Review article: Surgical approaches for correction of post-tubercular kyphosis

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ABSTRACT

This study reviewed the literature regarding the pros and cons of various surgical approaches (anterior, anterolateral, combined, and posterior) for correction of post-tubercular kyphosis. The anterior and anterolateral approaches are effective in improving neurological deficit but not in correcting kyphosis. The combined anterior and posterior approach and the posterior approach combined with 3-column osteotomy achieve good neurological improvement and kyphosis correction. The latter is superior when expertise and facilities are available.

Key words: kyphosis; tuberculosis, spinal

INTRODUCTION

It is estimated that 30 million people have active tuberculosis, and 2 million of these have spinal tuberculosis.1 Spinal tuberculosis usually manifests as a paradiscal infection. Surgery is indicated in patients with progressive neurological deficit, progressive spinal deformity, failed conservative treatment, pain caused by abscess or instability, and uncertain diagnosis.2 Sequelae of spinal tuberculosis (such as kyphotic deformity) may present many years after eradication of tuberculosis. The initial paradiscal inflammation causes weakening of the vertebral endplates and results in a loss of anterior vertebral column height and eventually kyphotic deformity. Adult patients with acute spinal tuberculosis treated conservatively on average have a 15º increase in kyphosis, and 5% of them eventually have a >60º deformity.3,4 In children the risk of developing kyphosis is even higher. The cartilaginous vertebral body is more prone to destruction by tuberculosis, together with continued growth in the unaffected posterior column, can result in severe deformity of >90º in 10% of patients.5 Neurological sequelae of kyphosis include paraplegia or quadriplegia secondary to cord compression, whereas physiological and anatomic sequelae include cardiorespiratory...
compromise and impingement of the costal margins over the iliac crest, respectively. Surgery can relieve cord compression and correct the spinal deformity, but the optimal approach remains controversial. This study reviewed the literature regarding the pros and cons of various surgical approaches (anterior, anterolateral, combined, and posterior) for correction of post-tubercular kyphosis.

REVIEW

The PubMed/MEDLINE database was searched using terms ‘spinal tuberculosis’, ‘post-tubercular kyphosis’, ‘tuberculosis kyphosis’, and ‘Pott’s paraplegia’. 11 retrospective observational studies that focused on surgical approaches were reviewed: 2 for anterior, one for anterolateral, 2 for combined anterior and posterior, and 6 for posterior.

Anterior approach

The anterior approach enables excision of the kyphus, visualisation of the dura mater, cranial and caudal debridement of diseased tissue until healthy bleeding cancellous bone is seen, and insertion of a strut graft, either rib or tricortical iliac crest into the space.

In a study in 1988, 22 patients with late-onset paraplegia and a mean kyphosis of 121º underwent anterior decompression followed by anterior fusion (n=9) or staged posterior fusion (n=13).6 The second-stage posterior fusion did not appear to improve outcome. 14 patients were found to have active tuberculosis intra-operatively, and 8 patients had healed tuberculosis and hard bony kyphus, which was more technically difficult to remove. 16 of 22 patients had neurological improvement; 12 of these had full recovery. The remaining 6 patients had unchanged or deteriorated neurological status. In the 8 patients with healed tuberculosis and hard bony kyphus, 4 had mild improvement only, and one with moderate neurological deficit had complete paralysis following surgery. Eight of 22 patients had complications of cerebrospinal fluid fistulae (n=2), neurological deterioration (n=2), and neurapraxia of the cord (n=4).

In a series of 8 patients who underwent anterior decompression and grafting for neurological deficit and a mean kyphosis of 105.6º, no correction of the kyphosis was made owing to the risks of neurological compromise. One patient had neurological deterioration secondary to worsening kyphosis and required further surgery.

Anterolateral approach

The anterolateral approach is used because the anterior approach has difficulty accessing the apex of a severe angular kyphosis. The kyphus is typically very deep and the large vessels can be encased within its core. A 6–8 cm curved longitudinal incision is made lateral to the midline centred over the kyphus to expose and excise up to 3 transverse processes and ribs and their articulating costotransverse joints. This approach is used to expose and excise the kyphus and visualise the spinal cord anterolaterally. It is less hazardous than the direct anterior approach. A cortical strut graft is used to support and facilitate bony union. In a series of 5 patients, 2 had neurological improvement from Frankel grade C to grade E and D, and all had spinal fusion, exception for one that died from respiratory tract infection. Kyphosis correction was negligible (from 113.6º to 113.2º).

Combined anterior and posterior approach

The combined anterior and posterior approach enables access to all 3 spinal columns. In a study of 30 patients (18 with healed tuberculosis and 12 with active tuberculosis) with a mean kyphosis of 115.5º who underwent halo-pelvic distraction and anterior decompression and further distraction for weeks, followed by posterior osteotomy with or without spinal fusion and further distraction for weeks, the mean kyphosis improved from 115.5º to 83.1º, and all 20 patients with neurological deficit had improvement. However, repeated surgeries resulted in 13 peri-operative complications; 3 patients died from ileus, cardiac arrest, or tracheostomy-related complication, and 6 patients had various respiratory-associated complications.

In a series of 35 patients who underwent a multi-stage procedure comprising anterior and posterior surgery, the mean kyphosis improved from 87º to 27º, and 15 patients developed complications including neurological complications (n=5), thrombophlebitis, bed sores, superficial wound infection, and halo pin tract infection.

Posterior approach

The posterior approach is combined with 3-column osteotomy and posterior instrumentation. There are 3 types of 3-column osteotomy: pedicle subtraction osteotomy, vertebral column resection, and vertebral column decancellation. Pedicle subtraction osteotomy enables kyphosis correction of 30º to 40º per level.
It is a V-shaped osteotomy with adequate resection of the posterior elements, pedicles, and much of the vertebral body at each level, but the anterior cortex of the vertebral body is left intact. This anterior cortex acts as the fulcrum of the osteotomy, as the posterior elements of the vertebra above and below are opposed in a controlled manner. For vertebral column resection, the entire vertebral body including the anterior cortex and the disc above and below is removed, and a cage is then inserted to restore the anterior column height. Vertebral column resection enables ≥40° of kyphosis correction per level.

In a series of 36 patients (mean age, 34.2 years) who underwent vertebral column resection and pedicle subtraction osteotomy for post-tubercular kyphosis, the outcomes of the 2 groups were comparable after a minimum follow-up of 2 years. The mean kyphosis improved from 89.3° to 29.3°; the mean visual analogue score for back pain improved from 2.0 to 0.7; 13 of the patients had neurological improvement; 6 patients had complications including cerebrospinal fluid leaks (n=2), nerve injuries (n=2), transient paralysis (n=1), and pseudarthrosis (n=1).

In a cohort of 15 patients (mean age, 27 years) with no neurological deficit who underwent pedicle subtraction osteotomy (for 11 patients with a deformity of <80°) or vertebral column resection (for 4 patients with a deformity of >80°), the mean kyphosis improved from 97.2° to 17.2°, and 3 patients had superficial or deep infection.

In a series of 9 patients who underwent modified vertebral column resection, the mean kyphosis improved from 100.3° to 15.9°, and only one complication occurred. In a series of 12 children (mean age, 9.4 years) who underwent closing-opening wedge osteotomy, the mean kyphosis improved from 83.3° to 27.6°; all patients had neurological improvement; one superficial wound infection occurred.

Vertebral column decancellation involves decancellation of multiple vertebrae and removal of residual discs. The deformity is reduced by opening the concave anterior cortex and closing the posterior convex cortex. In a series of 45 patients who underwent vertebral column decancellation, the mean kyphosis improved from 98.6° to 16.4° in the 16 patients with post-tubercular kyphosis; 8 of 45 patients had complications including permanent neurological deficit.

In a series of 17 patients who underwent transpedicular decancellation osteotomy, the mean kyphosis improved from 69.3° to 30.1°; all patients had neurological improvement, except for one who had an ASIA grade A deficit.

**DISCUSSION**

Tuberculosis can affect the spine in the acute and late settings. Early onset paraplegia is usually caused by active tuberculosis within 2 years, and late onset paraplegia is usually caused by healed tuberculosis after 2 years. In the acute setting, spinal surgery is effective in preventing kyphosis and improving neurological deficits, for example the anterior approach for kyphosis of the thoracolumbar spine. In the late setting, spinal surgery is less effective, because patients tend to be older and compromised neurologically and physiologically, and all 3 (anterior, middle, and posterior) columns tend to be affected. Ankylosis of the 3 columns can cause spinal deformity, whereas neurological deficit may be due to an anterior bony spur or fibrous mass transecting the spinal cord.

The anterior and anterolateral approaches are effective in resolving neurological deficits, but not in correcting kyphosis. 40% to 100% of patients have neurological improvement, with complication rates ranging from 12.5% to 36%. The combined anterior and posterior approach enables correction of both neurological deficit and kyphosis. 100% of patients have neurological improvement, and correction of kyphosis was 32.4° to 60°, but the complication rate was 43%. With improved intra-operative neuromonitoring and imaging and spinal instrumentation, the posterior approach with 3-column osteotomy achieves anterior decompression and correction of kyphosis of 39.2° to 84.4°. 33% to 100% of patients have neurological improvement, with a complication rate of 8% to 20%. Nonetheless, patients with the posterior approach combined with 3-column osteotomy were younger (mean age range, 9.83–34 years) than those with other approaches (mean age range, 16.3–45.4 years). In addition, the posterior approach is technically challenging and requires intra-operative neuromonitoring and spinal instrumentation including pedicle screws. In regions where tuberculosis is most prevalent, the posterior approach may be prohibitively expensive. The risk of neurological complications after the posterior approach is higher in older patients, particularly in those with a severe deformity, a vascularly compromised atrophic cord, and longstanding cord compression. The prognosis of post-tubercular kyphosis is poor. The combined anterior and posterior approach and the posterior approach with 3-column osteotomy achieve good neurological improvement and kyphosis correction. The latter is superior when expertise and facilities are available.
REFERENCES