A long-term follow-up study of anterior tibial allografting and instrumentation in the management of thoracolumbar tuberculous spondylitis

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Object. The purpose of this study was to determine the efficacy of anterior instrumentation following radical debridement and tibial allografting and its long-term progression in patients with multilevel spinal tuberculosis.

Methods. This prospective observational study was undertaken to analyze 22 patients with multilevel spinal tuberculosis (Pott disease) who underwent anterior radical debridement, decompression, and fusion using anterior spinal instrumentation and tibial allograft replacement between 1999 and 2001. Clinical outcomes were assessed using the American Spinal Injury Association (ASIA) Impairment Scale and a visual analog scale (VAS). Preoperative and postoperative plain radiographs were obtained, and the focal kyphotic angle of the surgically treated spinal segments and the overall sagittal and coronal contours of the thoracic and lumbar spine were evaluated in all patients.

Results. The mean follow-up time was 84 months (range 36–96 months). All patients demonstrated clinical healing of the tuberculosis infection. All patients showed evidence of successful bone fusion. The mean late postoperative kyphosis correction was 74% (range 63–91%). On average, 2° (range 0–5°) of loss of correction was noted in the local kyphotic angle postoperatively in late follow-up findings. Evaluation of the surgical effect on sagittal global contours showed a significant correction rate in thoracic, thoracolumbar, and lumbar regions. The mean late postoperative coronal plane alignment correction was 99%. The ASIA Impairment Scale scores demonstrated significant improvement in late follow-up results in our series. Surgical decompression also resulted in a dramatic reduction of overall pain in all patients (late postoperative VAS score 1.61 ± 0.81).

Conclusions. Anterior tibial allografting and instrumentation provide correction of the curvature, prevention of further deformation, improvement of sagittal and coronal balance, and restoration of neurological function in patients with spinal tuberculosis. (DOI: 10.3171/SPI-08/01/030)

KEY WORDS • anterior instrumentation • kyphosis • neurological recovery • Pott disease • tibial allograft • tuberculous spondylitis

S PINAL tuberculosis is the most dangerous form of skeletal tuberculosis because of its capacity to cause bone destruction, deformity, and paraplegia. Surgery is advocated in the presence of spinal deformity, significant neurological dysfunction at presentation, failure of nonoperative management for 6–8 weeks, persistent severe pain, and neurological dysfunction that does not resolve or that develops while patients with tuberculous spondylitis are undergoing medical treatment. The exposure of anteriorly placed lesions is accomplished by several approaches, including the transthoracic or retroperitoneal approach, the LECA, costotransversectomy and curettage of the vertebral body, and transpedicular drainage. Restoration of spinal stability and preservation of spinal alignment are prerequisites for healing and thus indispensable for regaining function in tuberculous spondylodiscitis. An unrestricted restoration of biomechanical function should be achieved.

In this study, the clinical and radiographic results of 22 patients with active multisegmental tuberculosis spondylitis who were treated with anterior spinal instrumentation and tibial allografts and followed up for 84 months were evaluated.
Anterior approach to thoracolumbar tuberculous spondylitis

Clinical Material and Methods

Patient Population

Between 1999 and 2001, 76 patients with tuberculous spondylitis were treated at our institution, and 22 were included in the present study. This prospective observational study was undertaken to analyze patients with thoracic, thoracolumbar, or lumbar tuberculous spondylitis who underwent anterior debridement, decompression, tibial allografting, and instrumentation placement. Fifty-four patients with tuberculous spondylitis were excluded from the study because they were treated conservatively, with only monosegmental anterior fusion or with multisegmental anterior and additional posterior fusion. In patients without vertebral instability and deformity, we preferred conservative management, and in those who had abscess formation in addition, we used drainage and chemotherapy. In patients with additional involvement of posterior column and/or cervicothoracic and lumbosacral junction lesions, we preferred posterior instrumentation after anterior debridement and anterior strut grafting at the same or a subsequent session.

Indications for surgery were radiological demonstration of a thoracic, thoracolumbar, or lumbar vertebral lesion; presence of acid-fast bacilli detected on direct examination, culture, or percutaneous or open biopsy examination; characteristic histological features with or without bacilli; multilevel involvement; major neurological deficits with associated bone destruction; sequestered bone and disc; cold abscess; poor response to medical treatment; deterioration in neurological status during medical treatment; mechanical instability (defined as sagittal-plane translation of 5 mm or more documented on flexion/extension radiography); and progressive deformity (loss of vertebral height more than 50% [it has been reported that more than 30° of kyphosis or more than a 30% loss in vertebral height have a significant potential to increase coronal and sagittal plane deformities]).

The assessment of the neurological status of patients was performed using a physical examination, and classification of spinal cord function was made using the ASIA Impairment Scale. Pain relief without use of an analgesic was incurred later. Ethambutol and pyrazinamide were discontinued after the initial 3 months of therapy. Infectious disease specialists regularly supervised this treatment.

Surgical Procedures

All patients underwent operations after the induction of general anesthesia using endotracheal intubation. Patients were placed in the right lateral decubitus position on a radiolucent table. An intrapleural approach was used for the thoracic and thoracolumbar region, and a retroperitoneal approach via a flank incision was used for the lumbar vertebrae. A corpectomy and disectomy were performed, and an abscess was evacuated if present. All necrotic and devitalized tissues were removed as much as possible until normal bleeding bone was reached. The spinal cord was then decompressed anteriorly. Before the bone graft was wedged into the defect, a Caspar distractor was usually used to correct the kyphotic deformity. Correction of deformities and graft position were confirmed with additional anteroposterior and lateral fluoroscopic images. Tibial allograft and autogenous rib were used in all patients. The tibial allograft was used for osteoconductive and structural support, whereas the rib was used for osteoinductivity. The average length of the tibia used was 6.9 cm (range 6.5–9 cm). Rib autografts were placed around the tibial allograft. Anterior instrumentation was performed following radical debridement, decompression, and tibial allograft placement in all patients. The instrumentation at the levels just above and below the fused segments was performed using an anterior Kaneda device. The instrument positions were confirmed using additional anteroposterior fluoroscopic images.

Postoperative Care

In addition to the antituberculous chemotherapy, intravenous antibiotic drugs were administered to all patients after surgery for 5–7 days until the patient was discharged from our clinic. Patients were allowed to turn in bed on the first postoperative day and to sit on the second postoperative day, and active rehabilitation was begun immediately for the patients who had neurological deficits. All patients were treated for 12 weeks in an external light brace.

Follow-Up Examinations

Postoperative routine lateral and anteroposterior radiographs and CT scans were acquired in all patients before discharge to evaluate the adequacy of the decompression and placement of the graft and instrumentation.

All patients were followed up regularly at intervals of 1, 3, 6, and 12 months, and annually thereafter. Routine radiological investigations at these time intervals were obtained, including anteroposterior, neutral, and flexion/extension lateral radiographs; white and red blood cell counts, the ESR, and liver function values were also monitored. The features of these investigations were studied to determine the fusion status, development or progression of deformity after surgery, and instrumentation failure noted on imaging data.

The initial and follow-up radiographs were obtained while the patient was in a standing position. The radiographic parameters that were evaluated included the treated segments and the overall curvature of the thoracic and lumbar spine.
On lateral radiographs, 2 lines were drawn—one through the superior surface of the first noncollapsed vertebra cephalad to the lesion and another line through the inferior surface of the first noncollapsed vertebra caudal to the lesion. Perpendicular lines were then drawn from these lines, and the angle was measured at their intersection. On anteroposterior radiographs, scoliosis angles were also measured.

On lateral radiographs, sagittal contours between the T-2 and T-12 and the L-1 and L-5 vertebrae were measured using the Cobb method. The angles were measured manually in the preoperative and early postoperative periods as well as serially at 3-month intervals for 12 months, and annually thereafter. A single radiologist, blinded to the results of surgery, reviewed all pre- and postoperative radiological studies and measurements. Measurements were rounded to the nearest whole number. Normal thoracic physiological kyphosis and physiological lumbar lordotic angles were accepted as 30–50° and 40–60°, respectively. Kyphotic angles were given positive values whereas lordotic angles were given negative values.

The radiological and clinical evidence of successful fusion was defined as the presence of bone bridges between the grafts and the vertebrae, the absence of abnormal motion and instrumentation failure, and pain relief.

**Statistical Analysis**

Statistical calculations were performed using the Graph Pad Prisma program for Windows (version 3, GraphPad Software). In addition to standard descriptive statistical calculations (means and standard deviations), one-way analysis of variance was used in the comparison of groups, the post hoc Newman–Keuls multiple comparison test was utilized in the comparison of subgroups, the unpaired t-test was used to compare 2 treatment values, and the chi-square test was performed during the evaluation of qualitative data. Statistical significance was established at a probability value of < 0.05.

**Results**

The average follow-up duration at the time of this submission was 84 months (range 36–96 months). One patient (Case 7) died of myocardial infarction 36 months after the procedure. The mean follow-up duration recorded for the other patients was 86.5 months (range 67–96 months). It was possible for all patients in this series to be followed up closely because of the way the Turkish social security system operates, so no patient was lost to follow-up. Table 1 provides a summary of the patient data.

No patient died of postoperative complications. There were no intraoperative complications. Postoperatively, 2 patients suffered superficial wound infections that were treated successfully using antibiotic therapy.

The average ESR was 88 mm/hour (range 56–134 mm/hour) on admission. In all patients, the ESR decreased gradually after surgery and returned completely to a normal level (< 20 mm/hour) between 4 and 7 months after surgery. The results of other laboratory tests were completely normal 3 months after surgery.

All patients demonstrated no apparent pseudarthrosis or implant failures at the last follow-up visit. Furthermore, all patients demonstrated clinical healing of the tuberculosis.

<table>
<thead>
<tr>
<th>Case No.</th>
<th>Age (yrs)</th>
<th>Sex</th>
<th>Segments</th>
<th>Duration of Disease (mos)</th>
<th>ASIA Grade</th>
<th>Intraoperative Kyphosis (°)</th>
<th>Scoliosis (°)</th>
<th>Sagittal Contours (°)</th>
<th>FU (mos)</th>
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* Kyphotic angles are presented as positive values whereas lordotic angles are presented as negative values. Abbreviation: FU = follow-up.
† The patient in this case died from myocardial infarction at 36 months.
Anterior approach to thoracolumbar tuberculous spondylitis

infection. No recurrences, reactivation, or draining sinuses were encountered. No graft fracture, resorption, or sliding was observed. The flexion/extension radiographic examination was performed in all patients at the last follow-up visit. No abnormal motion at the instrumented segments was seen.

All patients showed evidence of successful bone fusion. The average time until fusion was achieved was 7.5 months (range 6–9 months). Follow-up CT and MR examinations were performed in 3 patients because it was difficult to assess bone healing using plain radiographs alone. Mild displacement of 1 screw was found in 2 cases, but it did not cause a change in coronal and sagittal plane alignment, and no evidence of nonunion or persistent infection was identified.

The mean preoperative focal kyphotic angle was 19° (range 0–38°). The mean early postoperative kyphotic angle was 3° (range –3 to 10°). The mean late (at the last follow-up visit) postoperative kyphotic angle was 5° (range 0–12°). The mean late postoperative kyphosis correction was 74% (range 63–91%). A significant difference was found between the preoperative and early postoperative degrees of kyphosis (p < 0.001). On average, 2° (range 0–5°) of loss of correction was noted in the local kyphotic angle postoperatively in late follow-up findings. Most loss of correction occurs in the early postoperative period between 6 and 9 months. In our patients, kyphosis did not progress after 13 months.

In patients with thoracic tuberculous spondylitis, the overall mean preoperative thoracic curvature angle was 52° (range 49–54°). The mean early postoperative thoracic curvature angle was 39.1° (range 37–40°). The mean late postoperative thoracic curvature angle was 39.4° (range 38–41°). Evaluation of the effect on sagittal global contours showed a significant correction rate in the thoracic region (p < 0.05). There was no significant change between early and late postoperative overall thoracic curvature angles (p = 0.77).

In patients with thoracolumbar tuberculous spondylitis, the overall mean preoperative thoracic curvature angle was 23° (range 20–28°). The mean early postoperative thoracic curvature angle was 39.8° (range 38–42°). The mean late postoperative thoracic curvature angle was 39.4° (range 37–42°). Evaluation of the effect on sagittal global contours showed a significant correction rate in the thoracic region (p < 0.05). There was no significant change between early and late postoperative overall thoracic curvature angles (p = 0.91).

In patients with lumbar tuberculous spondylitis, the overall mean preoperative lumbar curvature angle was 32° (range 27–39°). The mean early postoperative lumbar curvature angle was 47.3° (range 44–51°). The mean late postoperative lumbar curvature angle was 47° (range 42–51°). Evaluation of the effect on sagittal global contours showed a significant correction rate in the lumbar region (p < 0.05). There was no significant change between early and late overall postoperative lumbar curvature angles (p = 0.83).

The mean preoperative scoliotic angle was 9° (range 3–14°). The mean late postoperative scoliosis correction rate was 99% (p < 0.001). In only 1 patient, 14° of scoliosis was corrected to 2° and persisted.

Neurological deficits were much improved at the final follow-up examination as defined by the scoring system of the ASIA Improvement Scale. No patients were made worse because of surgery. The average duration of neurological recovery was 5 months (range 3–9 months). Details of the preoperative and late postoperative neurological status are given in Table 2.

Surgical decompression resulted in a dramatic reduction of overall pain in all patients. The VAS scores decreased significantly in both early and late follow-up evaluations (p < 0.001, Newman–Keuls multiple comparisons test), from a mean preoperative score of 7.92 ± 1.04 to 2.14 ± 0.79 at 3 months, and to 1.61 ± 0.81 at 36–96 months.

**Illustrative Case**

This 57-year-old woman (Case 12) was admitted to our clinic because of deteriorating neurological function that developed during antituberculous therapy. This patient presented with Grade C impairment according to the ASIA Impairment Scale. Radiological studies showed destruction of the T-7 and T-8 vertebral bodies with anterior epidural and bilateral paraspinal abscesses (Figs. 1 and 2). The focal kyphotic and scoliotic deformities were 26° and 12°, respectively, at the start of treatment. She was treated with single-stage anterior radical debridement, decompression, tibial allografting, and instrumentation. Her back pain improved immediately after surgery and resolved gradually in 2 months. At the time of follow-up after 7 months, this patient’s neurological impairment was Grade E. The early postoperative focal kyphosis correction was satisfactory, and 5° of correction loss was identified at the final follow-up examination; however, there was no significant change between early and late overall postoperative thoracic curvature angles. Preoperative scoliotic deformity was completely corrected postoperatively, and loss of correction was not identified at the final follow-up examination. There was imaging evidence of a solid bone fusion (Figs. 3 and 4).

**Discussion**

Patients with Pott disease with mild neurological involvement can be treated with medical therapy alone with excellent results. Although chemotherapy is the standard treatment in the management of tuberculosis spondylitis, surgical procedures still play an important role. No drugs used in the management of tuberculosis can solve the problems arising from bone destruction, such as preexisting

| TABLE 2 | Summary of pre- and postoperative neurological impairment and improvement in 22 patients |
|-------------------|------------------|-----------------|-----------------|-----------------|-----------------|-----------------|
| Preoperative ASIA Grades | Postoperative ASIA Grades |
| A | B | C | D | E | % |
| A | 0 | 0 | 0 | 45.4 | 54.6 | 100 |
and/or residual deformity, paraplegia, and pulmonary insufficiency due to spinal deformity.

The surgical technique of choice for spinal tuberculosis has been an object of continuous discussion throughout the history of spinal surgery. Anterior thoracic spine lesions may be resected either via a transthoracic thoracotomy or a retropleural route. Both methods allow direct visualization of the anterior thoracic spine for optimum lesion resection and for the placement of anterior grafts and instrumentation. Lesions may also be reached via posterolateral and posterior approaches. These approaches allow anterior decompression and strut graft placement through a posterior incision, which is a procedure familiar to all spine surgeons. Because the anteriorly located lesion is not directly visualized, it may be difficult at times to achieve total lesion resection. Anterior instrumentation may not be placed using these approaches, except possibly using the LECA; therefore, posterior instrumentation is used to augment the anterior decompression. These strategies are ideal for implementation in patients whose medical conditions do not permit a thoracotomy or in whom circumferential lesions are present. Costotransversectomy and the LECA may also be used. These approaches differ in the direction of erector spinae muscle retraction, the extent of corpus vertebrae visualization, and the working angle created. The LECA is a formidable operation, but it avoids entrance into the thoracic cavity, which may be preferred. In addition, the diaphragm does not require incision in cases of thoracolumbar lesions using the LECA. Anteriorly, either a transthoracic or retropleural thoracotomy must be extended into the retroperitoneal space. Intrapleurally, the diaphragm must be incised, and the insertions to the spine must be bent backwards to allow entrance into the retroperitoneal space. Anterior pathological entities in the upper lumbar spine may be reached via a retroperitoneal approach. When a retroperitoneal approach is performed, lesions in the lower lumbar spine (L-5) are more difficult to resect and reconstruction is harder to perform. Because the iliac crest often hampers this approach in this region, a window may be made in the iliac crest to improve visualization. Because of the difficulty of placing anterior instrumentation at the lumbosacral junction, posterior instrumentation is often added when surgery is performed in this region. Posteriorly, a vertebrectomy may be performed via a bilateral transpedicular route.

As noted previously, because the inflammation is usually located in the ventral region of the spine, an anterior approach offers the most direct access to the disease process. This approach also allows minimal removal of uninvolved bone, rapid removal of inflammatory and necrotic components, effective reconstruction of the weight-bearing anterior column, strong torsional and axial stability, short-segment fixation (prevention of the inclusion of unnecessarily large numbers of levels into the fusion), prevention of posterior paraspinal musculature injury, and improved wound healing. Several studies of the anterior surgical approach to tuberculous spondylitis in the literature are summarized in Table 3. In some cases, patients are not can-
candidates for an anterior approach; for example, those who are at a high medical risk or who harbor circumferential lesions. Posterior and posterolateral approaches may be more appropriate in these cases. The operation is usually performed using unilateral or bilateral facet joint or pedicle resection and a bilateral hemilaminectomy, or a total laminectomy. This approach allows anterior decompressive surgery to be performed—although often not completely—and instrumentation to be placed posteriorly. The disadvantages of this approach are incomplete lesion resection and often suboptimal anterior graft placement. Anterior instrumentation can usually not be placed via a posterolateral incision.\textsuperscript{11,12,16,24,27,28,35,36} It is also possible to decompress the neural canal safely using the modified transpedicular approach without damaging the anatomic continuity of the posterior column.\textsuperscript{14} When the canal compromise involves the whole length of the posterior part of the affected vertebral body, however, it is also necessary to work caudally. This puts the surgeon under stress because of the risk of iatrogenic injury to the dural sac. The posterior placement of segmental instrumentation is also quite useful in cases involving vertebral body collapse at several levels and may be useful in cases requiring prophylactic stabilization.

Instrumentation is often placed anteriorly if an anterior approach is performed, and posteriorly after a posterior approach. Constructs placed anteriorly are usually short segments, often placed 1 level above and 1 below the level of the disease process. Posteriorly, constructs are often placed 2 spinal levels above and 2 levels below the level of the lesion, or longer if significant deformity is present.

Oga and colleagues\textsuperscript{28} obtained good clinical results using a posterior approach, but the instrumentation was extended to an alarming average of 8.5 levels despite the fact that only an average of 3.5 levels were involved by the disease. In addition, long-segment transpedicular screw fixation causes immobilization of more mobile segments than the anterior approach, which can cause mechanical back pain in the long term.\textsuperscript{10,20} When there is believed to be significant instability or major deformity, consideration should be given to the placement of anterior and supplemental posterior instrumentation. Yet the combined procedure was associated with an increased operating time, greater blood loss, more postoperative complications, and a longer hospital stay, although it proved to be a well-documented technique.\textsuperscript{17} Often, anterior-approach lesion resection at the cervicothoracic and lumbosacral junctions should be augmented with posteriorly placed instrumentation.

Several kinds of structural graft materials have been used to provide reliable support of the spine, including autogenous rib graft or iliac crest graft and femoral or fibular allograft.\textsuperscript{8,12,23,31,39} If the grafts fail, slip, or become absorbed, correction will be lost and progressive kyphosis develops.

**Fig. 3.** Case 12. Plain anteroposterior (left) and lateral (right) radiographs of the thoracic spine obtained 91 months after surgery.

**Fig. 4.** Case 12. Computed tomographic reconstructions of the spine obtained 91 months after surgery show sagittal plane balance and solid fusion.
### TABLE 3

*Summary of published studies on thoracolumbar tuberculous spondylitis involving treatment only using anterior surgery*

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<thead>
<tr>
<th>Authors &amp; Year</th>
<th>No. of Cases (affected vertebrae)</th>
<th>Mean FU (mos)</th>
<th>Type of Graft (no.)</th>
<th>Region (no. of cases)</th>
<th>Average Kyphosis (°)</th>
<th>Loss of Correction (°)</th>
<th>Final Correction</th>
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<td>Korkusuz et al., 1997</td>
<td>119 (1 level) 55 (2 levels) 11 (&gt; 2 levels)</td>
<td>90</td>
<td>iliac &amp; costal autograft</td>
<td>total (185) cervical (11) thoracic (84) thoracolumbar (50) lumbar (40)</td>
<td>16.2 7.1</td>
<td>12.2 (min in 5 cases treated w/ additional internal fixation)</td>
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</tr>
<tr>
<td>Govender &amp; Parbhoo, 1999</td>
<td>22 (1 or 2 levels) 19 (&gt; 2 levels) 8 (1 level) 14 (2 levels) 10 (3 levels) 4 (2 levels)</td>
<td>77</td>
<td>fresh frozen femoral allograft</td>
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<td>unknown</td>
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<td>Yilmaz et al., 1999</td>
<td>8 (1 level) 14 (2 levels) 10 (3 levels) 4 (2 levels)</td>
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<td>iliac &amp; costal autograft (28) fibular allograft (10)</td>
<td>total (38) involvement of 1 or 2 levels</td>
<td>52 (involvement of 3 or 4 levels) range 10–28 range 0–30</td>
<td>max loss of 3° in 16 patients 64% (involvement of 1 or 2 levels) 81% (involvement of 3 or 4 levels)</td>
<td>final correction maintained in 21 patients</td>
</tr>
<tr>
<td>Benli et al., 2003</td>
<td>23 (1 level) 39 (2 levels) 1 (3 levels)</td>
<td>51</td>
<td>iliac &amp; costal autograft</td>
<td>total (63) thoracic (25) thoracolumbar (21) lumbar (17)</td>
<td>23.4 22.6 24.0 23.5</td>
<td>1.1 1.2 0.9 1.4</td>
<td>74.2% 69.8% 81.2% 72.4%</td>
</tr>
<tr>
<td>Ozdemir et al., 2003†</td>
<td>9 (2 levels) 19 (3 levels)</td>
<td>40</td>
<td>fibular allograft: single-graft in 19 patients; double-graft in 9 patients</td>
<td>total (28) thoracic (9) thoracolumbar (16) lumbar (3)</td>
<td>32 6 3</td>
<td>1.1</td>
<td>60.3%</td>
</tr>
<tr>
<td>Dai et al., 2005</td>
<td>6 (1 level) 2 (skipped lesion) 31 (2 levels)</td>
<td>40</td>
<td>iliac &amp; costal autograft</td>
<td>total (39) cervical (3) thoracic (8) thoracolumbar (16) lumbar (12)</td>
<td>13.5 12.6 16.4 16.2 8.5</td>
<td>−1.9 −0.6 2.8 0.8 −9.3</td>
<td>no significant loss of deformity correction</td>
</tr>
<tr>
<td>present study</td>
<td>22 (2 levels)</td>
<td>84</td>
<td>tibial allograft</td>
<td>total (22) thoracic (13) thoracolumbar (5) lumbar (4)</td>
<td>19 21 29 8</td>
<td>3 4 5 1</td>
<td>74%</td>
</tr>
</tbody>
</table>

* FU = follow-up.
† One patient in this study experienced implant failure.
Anterior approach to thoracolumbar tuberculous spondylitis

Despite an intact cortical shell, the weakness of rib grafts can be attributed to their unfavorable length-to-width ratio, their curvature, and the small surface area of contact with the adjacent normal vertebral endplates. The rib graft is subjected to excess loads with enormous forces transmitted across the graft. When a rib graft is used alone, especially when multiple segments are involved, complications occur. Kyphotic deformity has been reported to be related to rib graft failure. Kemp and associates reported a 32% incidence of graft fracture in autogenous rib grafting for the treatment of Pott disease and an average increase in kyphotic angle of 20°. Rajasekaran and Soundarapandian reported a 59% rate of kyphotic deformity progression resulting from graft-related problems in a series of 81 patients treated using anterior fusion. Graft subsidence was observed in 24% of the patients, graft resorption in 20%, and graft fracture in 12%. Autogenous iliac crest grafting may be inadequate for the structural integrity of the anterior or column of the spine, especially in cases in which the grafts span more than 2 disc spaces. In addition, the harvesting area of iliac grafting can produce much morbidity. The rationale for using tibial allografting in this study was based on our previous experience with rib grafts, which were inadequate to support the anterior column, resulting in progressive deformity. There are reports, however, favoring autogenous iliac crest grafting.

Tibial allografts must be chosen for structural reconstruction of multiple corpectomy defects. Initial biomechanical stiffness and correction and maintenance of deformity are advantages of the allografts. In addition, the increased area of surface contact between the allograft and adjacent vertebral body and the placement of the graft under compression improved stability and allowed early axial loading. The low incorporation and fusion rates of allografts are well known, but some authors have reported successful results after allografting. A combination of a tibial allograft and an autogenous rib graft is quite good for conductivity and osteoinduction. The tibia is a good structural graft but has no osteoinductive effect. This deficiency is overcome by combination with autogenous rib graft, because the rib graft has osteogenic and osteoinductive effects. The early union may be attributed to the rib autografts, which were placed around the tibial allograft to enhance incorporation.

In the present series, no evidence of nonunion was identified. Complete deformity correction is often the goal, but it is not necessarily required to alleviate symptoms and prevent further deformity or neurological deficit. The goal of surgery, therefore, should be the attainment and maintenance of a nonpathological relationship between the neural elements and their supporting and surrounding osseous and soft-tissue structures. During the long-term follow-up period in the present series, the results were found to be acceptable. Surgical decompression resulted in a dramatic reduction of overall pain in all patients, and ASIA Impairment Scale scores demonstrated significant improvement in late follow-up results in our series.

Evaluation of the effect on sagittal global contours showed a significant correction rate in thoracic, thoracolumbar, and lumbar regions, and loss of correction rates at the last follow-up visit were very low. It is noted that application of a distraction for correction of the local kyphosis deformity in the thoracic region resulted in a decrease in the global kyphotic angle, but neither hypokyphosis nor lordosis was noted in the thoracic region. The distraction played a positive role in the lumbar region by increasing lordosis.

We found that correction of deformity in the coronal plane was also effective using anterior tibial allografting and instrumentation. All preoperative scoliotic angles with one exception were completely corrected postoperatively, and mild residual coronal plane deformities did not result in significant clinical problems for the one patient exception.

Conclusions

The surgical technique of choice for Pott disease should be specific to each patient. We believe that one-stage anterior tibial allografting and instrumentation in the surgical management of spinal tuberculosis is safe and effective in selected patients. This technique provides early healing, quick pain relief, early abscess resolution, and a good chance of neurological recovery, as well as a reduced degree of spinal deformity.

References


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