

Medieval management of spinal injuries: parallels between Theodoric of Bologna and contemporary spine surgeons

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In recent decades there have been revolutionary technological advances in the management of traumatic spinal column injuries. Despite these advances, the basic principles of reduction and stabilization of vertebral fractures and dislocations remain similar to those proposed by ancient and medieval physicians. Theodoric of Bologna, in his text *Chiurgica de Theodoric* (ca. AD 1267), described an extracorporeal approach to the management of traumatic spinal column misalignments. Surprisingly, his techniques are still used in many instances by contemporary spine surgeons, despite the availability of a more advanced technological armamentarium than that existent in medieval times.

KEY WORDS • Theodoric of Bologna • spine • medieval history • history of neurosurgery • trauma

The diagnosis and treatment of traumatic spinal column disorders was first described in the Edwin Smith Papyrus (2500 BC) and revisited during the Greek and Roman Eras, as exemplified by the practices of Hippocrates (460–370 BC) and Galen of Pergamon (ca. AD 129–210). These writings were preserved and reintroduced to medieval Europe by the Arabian School and its learned scholars, most notably Avicenna of Baghdad (ca. AD 979–1037).

Theodoric of Bologna (ca. AD 1205–1298), also known as Bishop Theodoric of Bitonto (1262) and later of Cervia (1266), was familiar with the teachings and practices of Hippocrates, Galen, and Avicenna. He devoted much of his life to studying medicine and surgery and wrote a surgical text, *Chiurgica de Theodoric*,² in which among general writings on medicine and surgery, he discussed the treatment of acute spinal column disorders. Theodoric taught that the reestablishment of proper alignment of vertebral bodies by reduction and stabilization was required to heal spine fractures and dislocations. The techniques he described are surprisingly similar to the general philosophy upheld by contemporary spine surgeons, who apply a different clinical armamentarium from that available to Theodoric.

EVOLUTION OF MEDICINE AND SURGERY DURING THE 13TH CENTURY

After the fall of the Roman Empire, progress in European medicine stagnated for nearly a millennium. The few scholars who studied medicine were generally clergymen who continued the traditions of Greek and Roman medicine. During the 12th century, the Church forbade the phy-

sician-clergyman from the study and practice of surgery. This came about when the Council of Tours (1169) pronounced the edict, “Ecclesia abhorret a sanguine” which meant that blood shedding was incompatible with a cleric’s holy duty to God.⁸ This edict restricted the organized study of surgery and, hence, this art eventually fell into the hands of the uneducated barber–surgeon.

Medical advancements in the understanding of human anatomy, physiology, and disease continued to languish until the 13th century, when formal medical education was established in Salerno, Italy. The School at Salerno became the center for medical scholars whose knowledge of medicine came from Greek, Roman, monastic, Arabic, Jewish, Asian, and Middle Eastern traditions. Soon, more universities opened and medicine flourished.^{1,9}

In Bologna, Italy, during the 13th century, anatomical dissections of executed criminals were permitted and the education of physicians was no longer limited to studying philosophy, astrology, and ancient Greek texts concerning the “humours” and “elements” of the human body.¹⁰ Cadaver dissections provided fodder for kindling a more thorough understanding of human anatomy and formal teaching in surgery. During that time the University of Bologna was one of the few universities where surgical practices were formally taught; it was attended by Hugo of Lucca (ca. 1160–1257) and Theodoric of Bologna.

Theodoric of Bologna is most noted for his practices concerning wine antisepsis, the “soporific sponge” (anesthesia consisting of opium, mandragora, and hemlock), and a radical approach to wound repair.⁸ Theodoric was criticized for his belief that pus interfered with proper wound healing because it was accepted that pus was a sign of healing, hence the term “laudable pus.”^{7–8} *Chiurgica de*

Theodoric was written at the request of Theodoric's spiritual father and dearest friend, Bishop Andres Albolat of Valencia.³ Bishop Albolat requested that Theodoric write a text to describe the art of medicine and surgery in accordance with the teachings of Hugo of Lucca, the renowned physician and possibly Theodoric's father, who enhanced the practice of medieval medicine.³ In these writings, Theodoric describes, tests, and expounds on the practices of Hugo of Lucca, makes reference to ancient Greek and Roman physicians, and criticizes the approach to medicine taken by two of his contemporaries, Rolando Capelluti (Roland of Parma) and Ruggiero Frugardi (Roger of Salerno).¹⁰

Medieval and Contemporary Management of Spine Injuries

In *Chiurgica de Theodoric*, Theodoric describes how to examine a patient with a cervical spine injury to determine whether the injury is "one to be treated" or "one to be left alone."³ In the absence of imaging modalities, his diagnosis was based on the neurological examination and external signs of gibbous (kyphotic) and nongibbous (lordotic) spinal deformities. The differential diagnosis was limited to partial or complete spinal cord injuries and vertebral dislocations and fractures.

Theodoric states in his manuscript that the presence, completeness, and level of spinal cord injury, were important prognosticators of morbidity and death. These factors were important for deciding whether a spinal injury should be treated or not.

... examine his hands to see if they are flaccid and numbed and deadened, and if the patient cannot move them nor flex them, and if there is no feeling in them when they are pressed, then you should know that something awful has happened. But if he moves them and feels the pressure of your fingers, then you may know that the spinal cord is safe.⁴

Sometimes cervical vertebrae leave their proper position and the neck is then out of joint; and if the physician does not tend to this matter quickly, death occurs shortly. . . . The dislocation of the cervical vertebrae is mortal if it is complete; and generally if it is near complete. . . .⁵

The relatively limited differential diagnosis offered by Theodoric has been broadened with the aid of modern imaging modalities such as plain radiography, computerized tomography, and magnetic resonance imaging. These diagnostic aids have made it possible for contemporary spine surgeons to understand spinal column injuries in terms of biomechanics. According to the biomechanical theory, forces applied parallel to the center of the spinal axis produce burst fractures, whereas forces applied ventrally produce compression fractures. Force applied perpendicular to the long axis of the spinal column (shear forces) result in fracture-dislocations and unilateral or bilateral, locked facet joints. Rotatory forces can create extremely unstable fracture patterns and are often associated with profound neurologic deficits. Each of these abnormalities has an important role in the physician's decision of whether extracorporeal reduction and stabilization or surgical instrumentation is indicated in the management of these spinal injuries.

Management of cervical spinal injuries by Theodoric involved reducing and stabilizing dislocations of the cer-

vical vertebra with extracorporeal traction devices consisting of slings and ropes for reduction and splints and plaster for stabilization.

... put a sling under the jaw . . . hold each end of the sling firmly while lifting upward, putting one foot on one of the patient's shoulders, the other on the other, so that pressing down with the feet and pulling hard on the sling with the hands, the vertebrae may be forced to align rightly by reason of tension, and return to proper articulation . . . lay the patient on his back . . . draw his head upward gently and align the vertebrae by pressure and manipulation. And when they are properly aligned, apply a comforting plaster, and cover it with dressings, and thereon bind a splint the length and width of the neck, and tie it to the head at one end and under the armpits at the other, so that the bandaging does not fall to the throat and become loose. These should be applied with bandages according to the individuals conformation.⁵

There are surprising similarities between the way in which a spine injury was managed by Theodoric and the manner in which it is managed by contemporary spine surgeons. Today, spine surgeons use weights and tongs to apply tension to the head and distract the fractured or dislocated vertebral bodies until the segment containing the injury has been reduced and secured in a halo device or cervical hard collar. Contemporary management of cervical spine injury diverges from medieval practice when nonsurgical reduction and stabilization fails; at this point surgery often becomes necessary.

Theodoric recognized that patients with thoracolumbar fractures and fecal or urinary bladder incontinence have a poor prognosis.

The symptoms of this condition are the emissions of feces and urine which occur involuntarily from the weakness of the vesical and anal muscles. . . . When vertebrae of the back are completely dislocated, the result is inevitably fatal. If the displacement is great, though not complete, the result is mortal too, because of the narrowing of the canal. . . .⁵

Theodoric considered gibbous (kyphotic) deformities of the thoracolumbar spine "treatable" because he was able to reduce them with extracorporeal traction devices. Nongibbous (lordotic) deformities, however, were considered "non-treatable" because medieval technology did not provide Theodoric with a means to reducing lordotic deformities. He describes a method for reducing and stabilizing gibbous deformities of the thoracolumbar spine in great detail.

If the dislocation has occurred in the vertebrae of the back, consider in which direction it tilts; because, if it should be directed toward the interior of the chest, there is no ingenious method for treating it, and it is therefore not curable . . . but the type which is displaced posteriorly is called gibbous. . . . Sometimes the vertebrae of the spine have been separated posteriorly by a fall or by some pressure, so that the patient must hold his head between his thighs and cannot lift his head. In such a case . . . make ready two long splints from the scapulae to the buttocks . . . they ought to be fitted with one on one side of the spine, and one on the other, so that they are parallel to the spine . . . place the patient straightway upon a flat table, face down. And first bind the patient down with wide bands from below the armpits to the shoulders, and lower down, over the hips and around the thighs . . . and be drawn tight from the two directions . . . that may be drawn tighter by assistants . . . apply pressure over the gibbosity with the palms and heels of the hands, pushing the protruding part inward until it returns to

Medieval management of spinal injuries

its proper place. And if it should be necessary to sit upon the patient, do so . . . the work should be done so, with zeal and ingenuity, until all is straight . . . put the splints described before . . . and bind them on well. Next, place the patient on his back in a flat bed. Or apply a restorative plaster. . . .⁵

Contemporaries of Theodoric treated traumatic thoracolumbar deformities according to the practices of Hippocrates and Galen. These disorders were managed by applying a series of jolting techniques (succussion) and using racklike traction devices (scamnum).¹¹ Bedrest and securely fitting braces were prescribed by Theodoric for the proper healing of spinal misalignments. In principle, Theodoric's splint to stabilize gibbous deformities is similar to a thoracolumbosacral orthotic brace used today. Thoracolumbar fractures can be stabilized with such a brace, but the effectiveness of the stabilization technique and the need for surgery is influenced by factors such as the patient's body habitus and associated comorbidities.

Advances in anesthesia, antiseptics, antibiotic agents, intraoperative cardiovascular monitoring, and spinal instrumentation have had a significant impact on reducing rates of mortality due to spine injury. Aggressive physical and occupational therapy and motorized devices such as wheelchairs, have further reduced the risks of morbidity and improved functionality not possible during Theodoric's time.

CONCLUSIONS

The surgical manuscript of Theodoric of Bologna survived the past millennium and provides a glimpse into the practice of medicine and surgery during the Medieval Era. Surprisingly, the extracorporeal traction and stabilization devices developed by Theodoric to correct spinal misalignments were very similar to those used today. Fortunately, advancements in medical technology now allow spine surgeons to treat forms of spinal column injuries that Theodoric considered "those not to be treated." Nevertheless, when a neurological deficit is present, the current prognosis parallels that of a millennium ago.

Future advancements toward reducing the incidence of

morbidity and death in patients with spine injury will not be developed in metallurgy or critical care medicine, but rather in the areas of stem cell transplantation and neuronal repair. These advancements represent the contemporary man's medicine for an ancient disease.

References

1. Bishop WJ: **The Early History of Surgery**. London: Robert Hale Limited, 1960, pp 59–65
2. Borgognoni T: **The Surgery of Theodoric (translated by Campbell EC, Colton JB)**. New York: Appleton-Century-Crofts, 1955, Vol 1, pp xv–xxxiii
3. Borgognoni T: **The Surgery of Theodoric (translated by Campbell EC, Colton JB)**. New York: Appleton-Century-Crofts, 1955, Vol 1, p xxxvii
4. Borgognoni T: **The Surgery of Theodoric (translated by Campbell EC, Colton JB)**. New York: Appleton-Century-Crofts, 1955, Vol 1, p 192
5. Borgognoni T: **The Surgery of Theodoric (translated by Campbell EC, Colton JB)**. New York: Appleton-Century-Crofts, 1955, Vol 1, pp 205–208
6. Campbell EC, Colton JB: Theodoric: master surgeon of the thirteenth century. *N Y State J Med* **54**:191–194, 1954
7. Edwards H: Theodoric of Cervia, a medieval antiseptic surgeon. *Proc R Soc Med* **69**:553–555, 1976
8. Goodrich JT: Neurosurgery in the ancient and medieval worlds, in Greenblatt SH (ed): **A History of Neurosurgery**. Park Ridge, IL: AANS, 1997, pp 51–62
9. Popp AJ: Crossroads at Salerno: Eldridge Campbell and the writings of Theodorico Borgognoni on wound healing. *J Neurosurg* **83**:174–179, 1995
10. Rutkow IM: **Surgery: An Illustrated History**. Philadelphia: Mosby-Year Book, 1993, pp 81–115
11. Vinas FC: **Lumbar Spine Fractures and Dislocations**. (<http://www.emedicine.com/orthoped/topic176.htm>) [Accessed 10 December 2003]

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