Gradual multiplanar cervical osteotomy to correct kyphotic ankylosing spondylitic deformities

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The majority of patients suffering from ankylosing spondylitis have progressive fusion of the spinal apophyseal joints, discs and sacroiliac joints, resulting in a complete ankylosis of the axial skeleton. Cervical, thoracic or lumbar kyphotic deformities may also develop. Fixed cervical kyphosis produces severe functional restrictions as the loss of horizontal gaze prevents those afflicted from engaging in various social interactions, driving a car or even determining direction when walking.

Cervicothoracic deformities have been corrected by osteotomies as described by Urist in 1958[1] and Simmons in 1972.[2] The purpose of this paper is to present a significant technical modification to these techniques that permitted safe, accurate treatment in 2 patients with unusual clinical presentations.

Case reports

Case 1

A 59-year-old man had suffered from ankylosing spondylitis for 20 years. Over the previous 5 years a kyphotic deformity of his cervical and thoracic spine had gradually developed. He presented with a chin–brow angle of 32° and a head tilt of 20°. A halo ring and body cast was applied before operation (Fig. 1) and a cervical osteotomy performed according to the technique described by Simmons.[2,3] Under local anesthesia a laminectomy of C6, C7 and T1 was performed with bilateral foraminotomies of C8. The surgeon grasped each side of the halo ring from the posterior aspect and the assistant performed an identical manoeuvre from the front. As the posterior laminectomy gap was being closed, the patient became bradycardic and hypotensive, presumably from excess traction of the vagus nerves. The correction was stopped before the osteotomy gap was completely closed. The halo ring was secured in a standard fashion to the body cast. Bone graft was placed laterally but not posteriorly within the laminectomy gap. A Luque rectangle-Wisconsin wire construct was placed such that further axial motion could occur. There were no postoperative complications, but we felt that the extent of the correction was suboptimal. Two days postoperatively the anterior bars of the halo were replaced by Ilizarov distraction bars and clickers. Over the next few days the anterior bars were distracted to obtain further correction (Fig. 2). Each clicker adjustment was completed without sedation as the patient was mobilizing in hospital and receiving neurologic monitoring by the nursing staff. He was discharged home and followed up monthly to adjust the

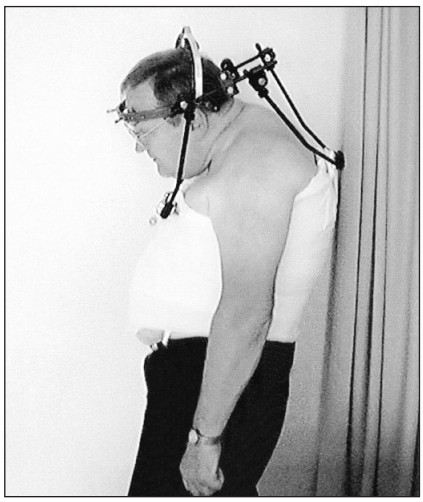

FIG. 1. Case 1. Side view 1 day before cervical osteotomy after application of a halo ring and cast. The halo bars have not been connected to the ring. The chin–brow angle measures 32°.

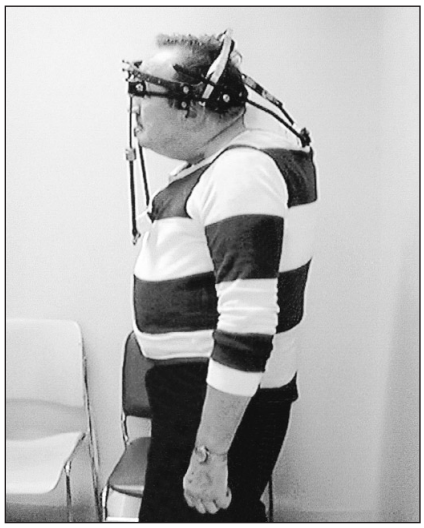

FIG. 2. Case 1. Two weeks after cervical osteotomy and additional distraction by anterior Ilizarov clickers. The chin–brow angle now measures 8°.

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halo. At 3 months, a lateral tomogram revealed bony union, and the halo was removed. After correction he had a chin–brow angle of 8° and a head tilt of 20°. He was followed up for 36 months with no recurrence of his deformity. Unfortunately, he fell 9 months after his surgery sustaining a fracture of T7 followed by a nonunion with conservative management for 3 months. He required an anteroposterior fusion and instrumentation of his thoracic spine.

Case 2

This 40-year-old man fell in 1990, sustaining an extension injury of his neck and becoming quadriparetic. He was treated at another centre with C2 to C7 laminectomy. Two weeks after the accident he made a significant neurologic recovery and eventually became ambulatory with a 4-poster cane. Three years later he underwent a total hip replacement at a small community hospital, but was not aware of the diagnosis. He presented in 1999 with a complete spinal ankylosis and a fixed cervical kyphosis and a left lateral tilt, which markedly impaired horizontal gaze (Fig. 3). He had a chin–brow angle of 42° before surgery and a head tilt of 20°. He had not noted any change in the function of his extremities, and the deformity was of gradual onset. Radiography revealed arthrodesis of the sacroiliac joints, facet joints and discs typical of ankylosing spondylitis. Magnetic resonance imaging demonstrated a cervical kyphosis with the apex at C5, the spinal cord was draping the posterior aspects of the vertebral bodies of C4 to C6, and the laminae of C2 to C6 inclusively had been resected (Fig. 4). A standard osteotomy was not considered possible or safe because of mild anterior compression of the spinal cord, posterior scarring of the dura and nerve roots and absence of posterior elements making spinal fixation more complex.

Surgical correction involved an anterior–posterior procedure. A body cast with anterior and posterior connectors was fashioned on the day before surgery. At operation, a standard halo ring was applied using 4 pins tightened to 0.9 Nm of torque (8 in/lb). An anterior right-sided approach to the neck was made with the patient in the supine position. There was very little distance between the chin and the clavicle and therefore the only level that could be accessed was C7 to T1. The anterior longitudinal ligament was divided at that level and the disc remnants were resected. The disc space was filled with cancellous allograft. An osteotome was used to notch and weaken the fused C7 to T1 lateral to the disc. The wound was closed and Ilizarov distraction bars were used to connect the anterior halo ring to the anterior body cast. The patient was turned prone on soft bolsters. Through a posterior approach, the dura was exposed by dissecting the fibrous tissue from the previous laminectomy site and resecting the remainder of the C7 and T1 laminae. Posterior osseous resection was extended lateral to the vertebral canal at C7. The pedicles of C7 were resected, and wide foraminotomies of C8 were performed. No correction was made at this stage. The nerve roots were covered by Gelfoam and then autologous local bone from the laminectomies was placed over the Gelfoam from C6 to T1. The wound was closed and 2 more Ilizarov bars were placed to connect the posterior halo ring to the posterior body cast. After surgery, anteroposterior and lateral radiography of the neck was done with large cassettes to visualize the Ilizarov rods and the cervical spine (Fig. 5). The radiographs were used as a template to indicate the amount of distraction or compression required for each rod in order to obtain multiplanar correction of the neck. Over the ensuing 6 days, the anterior bars were distracted and the posterior bars compressed twice daily to achieve this correction (Figs. 6 and 7). During this period the patient was mobilized, and he could provide feedback as to his neurologic status and his satisfaction of the correction achieved. The chin-brow angle was corrected to 20° and the head tilt to 0°. Once satisfactory correction was obtained he was discharged home and followed at monthly intervals. The halo was removed at 3 months and he was maintained in a rigid 2-poster orthosis

FIG. 3. Case 2. Preoperative frontal (left) and side (right) views. The head tilts to the left side by 20° and horizontal gaze is made difficult by his rigid cervical kyphosis. The chin–brow angle measures 42°.

FIG. 4. Case 2. On magnetic resonance imaging a kyphosis can be seen at C5 with the anterior aspect of the cord touching the kyphotic segment. The laminae of C3 to C6 inclusively had been resected 6 years earlier at another hospital.

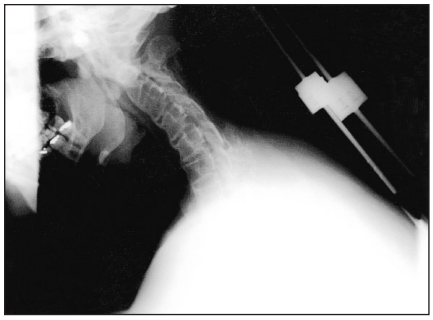
for an additional 3 months. At the last follow-up 18 months postoperatively the correction was maintained and function was improved (Fig. 8).

Comment

Both patients were very satisfied with the result of the surgery and denied having any neck pain. The only complication was transient C8 dysesthesias in Case 2 on day 4 of the gradual correction. Pre- and post-correction kyphotic angles could not be measured because the quality of the lateral radiographs was poor through the upper thoracic spine. Spot lateral tomograms were used to determine healing across the osteotomy site.

Discussion

In 1953, Mason and colleagues[4] described an osteotomy of T1 through a posterior approach with the patient in the decubitus position. The spinal cord was retracted on both sides to expose the body of T1 for the osteotomy. Correction was obtained gradually by skull tong traction. Five years later, Urist[1] recommended C7 as the preferred location for the osteotomy because of the relatively large vertebral canal, mobile cord and C8 nerve roots and the vertebral arteries entering the foramen transversarium at C6. The wide laminectomies at C6, C7 and T1 and the foraminotomies of C8 he reported are still utilized. In 1972, Simmons[2] emphasized the importance of performing cervical osteotomies in the sitting position under local anesthesia. He reported a series of 11 patients in which patient satisfaction was excellent



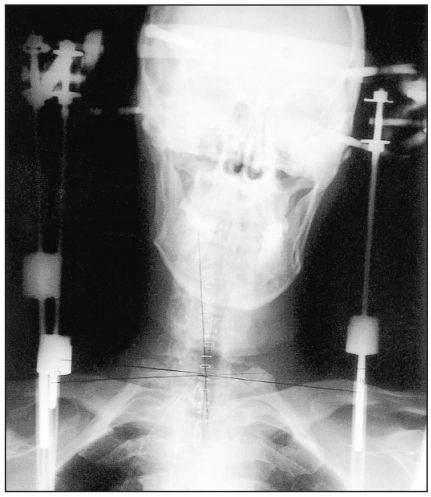


FIG. 5. Case 2. Left: a lateral radiograph obtained postoperatively to visualize the cervical spine and the Ilizarov clickers and to make a template of the amount of distraction and angle of correction. The amount of distraction in front and compression at the back is determined in millimetres. Right: an anteroposterior radiograph used to form a template for side-to-side distraction and compression for multiplanar correction.

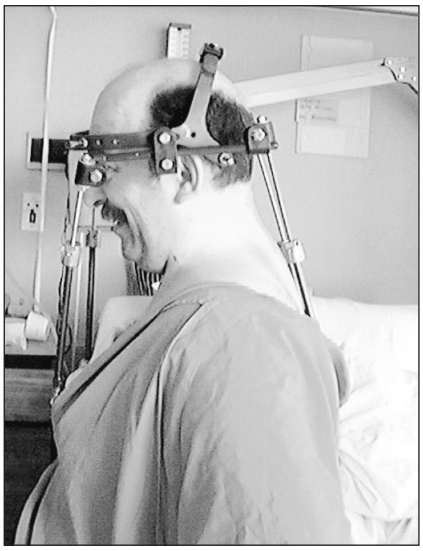


FIG. 6. Case 2. Two days postoperatively; on the second day of correction, the chin–brow angle is 20°.

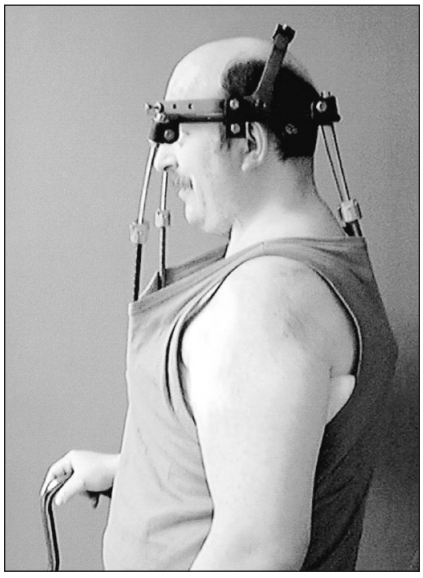


FIG. 7. Case 2. On the fifth day of correction, the chin–brow angle is 12°.

FIG. 8. Case 2. Frontal (left) and side (right) views 18 months postoperatively. Head tilt has been corrected from 20° to 0°and the chin–brow angle measures 20°. Forward vision is much improved.

and perioperative morbidity was low and subsequently reported on hundreds of patients who had safely undergone the procedure.

Several authors have described modifications of the these techniques in order to safely perform this procedure under general anesthesia. McMaster[5] published the results in 15 patients who were positioned supine and were monitored with somatosensory evoked potentials. Shimizu and colleagues[6] presented a patient in whom a prebent Hartshill rod was used for correction while the cord was monitored with somatosensory evoked potentials and a wake-up test. Mehdian and colleagues[7] employed a modular posterior cervical system to minimize the risk of intraoperative sagittal translation, and Duff and associates[8] described a severe midcervical kyphotic deformity that was corrected with a 2-level osteotomy done at C3–4 and C4–5.

The 2 patients described in this report could not be treated adequately by standard cervical osteotomies. The patient in case 1 had a failed conventional cervical osteotomy because of acute stretching of the vagus nerves. The patient in case 2 had anterior cord compression, previous multilevel laminectomies and a multiplanar deformity. The technique described essentially is the same as that proposed by Urist but with the correction performed gradually over several days with the patient alert and able to give accurate feedback on neurologic status and satisfaction with the correction. In fact, Urist[1] described the use of a turnbuckle cervical orthosis to optimize the spinal correction obtained intraoperatively. We also noted that during the 3-month postoperative period when the patient was in a halo cast, the Ilizarov clickers could be adjusted to account for changes in the position of the body cast and hence avoid loss of correction.

There is only 1 report in the literature of a halo-Ilizarov distraction cast used for correction of cervical deformity. It was reported by Graziano and associates.[9] The apparatus was used to manage 6 patients with complex cervical deformities, but only 1 patient suffered from ankylosing spondylitis. This patient differed from ours since his kyphosis was acute and had resulted from a fracture of C7 with angulation. The reduction was obtained using a halo-Ilizarov apparatus, and no surgery was performed.

Conclusions

The use of a halo-Ilizarov cast in conjunction with a low cervical osteotomy can provide accurate, safe correction of complex deformities of the cervical spine in patients with ankylosing spondylitis. Further clinical evaluation of this technique is in progress.

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