone chips from the laminae. He was also the first surgeon to perform the first spinal fusion for scoliosis on June-23-1914. He published a comprehensive report on 59 cases of spinal fusion surgery on infantile paralysis and scoliosis patients in 1924. He bridged the bones of the spinous processes and laminae by splitting and elevating them to come into contact with each other. Hibbs used the spinous processes to bridge the interlaminar space as well. Traction casts were fitted two weeks postoperatively; this two-week delay unknowingly allowed wound healing to take place before the casting procedure. The patients were bedbound in these casts for six weeks, after which they were fitted into a removable jacket for another six to twelve months and were allowed to move around. Hibbs reported good results in 35% of patients and concluded fusion as a successful means to halt the progression of deformity. He continued to perform spinal fusion surgeries and reported 360 such cases in 1931.

Fred Albee and Fritz de Quervain, two surgeons working independently, also performed spinal fusions using similar techniques as Hibbs in 1911. Albee used tibia and de Quervain used scapular spine as graft material to fuse the spines of patients suffering from Pott’s disease. In 1914, Galloway performed similar procedures on paralytic scoliosis patients suffering from poliomyelitis. Brown used bovine xenograft bone. In 1915, Gallie attempted fusion using boiled human allograft with less than satisfactory results.

The first anterior spinal surgery in the United States was performed by William von Lackum and Allen DeForest-Smith in 1924. They described a two-stage surgery that included an anterior approach. Unfortunately, the outcomes were
rather poor as patients developed kyphosis postoperatively.

In 1920, Joseph Risser, along with Hibbs, developed a short body jacket with a lateral hinge and turnbuckle for wedging. This jacket was effective in correcting lumbar curves and was generally applied preoperatively and for two weeks following the surgery\(^1\). In 1927, hinges were placed in front of and in the back of the cast over the convexity of the curve, providing more lateral bending and less traction. In 1952, a localizer cast, known as the Risser’s cast, was introduced allowing early ambulation of the patient\(^7\). Risser also developed radiographic means of determining vertebral growth based on the excursion of ossification of the iliac epiphysis (the Risser’s sign)\(^7\).

In 1928, Royle published an article on resection of hemi-vertebrae\(^8\), and in 1932, Compere reported excision of hemi-vertebrae in two patients with congenital scoliosis posteriorly, while fusing the vertebrae on the ipsilateral side to stomping further growth\(^9\). On long-term follow-up, one patient developed severe kyphosis for unknown reasons, and Compere did not recommend this method because of postoperative complications\(^10\). In 1941 and 1946, Phillip Wiles performed a dorsal wedge resection on two cases of congenital scoliosis. Both patients subsequently developed severe kyphosis; the second patient also developed paraplegia. Until then, all the surgical procedures focused on correcting the deformity only in the coronal plane. Despite disappointing outcomes, these were the first attempts at surgical correction of kyphotic deformity\(^10\). Roaf from England also performed wedge-type resections for kyphotic deformities with unpublished long-term results\(^8\).

In 1941, a cohort of 425 idiopathic scoliosis cases was studied by a committee under the auspices of the American Orthopaedic Association\(^4\). The report was rather dismal: 60% of scoliotic curves treated nonoperatively with exercise and bracing progressed. 54 out of 180 surgical correction and fusion cases resulted in pseudarthrosis. 29% of 214 patients who had fusion lost all correction. Overall, 69% reported poor or fair outcomes.

In 1943, Howorth conducted a comprehensive review on spinal fusion with scoliosis as one of the indications\(^4\). Surgical fusion was also indicated for patients with spinal deformity as a result of tuberculosis, despite the fact that this procedure was still fraught with danger with operative mortality around 1.4%. John Cobb introduced objective angular measurements of scoliosis on radiographs, known as the Cobb angle, in 1948\(^9\). He used both autologous and cadaveric allograft bone for his spinal fusions and reported a remarkable 4.39% pseudarthrosis rate in 672 cases over a fifteen-year period\(^8,63\).

Blount and Schmidt invented a distraction brace in 1946 that also contained lateral pressure pads\(^7\). This was the early Milwaukee brace that was used preoperatively to correct scoliosis, and its success led to further improvements in fit and construction.

In 1950, Ignacio Ponseti and Barry Friedman published an article titled *Prognosis of Idiopathic Scoliosis*, in which they classified scoliotic curves into five types and explained the basis of prognosis, which were the pattern of the curve, the age of onset, radiographic changes in the density of the vertebrae and abnormalities of the disc spaces, and the rate of curve progression\(^7\). Later that year, Ponseti and Friedman reported on 117 cases of scoliosis, out of which all the main lumbar curves progressed even after fusion, and the authors concluded that this was secondary to increased mobility in the lumbar segments\(^7\).

J. I. James from London proposed another classification in 1954 based on the degree of the curve: mild for <69 degrees, moderate for 69-99 degrees, and severe for >99 degrees. He also classified the idiopathic thoracic curves based on their peak age of onset and divided them into infantile (<3 years), juvenile (5-8 years), and adolescent (>10 years) scoliosis\(^46\). James made keen observations on infantile idiopathic scoliosis and wrote that it was more common in boys with the left-sided major curve and had a poor prognosis\(^47\).

In 1955, F. G. Allen, an English surgeon, invented a “jack” that consisted of an expandable rod with a 30-degree inclination at the junction between the stem and the limb\(^3\). The Y-shaped ends were fitted at the base of the transverse processes between the proximal and distal neutral vertebral on the concave side of the curve after longitudinal traction was applied to the head and the foot to increase the distance between the transverse processes before fixing the jack. Following maximal expansion, the spine was fused on the convex side with bone graft. This technique afforded shorter treatment period and obviated the need for postoperative jacket immobilization. The downside of this method was its limited use in spines with less than 70-degree curves and its inability to address the rotational deformity. Interestingly, the concept behind Allen’s jack was very similar to the hook-rod distraction system developed by Harrington a decade later.

In 1958, Adam Gruca of Poland proposed that the cause of scoliosis was muscular imbalance as a result of asymmetrical, congenital, or inherited abnormalities of innervations of the individual segments of spinal muscles\(^33\). He divided scoliosis into three categories (first [<30 degrees], second [30-60 degrees], and third [>60 degrees]) and recommended transplantation of healthy muscles from the arm or scapula on the convex side and denervation of the hyperactive muscles on the concave side. Gruca reported overall corrections of 50, 47.2, and 21.8% in the first-, second-, and third-degree curves, respectively, but this concept and method of treatment failed to gain wide acceptance in the spinal deformity community.
**THE MODERN ERA**

Paul Randal Harrington (1911-1980) marked the next milestone in spinal deformity surgery with his internal fixation system, known as the Harrington instrumentation, to treat scoliosis. It consisted of a threaded compression rod and a distraction bar that used ratcheting of hooks to achieve curve correction on poliomyelitis patients. Harrington initially tried correcting spinal deformity with his instrumentation alone and had discouraging results. He added fusion later on to internal fixation with improved outcomes. Harrington initially had difficulty getting his technique accepted by the spinal deformity community and was severely criticized as being too radical and for performing too dangerous a surgery where simpler and safer methods would suffice. His system won the day, however, and became the gold standard for the next two decades. Although significant correction of the coronal plane deformity was achieved with this system, many patients unfortunately developed sagittal imbalance and associated back pain.

In 1960, Hodgson described anterior spine fusion for treating tuberculous spine, and in 1965, he recommended anterior fusion after osteotomy on the concave side and wedge resection of the bones on the convex side of the vertebrae. He also suggested using rib grafts and additional posterior fusion to prevent thoracic kyphosis.

In 1964, Allen Dwyer of Australia conducted a two-stage surgery in which he first performed posterior release, resecting the ligaments and capsular structures overlaying the facet joints on the concave side and excising any fibrous and bony ankylosis between the laminae, followed by corrective instrumentation via an anterolateral approach. Screws were placed into the lateral wall of the vertebrae on the convex side, and a cable was then threaded through the screw heads and was tightened by compressing the screws together to straighten the curve. Unfortunately, high rate of late curve progression secondary to ineffective derotation and cable fracture with pseudarthrosis, as well as lack of surgical expertise in anterior approaches, caused many spine surgeons to avoid using this method. Further, these anterior deformity correction surgeries resulted in increased thoracic kyphosis on long-term follow-up.

The Scoliosis Research Society was founded at the University of Minnesota in 1966 and John Moe became the first president. Moe was a prolific writer and published numerous articles on scoliosis, including the one in which he classified adolescent idiopathic scoliosis (King-Moe classification system).

The use of the halo for distraction of the spinal column was developed by Nickel, Perry, and Garrett at Rancho Los Amigos Hospital in Downey, California. Later, femoral traction was added and became a fairly common method of correcting severe scoliosis. The halopelvic hoop was developed by DeWald in Chicago and was popularized in Hong Kong by Hodgson, Yau, and O’Brien.

Spinal surgery carries an inherent risk of causing neurologic injury. In 1973, Vauzelle, Stagnara, and colleagues introduced a “wake-up test” to detect any neurologic deficit caused by the surgery, whereby the patient is waken up from anesthesia and direct observation of voluntary motion of patient’s feet is made. In 1977, Nash and his colleagues published their work on somatosensory evoked potential (SSEP) monitoring. This test was designed to assess the integrity of the sensory pathways traversing the spinal cord. Motor evoked potential (MEP) monitoring was introduced soon afterwards to supplement SSEP monitoring. These crucial advances in assessing intraoperative nerve function made modern spinal deformity surgery much safer.

Klaus Zielke modified Dwyer’s procedure in 1976 and introduced his instrumentation (ventral derotation spondylodesis [VDS]) with which he was able to obtain better correction than Dwyer did a decade earlier. In VDS, the screws were placed more posteriorly through the vertebral bodies, and this decreased the incidence of kyphosis and also helped to derotate the spine. Further, anterior instrumentation allowed for fewer vertebral bodies to be included for fusion than the posterior procedures. Later on, the Halm-Zielke instrumentation was developed as a modification of the VDS system, in which an additional fluted rod was introduced to better derotate the spine while improving postoperative sagittal alignment. Kaneda also introduced a two-rod system as a modification of the VDS system; it was an anterior multisegmental instrumentation system for thoracolumbar and lumbar scoliosis.

In 1976, Eduardo Luque from Mexico City developed segmental spinal instrumentation based on the principle of lateral bending as the predominant corrective force. The rods were fixed proximally and distally with sublaminar wires. After excising any contracted structures on the concave side and performing facetectomies on both sides, the wires that encircled the lamina and the rod at each segment was tightened to straighten the spine in the coronal plane. Because of problems getting the wires around the laminae, Drummond from Wisconsin devised a system whereby the wire could be attached to the bases of the spinous processes. Although this technique was biomechanically inferior to sublaminar wiring, it was much safer.

Yves Cotrel and Jean Dubousset of Paris introduced the Cotrel-Dubousset (CD) instrumentation in 1984. It was a posterior segmental instrumentation system that used pedicle screws on the lumbar spine and pedicle and laminar hooks on...
either thoracic or lumbar spine, instead of sublaminar wires, to achieve three-dimensional correction of spinal deformities. The correction principle was based on fixing the rods on either side of the spine with either screws or hooks and applying sequential compression and distraction to each rod at various levels. This was the first time pedicle screws were used for scoliosis surgery. In addition, the rods were secured to each other with transverse connectors, thereby forming a frame that resisted rotational and torsional forces. Patients were mobilized one day after surgery and did not require any external immobilization. With this system, the reported results were quite successful.

Segmental instrumentation was a major advance in scoliosis surgery. As more surgeons gained experience, it was clear that pedicle screws were superior in achieving fixation of all three spinal columns and correcting the deformity in all three dimensions. In the beginning, pedicle screws were only used in the lumbar spine. Predictably, the next step was to try using pedicle screws in the thoracic spine. In 1995, Suk from Korea reported on his experience of using pedicle screws to treat thoracic idiopathic pedicle screws.

Other newer techniques include growing rod constructs, vertebral stapling, and vertical expandable prosthetic titanium rib (VEPTR) instrumentation that avoid surgical fusion in young, growing patients. Keith H. Bridwell in Washington University in St. Louis opened the gate of Scoliosis Research Society membership for neurospine surgeon during his presidential address by 38th SRS annual meeting at Quebec city on September 2003. His decision allowed neurospine surgeon as candidate and active SRS fellow which was not possible prior to his presidency. He also allocated one spine fellowship spot to growing patients. In Washington University in St. Louis, he wanted to be a spinal deformity surgeon.

**CONCLUSION**

The history of spinal deformity dates back to prehistoric times. The early attempts at treating patients suffering from this disease were mostly nonoperative. Only after the discovery of anesthesia did surgery become a realistic treatment option for these patients. Higgs highlighted the importance of fusion to halt the progression of deformity in the early 20th century. Harrington introduced the first modern internal fixation device to treat scoliosis in 1960's. Dwyer introduced anterior spinal surgery. Both Luque and CD segmental spinal instrumentation advanced the field further by allowing truly three-dimensional correction of the deformity. In addition, the use of pedicle screws is now well accepted and affords surgeons worldwide to provide stronger fixation as well as better correction of the spine. It remains to be seen as to how effective emerging techniques such as video-assisted thoracoscopic and fusionless surgeries will contribute to spinal deformity surgery. Moreover, the role of genetics is currently being elicited and may impact treatment modalities in the near future.

**REFERENCES**

5. Andry N: Orthopaedia or the art of preventing and correcting deformities in children. Translated from the French. London; 1743
15. Calot JF: Des moyens de guerir la bosse du mal de Pott. 52.


54. Levacher AFT: Nouveau moyen de prevenir et de guerir la courbure de l'epine. Mem Acad R Chir 4:596, 1768


56. Luque ER: The anatomic basis and development of segmental spinal instrumentation. Spine 7:256-259, 1982


66. Pare A. Oeuvres. Paris 528, 551, 559, 1958

67. Pare A. Oeuvres. Paris 528, 551, 559, 1958

68. Pare A. Oeuvres. Paris 528, 551, 559, 1958


New York: Dover 485-487, 1942
73. Pott P: Observations on the nature and consequences of those injuries to which the head is liable from external violence. In: Hawes L, Clarke W, Collins R, eds. London; 1768
74. Rauschmann MA, Thomand KD: 200 years orthopedics. Images from the past [in German]. Der Orthopade 29:1008-1017, 2000
85. Ruttimann B, Schreiber A: Before the word was coined and ahead of his time-the orthopedics of Ambroise Pare (1510-1590) [in German]. Z Orthop Ihre Grenzgeb 123:981-986, 1985
87. Sayre L: Lectures on orthopaedic surgery and diseases of the joints. New York; 1876
96. Unknown: One hundred years ago in spine. Spine J 1:1, 2001