History of skeletal traction in the treatment of cervical spine injuries

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Therapy of cervical spine fractures is reviewed from the time of the Egyptians (4000 B.C.) to the present day. Immobilization has been practiced for slightly more than a century; devices for exerting traction upon the skull have been in use for 37 years. The Renaissance surgeon, Fabricus Hildanus, designed a tool for exerting traction upon the cervical vertebrae, but this method did not become popular. Until the 20th century, few physicians considered the therapy of this common injury.

The human musculo-skeletal system was not designed to withstand the stresses of sudden deceleration and impact caused by high speed vehicles. Injuries to the cervical spine certainly have been known to all civilizations, but the advent of the automobile has increased their frequency. The resulting need for the services of physicians and hospitals has also led to a greater awareness of the number of patients with neck injuries. During the past 50 years, the development of radiology and the continuous acquisition of knowledge about the mechanisms of injury and tissue repair have led to improvements in the therapy of cervical spine injuries. This report is a brief historical review of the development of tools for reducing and stabilizing fractures of the cervical spine.

The earliest reference to injuries of the cervical spine occurs in the Edwin Smith Surgical Papyrus, a treatise on surgical therapy written in the 17th century B.C., but probably a copy of an Egyptian medical codex already 2000 years old. The Egyptians recognized the signs of cervical cord transection without identifying the spinal cord as the structure critically involved. They distinguished between dislocation, fracture, and open wound of the osseous structures, and described cases with and without signs of paraplegia, quadriplegia, anesthesia, and priapism. The Egyptian surgeon did not treat patients with signs of cord injury but advocated local application of meat and honey to the neck and maintenance of the seated position. Case 32 from the Smith Papyrus has been translated by Breasted as:

"Thou should bind it with meat the first day. Thou should loose his bandages and apply grease to his head as far as his neck, (and) thou shouldst bind it with ymrw. Thou shouldst treat it afterward with honey everyday and his relief is sitting until he recovers."4

There are no other known works that deal with neck trauma from this epoch, and it is probable that traction, skeletal or otherwise, was not practiced.13

We know little of the medicine of the pre-classical Greeks, but by the time of Hippocrates (4th century B.C.) physical means were used to reduce the deformity found with axial dislocation. While some types of
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therapy involved manipulation and local pressure, others were more vehement and were unfavorably regarded by Hippocrates. The best known measure, which persisted at least until the 15th century A.D., was sucession. The patient was affixed to a board which was allowed to fall until a restraining rope abruptly terminated its descent; inertia carried the patient's head downward and stretched the muscles and ligaments so that realignment might occur. It is easy to see how this method could convert a minor neck injury into a severe head injury; the Hippocratic opprobrium would seem justified. Hippocrates did use traction in the treatment of thoracic spine dislocation, and his method survived through the middle ages. He also recognized the role of the spinal cord in the genesis of the symptoms of spinal injury.

The Romans adopted the Hippocratic method; however, Celsus commented on the ineffectiveness of Hippocratic traction in treating complete dislocations; perhaps this was an allusion to the problem of locked facets. Paul of Aegina, a 7th century Byzantine, did not use traction of any type but introduced early decompressive laminectomy, as he recognized the danger of spinal cord compression. In the 9th century, Rhazes, in Arabia, applied an external metal splint in the treatment of spinal curvature, but it is not known whether the splint was also used for acute traumatic lesions.

In medieval Europe there were few therapeutic advances. The leading men, Henri de Mondeville and Guy de Chauliac, advised against therapy for spinal dislocations because they felt that the prognosis was hopeless. Petrus de l'Argelata, it is reported, reduced a cervical fracture dislocation by manipulation in 1531; and Ambroise Paré used a wooden traction frame at about the same time. This brilliant army surgeon operated when he felt that the spinal cord was being compressed by bony fragments. It is not known if he used traction for injuries of the cervical vertebrae as well as those of the thoracic region. It is significant that he attributed the local pain of these injuries to periosteal irritation, an astute observation for the 16th century.

The most original therapy of the Renaissance period, indeed of the entire history of cervical injuries, was that of Fabricus Hildanus, a German, who in 1646 described his method for reducing fracture dislocations of the cervical spine. He placed a large forceps, each blade of which was perforated, over the posterior aspect of the neck (Fig. 1). A silver needle was passed between the blades through the intervening soft tissues and spinous processes or interspinous ligaments. The average patient must have been short and the surgeon tall, for Fabricus then described how he stood on the patient's feet, abdomen to abdomen, and exerted upward traction by lifting his forceps. If this method did not reduce the dislocation, he undertook open decompression and reduction. Fabricus' method did not become popular, and no further reference to it can be found. In the 18th century, surgeons apparently used open decompression of fracture dislocations, for traction was not described. Prevailing medical thought advised against any form of therapy for patients with spinal cord signs.

In 1852 Antoninus Mathijsen, a Flemish

![Fig. 1. An illustration from the work of Fabricus Hildanus depicting the forceps and pin which he placed through the spinous process to reduce a fracture of the cervical spine.](Image)
army surgeon, first used a plaster of Paris cast to immobilize a vertebral fracture. He did not incorporate any traction device in his casting procedure. In 1887 Burrell combined traction and subsequent casting. He distracted and manipulated a cervical fracture dislocation prior to the application of a cast designed to restrict neck motion. Burrell advocated immediate decompressive laminectomy if any sign of cord compression was present. His articles were among the first reporting a large series of cases (244) treated by one method. One-third of the spinal injuries were in the cervical region, and 85% of these patients died; his over-all mortality for all injuries of the spine was 65%. It was the work of such men as Burrell at the end of the 19th century that validated the necessity for treating injuries of the cervical spine. Earlier in that century the English literature was equivocal about the value of any form of therapy for patients with spinal cord injury.

Halter traction was first employed in 1929 by A. S. Taylor. He stated that C5–6 hyperflexion injury was increasing because of automobile accidents; he advocated halter traction followed by immobilization in a plaster jacket for 3 to 4 weeks, and then a neck brace (Fig. 2). The use of halter traction has since become so widespread that most authors have described it without comment as to its origin. Other forms of traction that used the occipital protuberance and the mandible for purchase apparently had been in existence prior to Taylor's concise description, but it has been impossible for me to ferret out the origin of such devices.

A sudden explosion of devices to exert traction upon the skull appeared in the decade prior to World War II, making it the major developmental period in the treatment of cervical spine injuries in the 20th century. Priority probably belongs to W. G. Crutchfield, who in 1933 described a patient with a C2-3 fracture dislocation and a fractured mandible upon whom halter traction could not be used. At the suggestion of Dr. C. C. Coleman, Edmonton extension tongs were placed in the skull just over both ears after a short incision and burr hole of the outer table had been made (Fig. 3 left). The tongs were left in place for 36 days and Crutchfield was "impressed with its (sic) effectiveness and relative comfort" despite the very poor alignment obtained. During the next 5 years Crutchfield published additional articles detailing the Crutchfield-Coleman method and its modifications until the Crutchfield tong, basically as we know it, was evolved (Fig. 3 right). Crutchfield felt that the insertion of tongs and continuous traction should be the primary therapeutic approach unless cerebrospinal fluid block, progressive loss of function, or irreducibility of the dislocation were present. Coleman and Meredith pointed out that the skeletal traction method was much safer than manual reduction, which was still in vogue at that time.

![Fig. 2. Halter traction as used by Taylor to reduce a cervical spine fracture before immobilization in a plaster cast. (Reproduced by permission of the editor of Annals of Surgery.)](image-url)
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In 1933 Crutchfield could report on 43 patients treated with his tongs with only one complication—osteomyelitis at the tong site in a patient with pre-existing vertebral osteomyelitis. He felt that optimal therapy would be prompt insertion of tongs and traction until reduction was obtained. The tongs were to be removed as soon as plaster cast fixation was feasible, at best on the same day; however, the tongs could be left in longer if the patient was too ill for immediate immobilization.

In 1933 Neubeiser described a method of skeletal traction that he invented, although he did not state that he had ever used it! He advocated the use of a large fish hook, previously debarbed, placed under each zygoma and connected to a spreader bar upon which 6 to 15 lbs of traction was to be applied. In 1939 Selmo described a more sophisticated but similar apparatus (Fig. 4) which he had successfully used on an unspecified number of patients. Peyton, et al., in 1944 stated their preference for the zygoma-hook method and reported 11 patients treated in this fashion without complication. This method is not commonly seen in contemporary therapy.

Another method that is not frequently seen was proposed by Hoen in 1936. He made two parasagittal incisions 5 cm long and placed burr holes at the end of each. After a few strokes with a Gigli saw, he passed a steel wire through each pair of holes and...
connected them to a spreader bar for up to 22 lbs of traction (Fig. 5). The incisions were then sutured. He also suggested the use of this form of traction during laminectomy to prevent further dislocation.\textsuperscript{37} In 1937 Cone and Turner\textsuperscript{1} reported favorably on a series of patients treated in this fashion. One advantage of the method is that tongs are not required; however, a modicum of neurosurgical sophistication and specialized tools are necessary. In 1940 Jefferson and Eastwood\textsuperscript{12} debated the role of skeletal traction in the treatment of cervical injuries. Eastwood\textsuperscript{12} felt that the complications and risks of the procedure far outweighed its potential advantages; Jefferson\textsuperscript{18} held that skeletal traction was the only effective method to treat fracture dislocations in the cervical region. Rogers,\textsuperscript{24} in 1942, advocated the use of Crutchfield tongs or Hoen wires, but reported complications with both. He felt that optimal therapy would involve skeletal traction to effect a reduction and then prompt internal fixation to maintain the proper alignment of the bony parts.

The majority of other reports of this era are concerned with methods of applying tongs to the skull. Usually, no mention was made of Crutchfield's earlier use of skull traction. In 1937 and 1939 Gallie\textsuperscript{14,15} described a method that he had used since 1932, namely, ice tongs set into the skull by a hammer blow for traction and a Minerva jacket applied to hold the reduction. He claimed that his tongs never became dislodged and their use was completely benign. It was his belief that all dislocations should be reduced with skeletal traction. In 1938 Barton\textsuperscript{3} first reported his tongs made specifically for skull traction (Fig. 6), which he felt were better than others because of their simple construction, ease of installation, and low risk of skull fracture or scalp laceration. They had already been commented on favorably by Cone and Turner,\textsuperscript{7} and their use has become widespread in the intervening 32 years.

In 1948 Vinke\textsuperscript{29} described a new design for tongs based on the principle of Barton's tongs. Vinke's were much more complicated, both to build and to use, but they had safety features that helped prevent damage to the underlying brain and facilitated proper direction and force of traction. In 1953 Abbott and Hale\textsuperscript{4} demonstrated their device for incorporating skeletal traction in a plaster body jacket for long-term stabilization. Although modifications of basic designs have

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Fig. 5. Detail of Hoen's method of exerting skeletal traction by passing a wire through two burr holes. (Reproduced by permission of the editor of Archives of Neurology, Neurosurgery, and Psychiatry.)

Fig. 6. Tongs designed by Barton.
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appeared, no significant new devices for skeletal traction has been described in the literature for the past 10 years.

The use of skull tongs for reducing fracture dislocation and maintaining alignment of cervical spine fractures is now universal. Halter traction also is a widely accepted tool in the treatment of minor neck injuries and as a temporizing maneuver until skeletal traction can be established. Long-term application of skull tongs is feasible, provided that the tongs are installed aseptically and the sites remain sterile. Contemporary trends toward early operative stabilization, either posteriorly or via the anterior interbody approach, minimize the long-term role of external traction in the therapy of cervical fractures. When stable alignment can be obtained, however, long-term skeletal traction still is considered by many to be the therapy of choice. Manipulation, which was the major form of treatment for thousands of years, is not now an accepted method of therapy.

References

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