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Case Report

Preoperative management through modified halo-pelvic distraction assembly in a case of severe thoracic spine kyphosis

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ABSTRACT

Background: Halo-traction device has been seen with favorable outcome in managing the patients with severe kyphotic deformities preoperatively, however, associated complications are inevitable. Slight modifications can improve the outcome and clinical efficacy.

Case Description: A 14-year-old boy was presented with severe kyphotic deformity of 141° from T1 to T10 thoracic vertebrae with diffuse paraspinal calcification in thoracic spine and complete loss of power of both lower limbs. A modified halo-pelvic distraction device was applied before the definitive surgery. The device comprised halo and pelvic assembly, the halo ring was connected to the head with 06 pins, while pelvic assembly had Ilizarov half pins connected to the arches. The assembly construct had four threaded rods, two of them were placed anterolateral and the other two were posterolateral. Distraction at the rate of 3 mm/day was started from 1st postoperative day for 35 days. The neurology improved in both lower limbs and kyphotic angle reduced to 56° from 141°. Surgery at this stage was done and a standalone solid titanium cage was placed from T1 to T10 vertebral body after debridement. No peri- or post-operative complications were observed.

Conclusion: The application of halo-pelvic distraction before corrective surgeries can not only reduce the severity of the kyphotic deformity making the definitive surgery easy but neurology can also be improved. The high-risk complications associated with acute correction of deformities can be minimized using our modified halo-pelvic distraction device.

Keywords: Halo-pelvic distraction, Kyphosis, Spine

INTRODUCTION

The management of severe form of kyphosis is always a challenge for spine surgeons considering the associated risk of pulmonary complications, high potential for bleeding, and related neurological complications.[9] The single-stage correction surgery usually requires complex osteotomy, correction with strong forces using long segmental instrumentation and several hours of highly skilled surgery.[3] To reduce the risks and complications in these patients, it is advised that the severity of the curve should be decreased with traction using either halo-femoral, halo-pelvic, or halo-gravity traction before surgery.[7] The halo-traction was introduced in 1959 by

Perry and Nickel which later developed as halo-femoral traction, the device consisted of a "Halo" ring secured with four screws into the outer dipole of the skull with pins inserted into the lower femur.[8] The device did traction but was not practical and proved to be inefficient, as the femoral pins got infected very easily and the patients also had to remain in bed during the traction.[1]

Later on, the technique was improved and a pelvic ring was used that secured the two halves of the pelvis by two threaded pins traversing the whole length of the pelvis. The extension bars fitted to the halo and pelvic rings were gradually elongated to provide fixation and distraction. The powerful corrective forces could be applied through this technique while the patient remained mobile during treatment.[3] The apparatus further improved with time and was extensively used in the 1970s and 80s. However, the associated limitations such as long duration of hospitalization, a multistage process, pain, discomfort, infection, unflattering appearance, and various neurological complications diminished its practice.[11]

Recently, a few studies have published the outcome of self-designed halo-pelvic ring on patients with severe kyphotic deformities and showed satisfactory results, but few complications still persist.[6,9,11] Keeping in mind, the halo-pelvic distraction an effective and affordable means of treatment which can reduce the kyphotic deformity of the spine to an extent that can be easily managed with surgical intervention, we designed a halo-pelvic apparatus in our center for patients with severe kyphotic deformity. We present the case of a patient who was managed with this modified apparatus before surgery and satisfactory outcome was achieved with no complications.

CASE PRESENTATION

A 14-year-old boy was presented in outpatient department with severe kyphotic deformity of the thoracic spine and complete loss of power of both lower limbs. The patient had a history of a progressively increasing kyphotic deformity since the age of 4 years, almost 4–5 months back, he started developing weakness of both legs.

On physical examination, bossing of the thoracic cage was observed with short abdomen and both iliac crest almost touching the ribs [Figure 1a]. There was a prominent kyphotic hump at the thoracic level, the lower extremities had 0/5 power bilaterally along with spasticity. Reflexes of knees and ankles were exaggerated and Babinski sign was positive. Flexion contracture of 40° was observed in both knees.

Radiographic picture of spine showed severe kyphosis of 141° from T1 to T10 thoracic vertebrae on lateral view with diffuse paraspinal calcifications, most likely representing a granulomatous lesion [Figure1b]. MRI revealed acute angle kyphotic deformity appreciated at the upper-mid dorsal spine due to multiple deshaped dorsal vertebrae (starting from T1 down till T10), resulting in significant canal narrowing posteriorly with cord compression and compressive myelopathic changes. Abnormal marrow signals were appreciated in vertebrae with pathological reduction in their heights, with indistinct/eroded adjacent end plates and involved intervening discs, suggesting squeal of chronic disco vertebral osteomyelitis (caries spine).

Pathological necrotic tissue was also appreciated in pre- and para-vertebral spaces at the affected levels. Similarly, variable sized paraspinal collections were identified with areas of low-intensity signals/signal void suggested chronic calcified component [Figure 2]. Blood work-up was within normal limits.

Distraction using a modified halo-pelvic distraction assembly was planned to stretch out the soft tissues aiming to decrease the severity of the deformity and compression on the spinal cord and to improve the neurology.

Modified halo-pelvic distraction assembly and its application

An assembly was prepared with the following modifications:

1. Pelvic ring was substituted with two lateral arches which allowed the patient to lie supine in bed.
2. Supra-acetabular region was chosen for half pin placement which provided a sturdy anchorage and gave a strong construct.
3. Muscles were not pierced for the placement of wires or pins that minimized the risk of infection and pain.
4. The assembly construct had four rods, two of them were placed anterolateral and the other two were posterolateral. The aim was to provide balanced distraction forces so that the sagittal or coronal balance should not be affected.

Halo assembly

A halo ring according to the head size was chosen and connected to the head with 06 threaded pins.

Pelvic assembly

A total of four Ilizarov half pins were used in the pelvic assembly. Two Ilizarov half pins of 6 mm each were passed in the supra acetabular area one on both sides. Anterior inferior iliac spine was approached through blunt dissection after giving a 2 cm incision, almost 2 cm below and medial to the anterior superior iliac spine (ASIS) on both sides. The outer cortex at anterior inferior iliac spine was drilled with a 4 mm drill bit and a 6 mm half pin was passed using a T handle.

The 2nd site for half pin placement was about 10 cm posterior to the ASIS. After making a small incision, the outer cortex was drilled and a 6 mm half pin was passed in between the

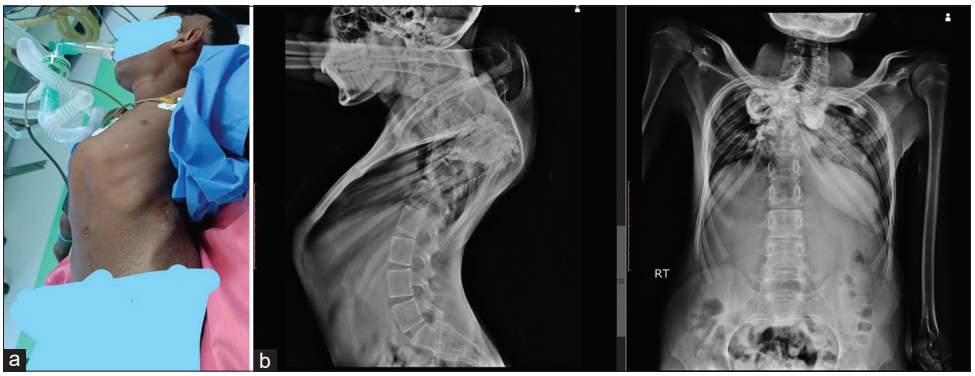

Figure 1: (a) Clinical picture of the patient showing prominent thoracic hump. (b) Lateral and AP view of spine radiograph showing severe thoracic kyphosis.

inner and outer tables of the iliac bone on both sides using a T handle. Both half pins on either side were connected to an Ilizarov arch using male posts and rancho cubes. Both arches were connected with each other through two threaded rods to strengthen the construct [Figure 3].

Distraction device consisted of four threaded rods, two anterolateral and two posterolateral connecting pelvic assembly to the halo assembly.

Postdistraction outcome

Distraction was started on the 1st postoperative day at the rate of 3 mm per day divided in three intervals of 1 mm each. On the 5th postoperative day, the patient started to move his right foot and started to feel touch sensations in his right leg. Distraction was continued at this constant pace of 3 mm per day for 35 days. The patient was closely monitored for his progress by getting weekly X-rays of the spine and measuring the trunk height and kyphotic angle.

After 35 days of distraction, rib hump and thoracic knuckle markedly improved and Cobb angle reduced from 141° to 56° [Figure 4] and the patient height increased up to 8 cm. Power of the legs improved to 2/5 bilaterally.

At this time, resection of vertebral bodies, thorough debridement and stabilization using a vertebral standalone cage through anterior approach, was planned and surgery was performed by the senior author (AA). A cage was placed from T1 to T10 vertebral body after debridement [Figure 5]. After the definitive surgery, kyphotic angle was reduced to 46°.

GeneXpert analysis of the tissue revealed multidrug-resistant tuberculosis. Postoperatively, the patient is doing well and put on 2nd line antituberculous therapy.

DISCUSSION

The standard surgical technique for severe kyphotic deformity is associated with serious complications. Preoperative

Figure 2: Sagittal MRI showing collapsed dorsal spine with gibbous formation.

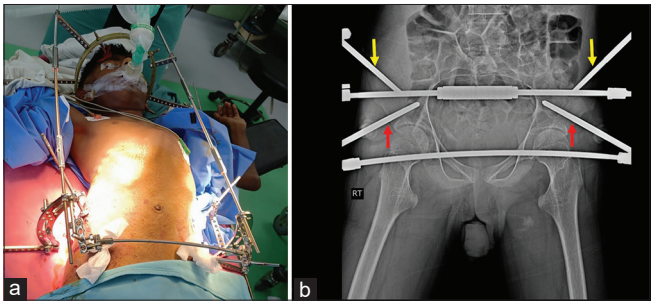

Figure 3: (a) Image of the patient just after the placement of halo-pelvic assembly. (b) Radiograph showing exact position of half pins in pelvic assembly; supra-acetabular half pins (red arrows) half pins in ilium (yellow arrows).

correction through halo-pelvic distraction can reduce the risk of perioperative and postoperative complications and can significantly reduce the kyphotic deformity.[4] The reduction in kyphotic angle is important as Cobb angle between 40° and 70° is associated with high correction

rates and successful outcomes.[2] In the current case, the management of the patient through halo-pelvic distraction not only reduced the severity of the Cobb angle which made the second-stage correction surgery easy and eventless but neurology also improved beforehand. The gradual correction and closed monitoring adopted in this technique can help the surgeons to attain the desired correction before the surgery.[9] Our modified pelvic frame consists of two lateral arches that were purposely designed to increase the comfort level of patients, allowing them to sleep in supine position, do their routine tasks and remain ambulatory.

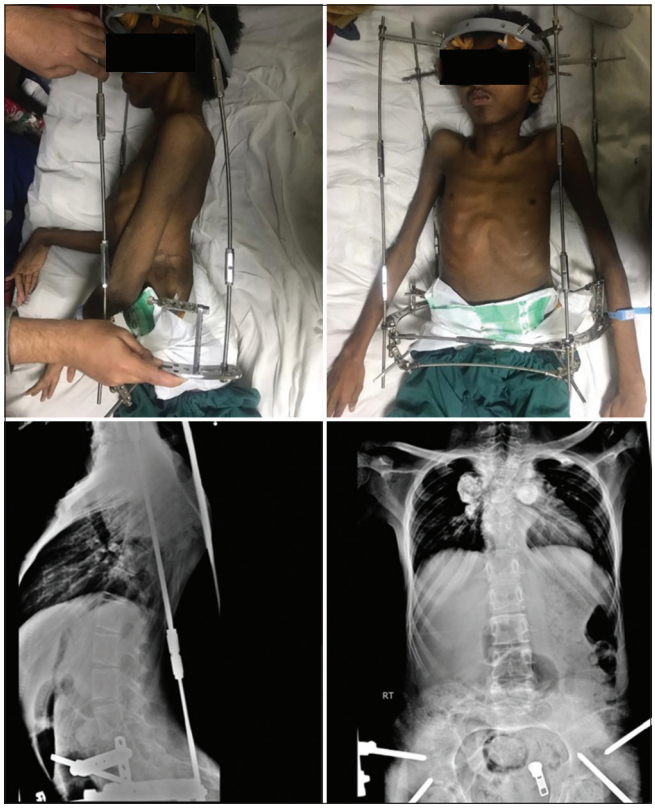

Figure 4: Both clinical and radiographic images of the patient after a month of distraction. Note the substantial reduction of the kyphosis.

Two out of four Ilizarov half pins were placed in the supra-acetabular area instead of only placing them in ilium or iliac crest[6,10] which proved to be a strong anchorage area and provided sturdy support. Pin site infection risk was minimized by avoiding piercing of any muscles.

To the best of our knowledge, this is the 1st time modified halo-pelvic distraction device has used the antero- and postero-lateral rods for the provision of balanced distraction force and for maintaining sagittal and coronal balance. A recently published report on modified halo-pelvic assembly reported cervical discomfort and negative sagittal balance in patients managed with their modified assembly. Their distraction assembly used only anterolateral rods which might have hyperextended the cervical region and caused these symptoms,[9] this limitation was addressed in the current case by introducing the second set of rods on the posterolateral side and keeping the distraction force balanced.

Most neurologic complications, such as cranial nerve injuries and paraplegia, are known to occur as a result of high distraction forces,[9] therefore, careful selection of distraction force (at the rate of 3 mm/day) and duration was done in the current case to gain effective outcome and to avoid the above mentioned complications. Reduction in angle is believed to be associated with better respiratory function and decrease in associated complications.[5] Since there is no consensus on the optimal duration for halo-pelvic distraction,[12] we observed in the current case that the desired correction could be achieved in 4–5 weeks of distraction with nominal chance of related complications.

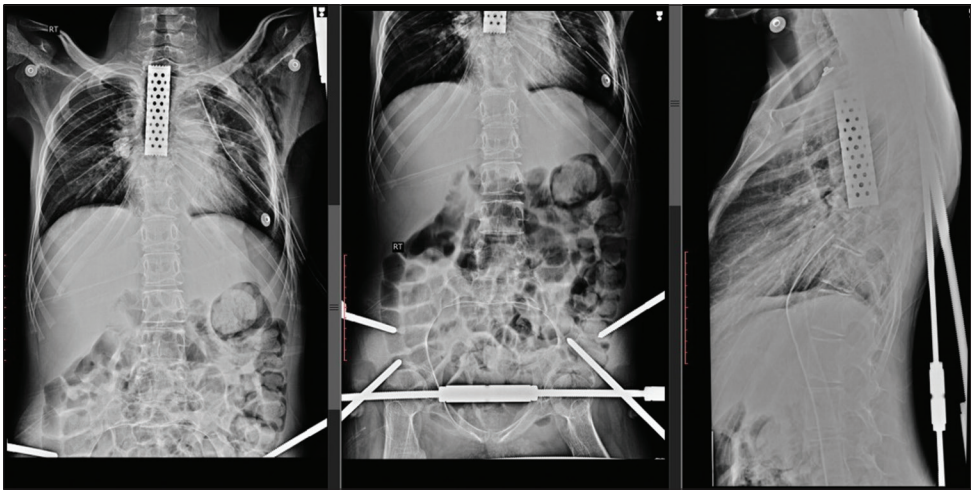

Figure 5: Radiographic images taken just after corrective surgery showing placement of thoracic cage from T1 to T10.

The halo-pelvic distraction can make intraoperative instrumentation easy for surgeons, during correction surgery, due to adjusted paraspinal musculature and lengthened spinal canal hence reducing surgery time.[4,6]

Considering the excellent outcome in the current case, it is hoped that this modified assembly may help surgeons who are involved in the treatment of rigid scoliosis.

CONCLUSION

The preoperative management of severe kyphotic deformity through our modified halo-pelvic distraction device can significantly decrease the perioperative and postoperative complications associated with corrective surgeries. The application of halo-pelvic distraction before corrective surgeries can not only reduce the severity of the kyphotic deformity making the definitive surgery easy but also improve the patient's subsequent neurological examination. The high-risk complications associated with acute correction of deformities can be minimized using our modified halo-pelvic distraction device.

Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent.

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Nil.

Conflicts of interest

There are no conflicts of interest.

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