Cervical Traction for the Treatment of Spinal Injury and Deformity

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CERVICAL TRACTION FOR THE TREATMENT OF SPINAL INJURY AND DEFORMITY

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» Following cervical spine trauma, traction can be used to restore sagittal plane alignment in patients with subaxial injuries, to reduce unilateral or bilateral cervical facet dislocations, and to improve alignment in patients with traumatic spondylolisthesis of the axis.

» The use of halter or skull traction may obviate the need for operative treatment for some patients with atlanto-axial rotatory subluxation.

» Perioperative and intraoperative spinal traction has been shown to assist with preoperative planning and to improve overall correction and pulmonary function in patients with spinal deformity.

» The most common complications associated with cervical spine traction are pin-site irritation and infection; however, more serious neurological complications, including cranial nerve palsy and spinal cord injury, also can occur; thus, careful monitoring of patients undergoing traction is essential.

History of Spinal Traction

As early as the 4th century BCE, Hippocrates described spinal traction as a treatment for kyphotic deformity[1]. His invention, the scamnum, was a device composed of ropes attached to windlasses that produced traction on the body. This device was used for the treatment of fractures and deformity into the 17th century[1]. In the 1600s, the German surgeon Fabricius Hildanus described a method for reducing cervical fracture-dislocations by combining traction with open reduction. With this method, the patient was positioned on a stretching bench to extend the cervical spine, after which the surgeon made an incision to expose and grasp the spinous process with forceps. The dislocated vertebrae were then manipulated into physiological alignment[2].

While spinal traction techniques did not evolve further until the 20th century, the understanding of spinal anatomy and biomechanics improved during this period, providing the foundation for many of the developments in spinal traction and instrumentation that would occur in the modern era.

In 1929, Taylor introduced the halter device as a method of applying traction for the reduction of cervical injuries[3]. In 1933, Crutchfield introduced the use of cranial tongs for cervical traction[4]. These tongs required pin placement near the cranial vertex, which limited the amount of traction that could be safely applied[1]. In 1973, Gardner improved on the system described by Crutchfield by creating tongs with cranial pin angulation for improved skeletal fixation[5] (Fig. 1). These larger Gardner-Wells tongs did not require placement close to the vertex of the skull, and the tapered-pin design allowed for greater force

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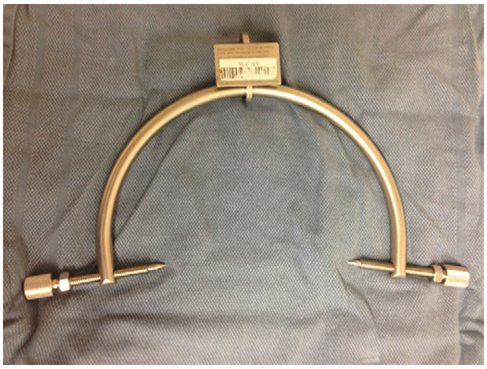

Fig. 1

Photograph showing Gardner-Wells tongs. The tapered-pin design allows for greater force application without penetration of the inner table of the skull. Pins are angled toward the vertex of the skull and are placed below temporal ridges to maximize the strength of the pin-bone interface and to reduce the chance of pin cut-out with large traction weights.

application without penetration of the inner table of the skull. In 1968, Nickel et al. developed the halo device[6] (Fig. 2), which was followed by the introduction of halo-femoral traction in 1967[7]. Halo-gravity traction, the most commonly used form of spinal traction for spinal deformities, was introduced soon thereafter[8].

Modern Spinal Traction

Spinal traction utilizes a tensile force to achieve improved alignment. The traction apparatus produces tension across all distractible joints in the vertebral column. Force is dissipated when applied over long segments of the spine. Thus, a large amount of weight may be necessary to restore alignment of the spinal column as in cases of facet dislocation in the lower cervical spine.

The most common cranial attachments for spinal traction include halter, tong, and halo devices. The halter apparatus is made of soft material and is placed under the chin. A limited amount of force can be applied with these devices. Tongs most commonly consist of pins that are placed through the outer table of the skull at a point 1 cm above and in line with the pinna bilaterally (Fig. 3, *A*); a third pin can be inserted for greater control of flexion and extension. Pin placement anterior to the pinna will place the head in relative extension, whereas pin placement posterior to the pinna will produce flexion (Fig. 3, *B*).

Halo Placement in Adult Patients

Halo placement in adults typically is performed with use of four pins that are inserted with 8 in-lb (0.90 N-m) of torque. Several commercially available incomplete halo rings are now available; however, the principles of pin placement still apply to nontraditional halo devices. The two anterior pins are placed 1 cm above the outer thirds of the eyebrows (Fig. 2, *B*). The two posterior pins are inserted at 180° from the anterior pins, above the level of the pinna. In certain situations (e.g., cervical deformity correction), a greater number of pins may be used for added control and better cranial fixation (Fig. 2, *A*).

Halo Placement in Pediatric Patients

In children two years of age and older, six to eight pins should be placed through the ring. An insertion torque of 2 to 4 in-lb (0.23 to 0.45 N-m) is necessary to avoid penetration through the inner table of the skull. Halo placement with skeletal pins in children under the age of two years is contraindicated because of the heightened risk of dural penetration. The accuracy of torque wrenches for

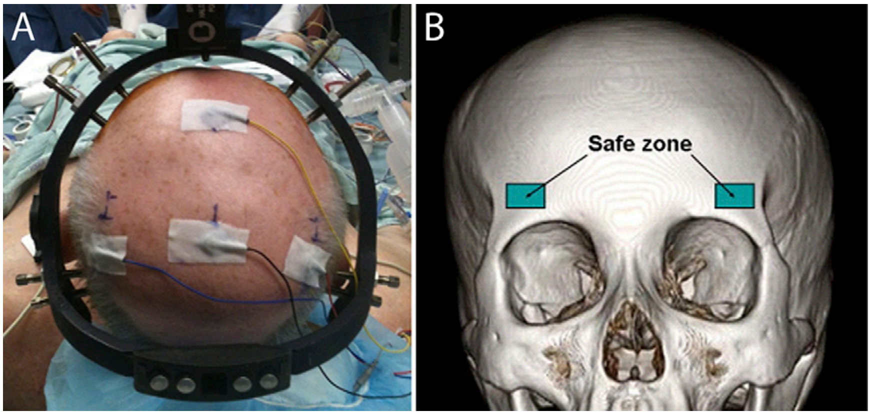

Fig. 2

Fig. 2A Photograph showing the skeletal halo device, with double-pin placement for additional control and safety. **Fig. 2B** CT reconstruction image showing the safe zones for anterior pin placement (in the lateral one-third of the orbit, 1 cm above the eyebrow). (Reproduced, with permission of Elsevier, from: Ebraheim NA, Liu J, Patil V, Sanford CG Jr, Crotty MJ, Haman SP, Yeasting RA. Evaluation of skull thickness and insertion torque at the halo pin insertion areas in the elderly: a cadaveric study. Spine J. 2007 Nov-Dec;7(6):689-93. Epub 2007 Feb 08. http://www.thespinejournalonline.com/article/S1529-9430%2806%2900922-3/abstract)

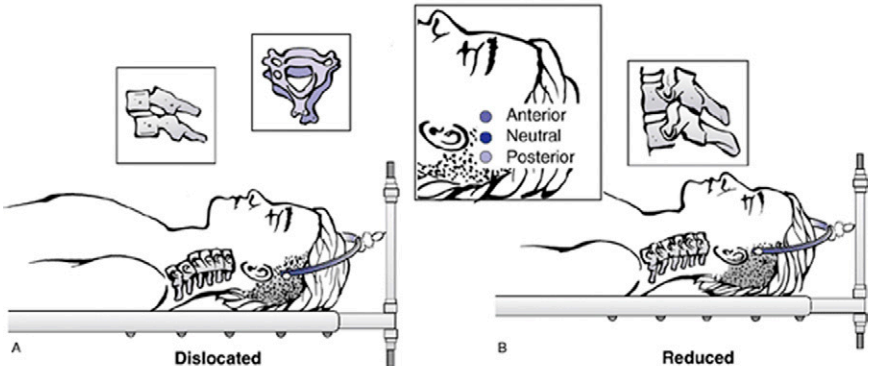

Fig. 3

Fig. 3A Illustration showing tong position placed 1 cm above the pinna. **Fig. 3B** Anterior tong placement leads to relative neck extension, whereas posterior placement leads to neck flexion. (Reproduced, with permission, from: Rockwood CA, Bucholz RW, Court-Brown CM, Heckman JD, Tornetta P. Rockwood and Green's fractures in adults. Philadelphia: Lippincott, Williams & Wilkins; 2010.)

providing lower pin-insertion force in children is variable, with additional inconsistency between wrench operators[9]. Thus, caution must be utilized to avoid placing too much torque on skeletal pins in children. A computed tomographic (CT) scan of the head can be used to assess skull thickness and to plan optimal pin location before halo placement.

Spinal Traction Techniques

Tong or halo traction is most often used for the treatment of cervical spine trauma and spinal deformity. Tongs are temporary devices. When longer-term traction is needed, a halo ring is utilized. Recumbent traction is typically used with the patient in the supine or prone position and with the bed or operating table in the reverse Trendelenburg position. The body mass of the patient acts as a counterforce. To further enhance the tensile force applied to the spinal column, countertraction can be instituted with use of a halter device around the iliac crests, skeletal fixation pins in the long bones of the lower extremities, or distal skin traction. Halo-gravity traction is useful for the correction of flexible spine deformity and allows the patient to sit or stand upright while traction is applied. Options for halo-gravity traction include wheelchair traction (Fig. 4, *A*) and walker traction (Fig. 4, *B*).

Traction Utilization for Spinal Trauma

Traction is a fundamental treatment technique in cases of cervical spine trauma. It is particularly useful for reducing flexion-distraction injuries (i.e., unilateral or bilateral facet dislocations). Restoration of sagittal plane alignment and spinal canal dimensions can be achieved with traction in cases of kyphotic angulation and retropulsion due to flexion-compression and/or axial load fracture patterns. In all of these situations, the realignment produced by


[redacted]
[redacted]

Fig. 4

Fig. 4A Wheelchair halo-gravity traction apparatus. **Fig. 4B** Walker halo-gravity traction apparatus.

traction provides for indirect decompression of the spinal cord. Traction also may be used for temporary immobilization and stabilization while a patient awaits definitive fixation.

Patients who have sustained a traumatic injury should be assessed for a skull fracture with CT before the placement of cranial fixation pins. Additionally, traction never should be used in cases of occipitocervical dissociation. For this reason, whenever traction is applied to the cervical spine in the setting of trauma, a lateral radiograph should be made immediately after the application of light traction (approximately 10 lb [4.5 kg]) to rule out distraction of the occipitocervical joint. If no occipitocervical distraction occurs, further traction can then be applied as needed.

Cervical Facet Dislocation

Unilateral or bilateral cervical facet dislocation in an awake and cooperative patient is typically treated with an initial attempt at closed reduction followed by internal fixation[10-12]. Traction with use of Gardner-Wells tongs is an effective means of reducing dislocated facets, with reported success rates of as high as 80%[12-14]. A slightly posterior pin position provides for neck flexion, which can aid facet relocation. A pad placed under the head, with the pulley positioned anterior to the tongs, also can facilitate unlocking of the facets. Commonly, traction is initiated at 10 lb (4.5 kg), followed by sequential increases of 10 to 15 lb (4.5 to 6.8 kg) every few minutes. A lateral cervical radiograph is made after each weight increase to monitor spinal alignment and occipitocervical joint congruity, and a thorough neurological examination is performed after the initial application and after each subsequent weight increase. The weight must be immediately decreased if overdistraction is identified or neurological symptoms or signs develop.

Reduction of a flexion-distraction injury pattern may require large traction weights, and manual flexion and/or rotational maneuvers may be necessary to unlock the facets[15]. Traditional teaching is that 10 lb (4.5 kg) per cervical spinal level is required in order to achieve reduction of facet dislocations, although an additional 20 to 30 lb (9.1 to 13.6 kg) is often needed and total weights of as much as 140 lb (63.5 kg) may be required. Greater loads are needed for lower cervical spine injuries and unilateral facet dislocations[16]. Overdistraction of the spine should be avoided as neurological compromise can occur[17]. After closed reduction is successfully obtained, traction may be reduced to 10 to 20 lb (4.5 to 9.1 kg) and the traction force-vector can be transitioned to neutral or slight extension. If the relocation attempt is unsuccessful, early operative reduction is undertaken.

The timing of spinal column reduction remains controversial. While some studies have suggested that early reduction may provide an improved chance of neurological recovery[14,18,19], others have indicated that the time to reduction is not a significant predictor of neurological recovery ($p = 0.22$)[20]. Similarly, the risk of disc herniation and the need to evaluate the cervical spine with magnetic resonance imaging (MRI) before closed reduction in awake and cooperative patients are controversial[21-26]. We are not aware of any reported cases of permanent neurological injury in awake, cooperative patients undergoing traction-assisted reduction of dislocated facets. Additionally, the ease and speed of obtaining an MRI evaluation varies between institutions, and thus individual assessment is needed in order to determine the appropriateness of pre-reduction MRI for patients with dislocated facets. For patients who are unable to fully cooperate with a neurological examination during attempted reduction of facets with spine traction, MRI is essential. For cooperative patients with facet dislocation without neurological deficit, pre-reduction MRI may be considered, given that emergent reduction is not necessary. For patients who have a neurological deficit, reduction with traction prior to MRI may be appropriate as the delay in reduction associated with obtaining a pre-reduction MRI could be detrimental to the neurological status of the patient.

Traumatic Spondylolisthesis of the Axis (Hangman Fracture)

Treatment of a displaced hangman fracture (traumatic spondylolisthesis of the axis) with traction reduction followed by halo-vest immobilization has been well described[27-31]. However, there is a difference between the treatment of Type-II and Type-IIa fractures as characterized by Levine and Edwards[29]. Type-I fractures are characterized by <3 mm of horizontal displacement, with no angulation and an intact C2-C3 disc and ligaments. Type-II fractures result from hyperextension-axial loading forces followed by flexion and are characterized by anterior translation of C2 by >3 mm and angulation of >10°. Type-IIa fractures result from flexion-compression forces and are associated with substantial angulation but minimal anterior translation of C2 over C3. Type-III fractures are characterized by all of the characteristics of Type-II fractures, with the addition of bilateral facet dislocation[29,32,33]. While most Type-II injuries can be treated with traction followed by halo-vest immobilization (Fig. 5), the traditional teaching is that traction should be avoided for Type-IIa injuries because of the potential for increased fracture displacement and neurological injury with traction[29]. Instead, gentle cervical spine extension followed by compression in a halo vest may be used for the treatment of Type-IIa injuries[29]. Type-I injuries are typically treated with collar immobilization, whereas Type-III injuries require open reduction and internal fixation[32].

More recently, Gardner-Wells tong traction with weights of 5 to 15 lb (2.3 to 6.8 kg) followed by halo-vest immobilization has been described for both Type-II and IIa fractures[34]. Traction resulting in a pure axial tensile force should be avoided for Type-IIa fractures, which should instead be treated

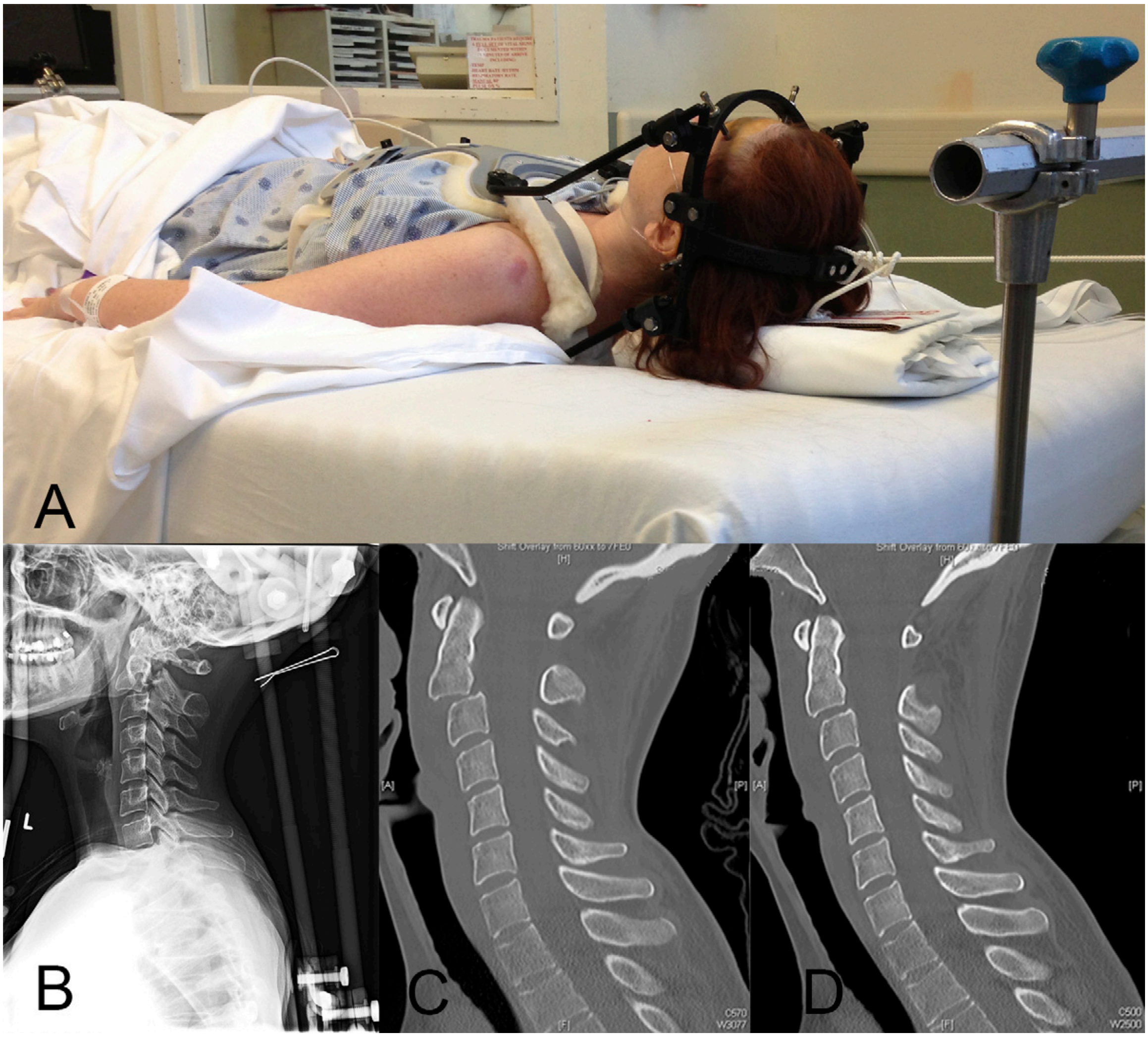

Fig. 5

Fig. 5A Clinical photograph of patient with a Type-II hangman fracture that was treated with traction followed by halo-vest immobilization. **Fig. 5B** Lateral cervical spine radiograph showing a Type-II hangman fracture. **Fig. 5C** Pre-traction sagittal CT scan. **Fig. 5D** Post-traction sagittal CT scan.

with a traction force vector that will produce extension at the fracture site. In a retrospective study of twenty-seven patients with Type-II fractures and four patients with Type-IIa fractures, the patients with Type-II fractures who had >12° of fracture angulation tended to have a failure of maintenance of the initial traction reduction, whereas no patient with a Type-IIa fracture had a failure of maintenance of initial traction reduction[34]. While conservative treatment with halo traction followed by halo-vest immobilization is well established for hangman fractures, recent studies have advocated immediate surgical intervention after careful traction for reduction, even in cases of Type-IIa fractures[35-38].

Atlanto-Axial Rotary Subluxation

Atlanto-axial rotatory subluxation is a cause of childhood torticollis and may occur as a consequence of a variety of etiologies. Atlanto-axial rotatory subluxation can be idiopathic, can result from trauma, or can occur in association with upper respiratory tract infection (Grisel syndrome)[39,40]. It can also occur in association with congenital conditions such as Down syndrome, Morquio syndrome, or Marfan syndrome. The treatment of torticollis due to atlanto-axial rotatory subluxation in children can involve a combination of analgesic medication, soft cervical collar or four-post bracing, halter or skull traction, and, if conservative measures fail, C1-C2 arthrodesis. The order and duration of each of these measures varies depending on the extent to which the subluxation improves with each intervention.

A soft cervical collar in addition to analgesic medication and physical therapy may be initially attempted in acute cases[41,42]. When deformity correction is not achieved within first two weeks of nonoperative therapy, traction is typically initiated. Favorable results have been reported in association with an extended period of halter traction lasting for as long as six weeks, followed by collar application for one to six months[43-45]. In cases in which halter traction is unsuccessful or is not tolerated, immediate C1-C2 arthrodesis may be performed[46], but, more frequently, a trial of skull traction (halo or Gardner-Wells) is attempted for as long as two months before proceeding to C1-C2 arthrodesis[47-50].

If reduction with halter or skull traction is successful, three months of brace or cast immobilization is recommended[51]. In some cases, the C1-C2 subluxation may be irreducibile with traction or the subluxation may recur after successful reduction with traction. Subluxations that are irreducible with traction are treated operatively, whereas recurrences may be treated with repeat traction and bracing prior to operative intervention[48-50].

Recent evidence has demonstrated that a two to three-month delay in the treatment of atlanto-axial rotatory subluxation often leads to more severe involvement with increased stiffness and pain[52]. On the basis of this evidence, Pang strongly suggested that all children with atlanto-axial rotatory subluxation, irrespective of symptom duration, should receive an initial course of traction rather than initial treatment with conservative measures such as a cervical soft collar, analgesics, or physical therapy as delay may reduce the probability of complete cure[51].

Spinal Traction for the Treatment of Spinal Deformity

A number of novel techniques, including Harrington rod-and-hook instrumentation, Kane halo-femoral traction, and halo-gravity traction, were introduced in the 1960s to correct thoracolumbar spinal deformity in children and adolescents. Prior to that decade, the treatment of pediatric deformity most commonly involved serial casting or the use of the Milwaukee brace. While reasonably effective for obtaining curve correction, casting was associated with substantial complications, including pressure sores, chest constriction, and deformation of the ribs and mandible[53]. The introduction of Harrington spinal instrumentation in 1962 offered both curve correction and, in contrast to casting, rapid return to mobility and activity[54].

Since the introduction of the Harrington rod-and-hook system, the operative treatment of spinal deformities has increased dramatically, although traction, bracing, and casting are still useful adjuncts. A 2011 survey of members of the Pediatric Orthopaedic Society of North America reflected the frequency of nonoperative treatment of idiopathic early-onset scoliosis, with 62% of the 195 respondents reporting that they commonly used casting, 89.1% reporting that they commonly used bracing, and 27% reporting that they commonly used halo-gravity traction[55]. Recent studies have shown that spinal traction is useful for preoperative assessment as well as for perioperative and intraoperative management[56-72].

Preoperative evaluation of curve flexibility is important for deciding how much correction can be attempted intraoperatively, for determining the necessity of anterior release, and for selecting levels for arthrodesis. Radiographic evaluation of curve flexibility can include a variety of imaging techniques such as supine, push-prone, traction, side-bending, and fulcrum-bending radiographs[56]. Traction radiographs made with the patient under general anesthesia have been shown to be superior to side-bending, push-prone, and fulcrum-bending radiographs for assessing curve mobility[56-59].

Watanabe et al., in a prospective study of 229 patients, found that traction radiographs outperformed side-bending radiographs in multiple subgroups of patients, such as those with a Cobb angle of >60°, an age of less than fifteen years, and a curve apex between T4 and T8 or T9[56]. Liu et al., in a prospective study of fifty-eight patients, did not identify a significant difference between traction radiographs made with the patient under general anesthesia and side-bending radiographs in terms of the maximum flexibility of main thoracic structural curves ($p = 0.09$) and thoracolumbar and lumbar structural curves ($p = 0.95$); however, they did identify a significant difference between traction radiographs with the patient under general anesthesia and push-prone radiographs in terms of the flexibility of main thoracic curves of ≥60° ($p = 0.00007$) and <60° ($p = 0.000004$) as well as that of thoracolumbar and lumbar curves of ≥60° ($p = 0.01$) and <60° ($p = 0.02$)[59]. Davis et al., in a prospective review of twenty-four patients, also found that traction radiography with the patient under general anesthesia was superior to side-bending radiography for assessing curves of both ≥60° and <60°[57], whereas Ibrahim et al., in a prospective review of thirty-three patients, found that traction radiography with the patient under general anesthesia was superior to fulcrum-bending radiography for assessing patients who had a Cobb angle of >60° in the standing position[58]. Traction radiography with the patient under general anesthesia may also be useful for identifying the lowest level of instrumentation and fusion for the treatment of spinal deformity. Hamzaoglu et al., in a retrospective study of eighty-nine patients, reported that traction radiographs with the patient under general anesthesia allowed L3 to be selected as the lower instrumented vertebra in forty-six cases (52%) in which L4 would have been selected as the lower instrumented vertebra on the basis of traditional radiography[60].

Spinal traction not only has been used for preoperative planning of operative correction of spinal deformities but also has been used perioperatively in conjunction with operative treatment (Fig. 6). Sink et al., in a retrospective review of nineteen patients who underwent halo-gravity traction perioperatively, reported that the Cobb angle improved by an average of 29° (35%)[61]. Rinella et al., in a retrospective review of thirty-three patients who underwent halo-gravity traction before posterior

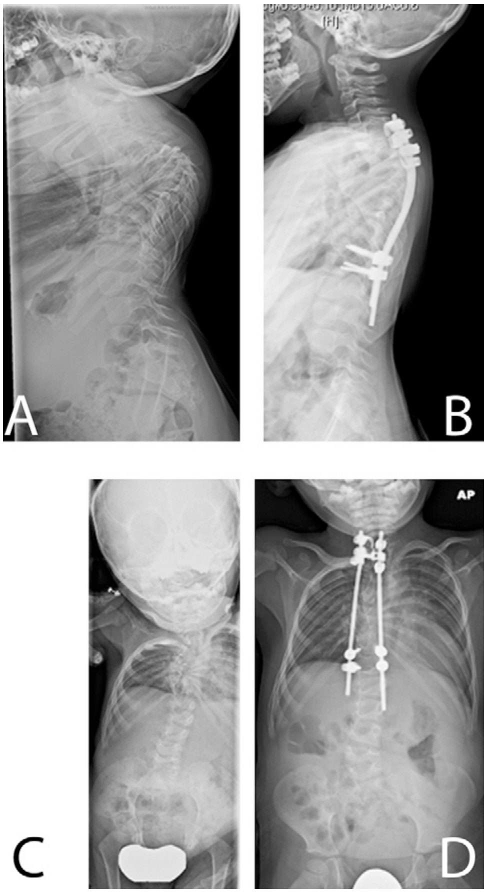

Fig. 6

Figs. 6A through 6D Radiographs of the spine of a pediatric patient with congenital thoracic kyphoscoliosis that was treated with three months of preoperative traction followed by posterior instrumentation. **Fig. 6A** Lateral radiograph made before traction. **Fig. 6B** Lateral radiograph made after traction and posterior instrumentation. **Fig. 6C** Anteroposterior radiograph made before traction. **Fig. 6D** Anteroposterior radiograph made after traction and posterior instrumentation.

fusion with or without preceding anterior fusion, reported that the major coronal curve was reduced by an average of 38° (46%)[62]. Watanabe et al., in a study of twenty-one patients with severe scoliosis ($\geq$100°) who underwent halo-gravity traction before posterior fusion, between anterior release and posterior fusion, or both before anterior release and between anterior release and posterior fusion, demonstrated an average of 51.3% correction of the major Cobb angle and a 20.7% increase of space available for the lungs[63]. Park et al., in a study of twenty patients undergoing preoperative halo-gravity traction, demonstrated major coronal and sagittal curve correction of 66.3% and 62.7%, respectively, in the first two weeks; 21.7% and 24.3%, respectively, in the third week; and 7.5% and 15.9%, respectively, in the fourth week[64].

Although all of those studies demonstrated improvement of the Cobb angle without any major neurological complications, they were limited in that the patients who underwent halo-gravity traction were not compared with a control group of patients who did not undergo halo-gravity traction. Sponseller et al., in a study in which thirty patients who underwent halo-gravity traction perioperatively were compared with twenty-three patients who did not, reported that there was no significant difference between the two groups in terms of coronal or sagittal curve correction ($p = 0.27$, $p = 0.55$), spinal length gain ($p = 0.643$), blood loss ($p = 0.902$), operative time ($p = 0.562$), or complications ($p = 0.058$)[65]. However, that study was limited by small sample size; a power analysis of the data suggested a study population of >2000 would have been required to establish a significant difference in curve correction[65]. Koptan and ElMiligui, in a retrospective case-control study in which twenty-one patients who were managed with anterior release and two weeks of halo-gravity traction followed by posterior instrumentation were compared with twenty-six patients who were managed without traction, demonstrated significantly better correction in the traction group as compared with the nontraction group (59% compared with 47%; $p < 0.01$)[66].

In addition to potentially contributing to overall curve correction, perioperative halo-gravity traction also may contribute to improved pulmonary function in patients with spinal deformity. Koller et al. retrospectively reviewed the records for forty-five patients who had undergone halo-gravity traction perioperatively and found an increase of 9% in the forced vital capacity of patients with severe pulmonary impairment[67]. Bogunovic et al. retrospectively observed that nineteen of twenty-two patients undergoing perioperative halo-gravity traction had an average of 20.7% improvement in forced vital capacity and 20.6% improvement in the forced expiratory volume in 1 second from baseline values[68].

Intraoperative Traction

Intraoperative spinal traction has been reported to be an effective technique for the surgical treatment of spinal deformity. Hamzaoglu et al., in a retrospective case series of fifteen patients with severe (>100°) thoracic idiopathic scoliosis and/or kyphoscoliosis who were managed with intraoperative halo-femoral traction and posterior pedicle screw instrumentation, reported an average improvement of 51% in the major thoracic curve, 33% in the compensatory lumbar curve, and 53% in the major sagittal curve[69]. Jhaveri et al., in a retrospective case series of twenty-two pediatric patients who were managed with intraoperative halo-femoral traction, reported an overall 23% improvement in the mean apical vertebral rotation of the major structural curve postoperatively and an improvement of the Cobb angle from a mean of 88.2° preoperatively to 49.1° postoperatively[70]. Those studies were limited by the lack of control groups that did not receive intraoperative traction.

More recent studies incorporating a control group have indicated that intraoperative halo-skeletal traction is an effective adjunct in the treatment of spinal deformity. Intraoperative halo-skeletal traction has been shown to be effective for the correction of pelvic obliquity, which is achieved by applying the traction unilaterally on the high-side iliac wing. Takeshita et al., in a study of forty patients undergoing posterior or anterior-posterior fusion with (n = 20) or without (n = 20) intraoperative halo-femoral traction, noted a significant difference in the correction of pelvic obliquity in the halo-femoral traction group as compared with the control group (78% compared with 52%; p = 0.001)[71]. In the study by Vialle et al., fifty-one patients who underwent intraoperative unilateral bipolar traction between a cranial halo and the lower extremity with pelvic-side elevation were compared with fifty-nine patients who did not undergo intraoperative traction[72]. The Cobb angle correction and frontal pelvic obliquity angle were significantly improved in the intraoperative traction group as compared with the control group (p = 0.002 and p = 0.006, respectively).

Not all intraoperative traction techniques have been shown to significantly improve Cobb angle correction in patients with pediatric spinal deformity. In the study by Mac-Thiong et al., forty patients with adolescent idiopathic scoliosis who received intraoperative traction with use of a head halter combined with skin traction were compared with 100 patients who did not receive intraoperative traction[73]. There was no significant difference between the two groups with respect to correction of the coronal primary Cobb angle (p = 0.052).

Intraoperative traction is useful not only for the treatment of pediatric spinal deformity but also for assisting with intraoperative alignment during the surgical treatment of adult cervical spine deformity[74,75]. Intraoperative traction with halo fixation can be useful for the correction of flexible adult cervical spine deformities, and it can also be useful as an adjunct to cervical osteotomy in the treatment of more rigid adult cervical spine deformities, such as chin-on-chest deformity.

Complications of Spinal Traction

Spinal traction can lead to a variety of complications. Problems related to halo fixation pins are particularly common. Medial placement of the anterior halo pins can cause supraorbital nerve or supratrochlear nerve injury. Pin penetration into the frontal sinus is also possible[76]. In children, penetration through the skull may lead to dural leak and subsequent meningitis or brain abscess[77,78].

A halo ring that is left in place for an extended period of time also can lead to pin-site irritation and infection, which at times necessitates pin removal. Pin-site infection was the most common complication observed in one series of patients and occurred at an average of six weeks after halo application[79]. Local daily pin-site care cleansing with either 4% chlorhexidine gluconate or a 50:50 mixture of water and hydrogen peroxide may be a useful preventive measure[80,81]. Tightening of pins with a calibrated torque wrench daily for three days following halo placement and subsequently every three to four days also may help to avoid pin-site complications.

In cases of preoperative traction, decubitus ulcers also may develop at skin-traction sites if halter devices are used or if prolonged sitting or bed rest occurs with traction. Frequent skin checks and patient turns are essential to prevent skin breakdown.

Spinal traction may lead to neurological injury. A commonly reported deficit is cranial nerve palsy, with the abducens nerve (the sixth cranial nerve) most frequently involved[82-84]. Intraoperative traction may produce stretch injury to the spinal cord, which, if not monitored properly, can lead to paralysis. Intraoperative halo-femoral traction increases the risk of motor evoked potential changes; however, whether motor evoked potential changes that are observed intraoperatively are associated with long-term neurological deficits is unclear. Lewis et al., in a study of thirty-six patients who underwent intraoperative skull-femoral traction during the correction of coronal plane deformity, reported that the risk of motor evoked potential changes was higher for such patients than for patients who do not undergo intraoperative traction[85]. It was also observed that the risk of motor evoked potential changes was higher for patients with stiffer curves[85]. However, recovery of motor evoked potential changes was achieved with adjustments in traction weight, and, despite incomplete recovery of loss in motor evoked potential amplitude at the end of eight procedures, none of the patients in the series had neurological deficits on awakening[85].

Summary

The modern use of spinal traction is rooted in a long tradition of treating spinal disorders via stretching techniques.

Today, spine traction remains an indispensable tool for the treatment of cervical spine trauma, atlanto-axial rotatory subluxation, and spinal deformity. However, only limited high-quality evidence is available to support the use of spinal traction, and future prospective studies are needed to aid in the development of evidence-based treatment guidelines. Nevertheless, practitioners utilizing spine traction must be aware of the potential benefits and risks of traction prior to initiating treatment.

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