History of scoliosis therapy

The history of the diagnosis and treatment of spinal column diseases goes back to antiquity. The spinal column has been a research field of great variety and depth for many physicians for over 2,000 years, with new insights and knowledge constantly being gained in the areas of anatomy, physiology, pathology, and therapy. Hippocrates of Kos (approx. 460-377 B.C.) is considered the founder of academic medicine in Europe.

* Hippokrates of Kos

Quotes from Hippocrates such as: “the spinal column bears cause and effect in one,” or “study the spinal column, for it is a source of many pathologies,” show that Hippocrates had clearly recognized the importance of the spinal column over 2,000 years ago.

The works of Hippocrates and others under his influence are collected in a work called the “corpus hippocratum”, which includes approx. 60 papers.

He wrote on the joints (de articulis), bone fractures (de fracturis), and rachiotherapy (rhachis, Greek for spine) or the treatment of the back. His functional anatomic descriptions mention displacement of joints and vertebrae under the term „parathremata,“ which he felt was the source of many diseases. Hippocrates was the first to describe treatments suggesting the beginnings of manual therapy. He made use of traction (tensile force) and pressure to correct dislocations, bone fractures, and malcurvatures of the spinal column.

Appolonius of Kitium (1st century B.C.) was the first to illustrate some of Hippocrates’ works. The pictures clearly show procedures for repositioning bone fractures and joint luxations as well as manipulative, corrective procedures to be carried out on the spine under traction. He describes, for example, the “straightening of the vertebrae with the heels of the physician and winches.”

Galen of Pergamon (129-199 A.D.)
Galen was a Roman physician of Greek origin. Together with Hippocrates, Galen was one of the physicians of antiquity whose work decisively influenced the development of medicine as a science. He was the author of many works in the fields of anatomy (”de usu partium corporis humani“ and “de anatomicis administrationibus”), physiology, and pathology based on animal dissections. His papers on bones (osteology), muscles (myology), the structure of the skeletal system, and descriptions of the cerebral and spinal cord nerves are significant. The knowledge gained thereby provided a considerable foundation for the training of physicians over the course of the following centuries.
Oribasius (326-403) was a Greek physician from Pergamon and the author of a collection of medical works, the "synagogia latrike," a 72-volume encyclopedia, mainly referring to the works of Galen and other Greek physicians. The illustrations also include examples of extension treatment.

- Extension treatment in Antiquity

Guido Guidi (1491-1547) was a professor of surgery at the famous "College de France" in Paris. He was the author of a detailed illustrated work on diseases of the spinal column and their treatment.

- Extension treatment in the Middle Ages

Ambroise Paré (1510-1590), a French army surgeon, is considered the founder of modern surgery and treatment with prostheses and supportive orthotic devices. He developed the first supporting braces made of iron plates to correct spinal deformities.
Andreas Vesal, called Vesalius, (1515-1564), a famous surgeon and author from Padua, was the founder of modern scientific anatomy with his work “De humani corporis fabrica libri septem.” In contrast to Galen’s works, his anatomical drawings were based on dissections he performed on all the prisoners executed in Padua.

• A. Vesal, „De humanis corporis”

Wilhelm Fabry, called Fabricius Hildanus (1560-1634), was an important German physician in the area of wound treatment. He was the first to describe a sciotic spinal column in his work “Der Abriß des Rückgrads.”

• Fabricius Hildanus
• Hildanus “Der Abriß des Rückgrads”
**History of scoliosis therapy**  •  **Scoliosis**  •  **Deformities**

Francis Glisson (1597-1677), an English anatomist, was the first to describe rachitis in detail – a bone disease very common at the time caused by a vitamin D deficiency, where the bone metabolism disorder caused skeletal deformations, in particular scoliosis. He developed an extension treatment for this disease where tensile force was exerted on the spinal column using a padded leather sling fixed at the chin and the back of the head to straighten the spinal curve. The principle of the Glisson sling is still used in modern extension therapy today.

- Francis Glisson

In the following period, the development of devices for extension treatment and orthotic devices for correction of spinal column curvatures continued.

Around 1762, Augustin Roux developed various different orthotic devices for the correction of spinal column curvatures.

- Roux corrective orthotic device
In 1783, Le Vacher and Sheldrake designed further corrective devices for straightening the deformed spinal column.

- Le Vacher and Sheldrake corrective orthotic devices
In 1835, J. Hossard made the first brace that could be mechanically adjusted to correct spinal column curvatures in the corset.

- Hossard corrective orthotic devices

Up to the beginning of the 20th century, the diagnostics and therapy of spinal column diseases was characterized mainly by clinical examination and the therapeutic application of various braces and extension treatments.

In 1839, Jules Guerin was the first to practice “myotomie rachidienne,” a transection of the paraspinal muscles to treat scoliosis, since he considered a dysbalance in the paraspinal muscles to be the cause of the development of scoliosis. The corrective results were poor, which is why the method did not become widespread.

On the 11th of November 1895, Wilhelm Conrad Röntgen, professor of physics in Würzburg, made an important step forward in diagnostics with his discovery of an as yet unknown type of radiation while experimenting with cathode ray tubes. In January of 1901 he presented his discovery to the public and prepared an x-ray image of his hand. These rays have been known as roentgen rays (x-rays) ever since. Spinal column images in 2 planes first became possible in 1925, facilitating appropriate conclusions concerning structural spinal column findings.

L. Wullstein made an important contribution to the understanding of scoliosis in 1902 with his publication “Die Skoliose in ihrer Behandlung und Entstehung” covering his clinical and experimental research on the subject.

- Wullstein, scoliosis therapy
In 1911, Fred Albee was the first to carry out fusion surgery (spondylodesis procedures) in tuberculosis patients with deformed spinal columns. The rigidification was achieved by fusing the vertebral arches by inserting bone material from the shinbone after the spinous processes were split.

In 1920, the surgeon Wreden was the first to present a surgical technique for the treatment of scoliosis involving metal implants.

In 1931, Russel Hibbs published the results of over 300 scoliosis operations in which he had carried out a spondylodesis (rigidification) based on the method worked out by Albee. He made use of the spinous processes and fine bone chips from the vertebral arches as autologous (the body’s own) bone material for spondylodesis. He also sclerosed the vertebral arch joints in the area of spondylodesis.

In 1933, Ghormley was the first to make use of iliac crest bone chip material as autologous material in spinal column spondylodesis.

In 1951, Lange published a scoliosis surgery technique in an orthopedic surgery textbook employing internal fixation with Küntscher nails to stabilize the corrected spine. The nails were attached to the spinous processes of the vertebrae.

- Lange, scoliosis surgery, use of Küntscher nails
In 1962, Paul R. Harrington, an American orthopedic surgeon, developed and introduced a set of instruments, the Harrington rod system, that revolutionized surgical scoliosis therapy. The main concept revolves around the insertion of a convex compression rod and a concave distraction rod to compensate and stabilize the scoliotic curvature of the spinal column. Many patients with idiopathic, congenital, and neuromuscular scoliosis have been successfully treated using this technique. Many modifications and further developments of Harrington’s ingenious innovation have been done in the years since.

• Paul R. Harrington

Pierre Stagnara, (1917-1995), an important French orthopedist, was a key figure in the development of scoliosis therapy in the period from 1950 to 1982. He recognized the importance of the removal of the costal hump (“resection du chevalet costal”) and the resulting increase in spinal column flexibility. He also developed the technique of “greffe anterieur,” i.e. anterior support chip, to support spinal column stability in the surgical treatment of scolioses combined with a severe kyphosis. He improved radiological evaluation of kyphosing scolioses with the introduction of a special angled x-ray image, where the plate is held parallel to the median surface of the costal hump (“plan d’élection” or elective plane).

• Pierre Stagnara

• Stagnara, plan d’élection
In 1975, Luque introduced a further development of the Harrington instruments for posterior segmental fixation of the spinal column. In this method, the scoliotic curve is compensated and stabilized with 2 individually curved metal rods attached to the vertebral arches with wire slings after the yellow ligaments have been severed. The advantage of this method was the high level of post-surgical biomechanical stability achieved: Practically no follow-up brace therapy was required. The drawback was the very high risk of neurological complications.

In 1973, Dwyer developed a surgical access route from the front (anterior or ventral) for the correction of scolioses. The preparatory work for the ventral access breakthrough was done by Hodgson and Stock, who had operated on many tuberculosis patients via transpleural-retroperitoneal access, thus establishing a standardized access to the lumbar spine and lower thoracic spine.

This ventral access approach reduced the number of neurological complications, the fusion length was shortened, and stability was improved by means of intercorporeal fusion. Drawbacks of this method consisted of the necessity of several months of follow-up treatment in a brace and the lack of derotation of the vertebrae.

- Dwyer

In 1975, Klaus Zielke presented the ventral derotation spondylodesis (VDS) method, developed on the basis of the Dwyer method. The main improvement was a new compression technique and use of a derotator. Using this method, excellent results were obtained in the frontal plane. The drawback was that the method paid too little attention to the sagittal profile of the spinal column with the elimination of the lumbar lordosis.

- K. Zielke
- K. Zielke, Derotator
In 1984, Yves Cotrel and Jean Dubousset developed a surgical method derived from the Luque method. The objective of the procedure was a three-dimensional correction of the spinal column by applying translation, distraction, and compression for improved derotation and an improved sagittal profile of the scoliotic spinal column in combination with primary stability. This basic concept is still the basis for dorsal instrumentation of scoliosis as it is done today. The neurological complications resulting from Luque’s procedure with wire cerclages around the vertebral arches were avoided in this method, since the two metal rods are directly inserted into the bone using hooks and screws placed in the vertebral pedicles. The disadvantage of the method was the insufficient restoration of the sagittal profile of the spinal column and frequent decompensation of the non-instrumented sections of the spinal column.

Both dorsal and ventral instrumentation are employed in the various advanced methods and in combined methods.

The Harrington, Luque and Cotrel-Dubousset surgical methods are based on dorsal access (posterior surgical access - through the back).

The Spinefix system is an example of the further development of the Cotrel-Dubousset instruments for dorsal surgery.

The surgical methods of Dwyer and Zielke use access from the front (anterior or ventral access). The instrumentation for ventral access has been continuously further developed, but it is still based on the principles formulated by Zielke.

More recent developments include the primary stability instruments of Halm-Zielke, Kaneda and CDH, along with ventral lordosing and derotation spondylodesis (VLDS).

Continuing advances in our understanding of the biomechanics of the spinal column and the pioneering work of Paul Harrington, who was the first to develop and use an implant system for scoliosis treatment, have resulted in steady development in the field of spinal column surgery since 1960. Continuous improvement of surgical techniques and implant systems, rapid developments in the area of computer-supported apparatus-based diagnostics that provide valuable and accurate information, plus well-developed intensive medical care procedures, make it possible to carry out highly complex and difficult surgical procedures on the spinal column today. These procedures can promise the patient complete healing of a condition or at least vast improvement in quality of life by bettering the existing findings.