



The results of anterior radical debridement and anterior instrumentation in pott's disease and comparison with other surgical techniques

Benli, I Teoman ; Kis, Mahmut ; Akalin, Serdar ; Citak, Mehmet ; Kanevetci, Serhan ; Duman, Evrim

(Citation)

The Kobe journal of the medical sciences, 46(1):39-68

(Issue Date)

2000-04

(Resource Type)

departmental bulletin paper

(Version)

Version of Record

(URL)

<https://hdl.handle.net/20.500.14094/E0001046>



THE RESULTS OF ANTERIOR RADICAL DEBRIDEMENT AND ANTERIOR INSTRUMENTATION IN POTT'S DISEASE AND COMPARISON WITH OTHER SURGICAL TECHNIQUES

**İ. Teoman BENLİ, Mahmut KIŞ, Serdar AKALIN,
Mehmet ÇITAK, Serhan KANEVETÇİ, and Evrim DUMAN**

1st Department of Orthopaedics and Traumatology,
Ankara Social Security Hospital,
Mithatpaşa Cad., 59 / 2, Kızılay , Ankara / TURKEY

INDEXING WORDS

Pott's disease; spinal tuberculosis; kyphosis; instrumentation

SYNOPSIS

Classic procedure in the treatment of vertebral tuberculosis is drainage of the abscess, curettage of the devitalized vertebra and application of antituberculous chemotherapy regimen. Posterior instrumentation results are encouraging in the prevention or treatment of late kyphosis ; however, a second stage operation is needed. Recently, posterolateral or transpedicular drainage without anterior drainage or posterior instrumentation following anterior drainage in the same session is preferred to avoid kyphotic deformity. Seventy - six patients with spinal tuberculosis were operated in the 1st Department of Orthopaedics and Traumatology, Ankara Social Security Hospital, between January 1987 and January 1997. There were four children in our series. Average follow-up period was 36.1 ± 14.5 months and the average age at the time of operation was 40.8 ± 15.2 years. This study reports the surgical results of 45 patients with Pott's disease who had anterior radical debridement with anterior fusion and anterior instrumentation [14 patients with Z-plate and 31 patients with Cotrel - Dubousset - Hopf (CDH system)]. The results are compared with those of 8 patients who had posterolateral drainage and posterior fusion, 12 patients who had only anterior drainage and anterior strut grafting and, 11

Received for publication: September 14, 1999

Authors' names in Japanese: イ テオマン ベンリ、マフムット クシュ、セルダル アカルン
メフメット チュタック、セルハン カネヴェトチ、エヴリム ドウマン

patients who had posterior instrumentation following anterior radical debridement in the same session in terms of fusion rates, correction of kyphotic deformity, recurrence rate and clinical results. All patients had one year consecutive triple drug therapy. Preoperative $23.2^{\circ} \pm 12.5^{\circ}$ local kyphosis angle was lowered to $6.1^{\circ} \pm 6.9^{\circ}$ with a correction rate of 77.4 ± 22.3 %. When the other three groups which had been instrumented were compared, the correction rates in the local kyphosis angle values were not statistically different and the variation in loss of correction at the last follow-up was also statistically insignificant. The sagittal contour of the involved vertebra's region did not change in the uninstrumented group, while it did so in instrumented groups which had normal range values postoperatively. Overall, 27 patients had neurologic deficits preoperatively. Twenty of these (74.1 %) had complete, and 5 (18.5 %) had partial recovery with a combined 92.6 % neurologic improvement. All the patients had a solid fusion mass at the last controls. Reactivation was not seen. Additionally, contrary to the common belief, anterior instrumentation which anterior autologous strut grafting following anterior radical debridement can be a good treatment option with low complication rate, high correction rate in acute local kyphosis, and high fusion rate.

INTRODUCTION

The most frequent site for extrapulmonary localization of tuberculous infection is the vertebral column. Tuberculosis of the vertebral column was described by Percival Pott in 1877 as a kyphotic deformity of the spine associated with paraplegia¹. Pott's disease is now infrequent in the developed countries because of advances in chemotherapy and preventive medicine.

Nemir and Krasinski found that 57 % of the 211 tuberculosis cases reported in the United States of America between 1980 and 1986 were immigrants³. Recent reports from the developed countries show that the majority of the patient population comes from the countries where the disease is endemic or socioeconomic conditions are poor, or the patients are either cocaine-like drug abusers or HIV porters²⁻⁵. Unfortunately the cases reported from Turkey is still as high as those from West and Middle Africa and Asia. Every year a few hundred new patients with neurologic deficit and deformities due to spinal tuberculosis are treated medically and surgically by Turkish spinal surgeons⁶⁻¹⁴.

ANTERIOR INSTRUMENTATION IN POTT'S DISEASE

According to the World Health Organization , tuberculosis has become the world's most deadly infectious disease, killing nearly 3 million people per year ³⁴. Mortality rate was reduced dramatically when Bosworth began using streptomycin for bone and joint tuberculosis in 1950 ³⁶. Korkusuz et al. reported 7 deaths in a series of 42 patients ¹¹.

Drainage and debridement of cold abscess has become popular after Hodgson and Stock since 1960 ¹⁶⁻¹⁸. Initially no drainage was done, only Plaster of Paris jacket or posterior laminectomy in patients with neurologic deficit was used. Afterwards radical debridement with anterior approach and anterior fusion with anterior strut graft were used in most of the cases ¹.

High fusion rates have been reported with only posterior and only anterior approaches ^{1,17-21}. Kyphotic deformity is inevitable in patients who underwent only medical treatment. However, albeit in low rates, graft resorption is seen in patients who had anterior or posterior fusion only, and kyphotic deformity due to asymmetric growing is seen in high rates in children ^{3,16,22-25}. Recently, posterolateral or transpedicular drainage without anterior drainage or posterior instrumentation following anterior drainage in the same session is preferred to avoid kyphotic deformity ^{3,6,7,24-28}.

Certainly the posterior approaches following drainage of the abscess or anterior fusion ,whether in the same or consecutive sessions, increase the complication rates and morbidity ². On the other hand, anterior approach and decompression is preferred for neural decompression because the spinal cord compression is usually anterior ^{1,29-31}. Many authors argue against anterior instrumentation for spinal tuberculosis ².

This study reports the surgical results of 45 patients with Pott's disease who had anterior radical debridement and anterior fusion. The results are compared with those of 8 patients who had posterolateral drainage and posterior fusion, 12 patients who had only anterior drainage and anterior strut grafting 11 patients who had posterior instrumentation following anterior radical debridement in the same session in terms of fusion rates, correction of kyphotic deformity, recurrence rate and clinical results. Additionally, the number of the affected segments and vertebrae, the neurologic status and the radiologic and clinical findings are assessed in a total series of 76 patients.

PATIENTS AND METHODS

Ninety-three patients with spinal tuberculosis were operated in the 1st

Department of Orthopaedics and Traumatology, Ankara Social Security Hospital, between January 1987 and January 1997. The patients who had a minimum follow-up of two years and who came to the last follow-up visit in January 1999 were included in the study. Average follow-up period was 36.1 ± 14.5 months and the average age at the time of operation was 40.8 ± 15.2 years.

The patients were assessed clinically and radiologically following hospitalization. All patients had MRI studies in addition to the direct radiographies. The level of involvement, the number of affected vertebra, local kyphosis angle were assessed radiologically and the sagittal contours measured independently for cervical, thoracic, thoracolumbar or lumbar vertebrae. Vertebral collapse, destruction, cold abscess, and spinal cord compression were assessed in MR graphies.

The patients had routine laboratory tests and also triple antituberculous chemotherapy for three weeks unless they had recently developed or progressive neurologic deficits which necessitated urgent decompression.

In our patients, abscess formation, vertebral collapse and severe spinal instability due to pathological fracture, local kyphosis deformity and compression in neural channel and neurological disturbance constitute the surgical indications. In all patients who have involvement at one or two levels, anterior vertebral destruction and collapse, anterior spinal channel compression, anterior radical debridement, anterior strut grafting and anterior instrumentation was employed. Following the extensive debridement and adequate release by anterior instrumentation, kyphosis deformity was attempted to be corrected by distraction in order to achieve normal physiological sagittal contours as much as possible. In cases where there was involvement at more one level, if long strut graft and long anterior instrumentation was warranted or if sufficient stability was difficult to achieve due to osteoporosis or a similar cause, and if the involvement is in lumbosacral junction, following anterior radical debridement and anterior strut grafting, posterior instrumentation was indicated at the same session. If there was only abscess formation without destruction in the corpus, anterior fusion was carried out on its own.

The access to the affected vertebra was by means of thoracotomy in the thoracic region and thoracophrenolumbotomy in the thoracolumbar and lumbar region. The abscess was drained if present and neural decompression was done with complete corpectomy of the destroyed vertebra. Afterwards, anterior fusion was accomplished with tricortical autologous graft from the iliac crest and at least three costal parts obtained by the thoracotomy. Only anterior fusion was done in 12 patients.

ANTERIOR INSTRUMENTATION IN POTT'S DISEASE

In eleven patients short segment posterior instrumentation and posterior fusion was done following anterior radical debridement and fusion in the same session. The instrumentation used was Texas Scottish Rite Hospital (TSRH) system in 10 patients and ISOLA spinal instrumentation in one patient.

Hooks were preferred in the thoracic and transpedicular screws in the thoracolumbar and lumbar region. In this group seven patients had more than one vertebra involved. Maximum 11 mobile segments were instrumented.

In 45 patients, following anterior radical debridement and strut grafting, anterior instrumentation at the vertebrae just above and below the fused segments was done. Titanium Z-plate instrumentation was used in 14 patients and Cotrel-Dubousset-Hopf (CDH) instrumentation in 31 patients after correction with distraction.

Underwater drainage with chest tube and aspirative suction drainage was used in 66 patients on whom anterior approach was used. Patients were turned to their sides in the first postoperative day, sat down in the second and encouraged to walk in the third postoperative day. Active rehabilitation was started in the 3rd postoperative day for the patients who had neurologic deficit. Eight patients had vertebral destruction and cold abscess near lumbosacral junction and these patients had posterolateral drainage, posterior decompression, curettage from the disc space and posterior instrumentation with posterolateral fusion in order to reduce the high morbidity of anterior drainage in this level. Six patients in this group were instrumented with TSRH while one with Isola and one with Compact Cotrel-Dubousset (CCD). Postoperative management was the same as above.

Histopathologic examination was done postoperatively and all specimens displayed typical tuberculous findings. No cast immobilization or bracing was used in 59 patients who had good bone quality. Vitraten mold braces were used for four months in 13 old, osteoporotic patients and 4 children.

Postoperatively the chemotherapy regimen consisted of 15 mg/kg rifampicin (maximum 600 mg/day), isoniasid 6 mg/kg (maximum 300 mg/day), and streptomycin 1 gr daily for a month. Thereafter, ethambutol 25 mg/kg/day (maximum 2.5 gr/day) replaced streptomycin. Ethambutol, in turn, was replaced by Pyrazinamide in the 6th month at a dosage of 25 mg/kg daily (maximum 2 gr/day) and the chemotherapy was ceased at one year.

Patients with neurologic deficit were assessed according to the Frankel's scale³². Preoperative and postoperative neurologic status was noted in all patients. Local kyphosis was measured as the angle between the upper and

lower end-plates of the collapsed vertebra postoperatively and at the last follow-up visit. Additionally thoracic lordosis and lumbar kyphosis angles of the involved site were measured. Recurrences and complications were noted. The tests used for statistical assessment were "Wilcoxon Matched - Pair Signed - ranks", "Mann - Whitney's U test" (SPSS for MS Windows). The probability value used was 0.05.

RESULTS

A) CHILD PATIENTS:

Four (5.3 %) of the 76 patients were children. The average age at the time of operation was 10.3 ± 1.3 years and 3 of the patients were female and one male. Patients had fatigue, weight loss, subfebrile fever and back-pain complaints and all lived in Blacksea region of Turkey under poor socioeconomic conditions. All except one had active tuberculosis, and PPD test was positive in all of them.

Two vertebrae were destroyed in two and three were destroyed in the other two patients. Averagely 2.5 ± 0.6 vertebrae were affected and the lesion was thoracic in three patients while it was lumbar in one patient. In three patients there was local kyphosis and collapse in at least one vertebra. One patient had vertebral destruction and cold abscess without collapse. Three patients had only anterior drainage, debridement and anterior fusion with autologous strut grafts. A twelve year old patient with L3-L4 destruction had posterior TSRH instrumentation and posterior fusion of four mobile segments following anterior radical debridement. This patient had a 20° local kyphosis and the correction rate was 100 % postoperatively. The other two patients with vertebral collapse had 29° and 32° local kyphosis angles. The average postoperative correction rate was 12.2 % in these patients. The local kyphosis angle remained 0° in the patient without vertebral collapse. Overall correction rate of the local kyphosis angle was $45.3^\circ \pm 45.1^\circ$. There was no neurologic deficit in the neurologically intact patients postoperatively.

There was no loss of correction in the follow-up visit of the patient at 48 months who had combined anterior and posterior surgery. However, although all had solid fusion mass, there was in average $23.3^\circ \pm 17.6^\circ$ loss of correction rate in the other three patients who had solely anterior radical debridement and strut grafting including the patient who had no preoperative vertebral collapse.

ANTERIOR INSTRUMENTATION IN POTT'S DISEASE

One of these patients had a 40° loss of correction and developed bilateral paresthesia at the follow-up visit. This patient was reoperated at the 18th postoperative month and posterior TSRH instrumentation and fusion following anterior vertebrectomy and strut grafting in the same session was carried out. The local kyphosis angle was 70° before the second operation and it was corrected by 64.3 % which was better than the first operation's result (25°). The other patients had 33° and 20° correction losses and reoperation was planned for both .

B) ADULT PATIENTS:

1) Clinical assessment :

Seventy-two (94.7 %) of the 76 patients included in this series were 19 years old or older, and the average age at the time of operation was 42.5 ± 13.7 years. The breakdown of patients according to the age decades are shown in Figure 1. According to this, most of the patients were treated in the fifth decade (26.4 %), which was followed by the fourth decade (22.6 %). All patients had general tuberculous symptoms like weight loss, subfebrile fever, fatigue and predominantly back pain. Additionally 27 patients (37.5 %) had partial or complete neurologic deficits.

Eleven patients (15.3 %) had active pulmonary system tuberculosis and 2 patients (2.8 %) active gastrointestinal system tuberculosis. Overall 13 patients (18.1 %) had active infected area. Two of these patients (both 19 years old) had miliary tuberculosis and showed spinal symptoms and neurologic deficits during their therapy in the sanatorium. Both of them had thoracal and lumbar spinal destruction. One of them had destruction of 7 vertebrae from T5 to T11 apart from two of the vertebrae showing collapse and also had destruction in L5. The patient was paraplegic. Another patient had destruction and collapse in T7 and destruction in L2. Both patients had posterior TSRH instrumentation with fusion following anterior radical debridement. The instrumented levels were 10 mobile segments in the first and 11 mobile segments in the second patient while the correction rates of the local kyphosis angles were 65 % and 75 %, respectively. Thoracal and sagittal contours were brought to normal ranges .

Breakdown of adult patients according to the levels of involvement are seen in Figure 2. Tuberculous infection was shown in 136 vertebrae of 72 adult patients. Thoracal region was the leading site for infection with 54 vertebrae

(39.7 %). Forty five lumbar vertebrae were involved (33.1 %). When the results were assessed according to the level of involvement (Figure 3), the most commonly affected vertebra was L3 with 13 cases (9.6 %). Infection is less frequent up to the cervical levels and down to the sacrum.

Twenty one (29.2 %) of the 72 patients in this group had one, 46 patients (63.8 %) had two, 4 patients (5.6 %) had three and one patient (1.7 %) had more than three (8 vertebrae) affected vertebrae.

2) Surgical Results :

a- Patients who had only anterior drainage :

Eight patients had only anterior drainage and debridement with autologous strut grafting. Three of these patients showed one vertebra involvement and cold abscess in the radiologic and MRI studies. They were all neurologically intact and had normal sagittal contours.

The remaining 5 patients had destruction and vertebral collapse. Three of these patients had thoracic involvement, while two had thoracolumbar and one lumbar involvement. One patient had infection in one vertebra, two patients in two vertebrae and the remaining two patients in three vertebrae. Following anterior radical debridement and anterior strut grafting the preoperative average $11.1^{\circ} \pm 11.5^{\circ}$ value of local kyphosis angle was decreased av. $8.9^{\circ} \pm 8.7^{\circ}$ with a correction rate of 11.5 ± 19.3 % (Table I). The correction was significant ($z: -1.34$, $p < 0.05$). Preoperative average thoracic and lumbar sagittal contours were $43.8^{\circ} \pm 10.5^{\circ}$ and $36.2^{\circ} \pm 2.5^{\circ}$ respectively, and they were brought to $40.5^{\circ} \pm 10.7^{\circ}$ and $36.2^{\circ} \pm 2.5^{\circ}$ postoperatively while these differences were also found to be insignificant.

One of the two patients with neurologic deficit in this group (Frankel C) completely recovered while the other one become Frankel grade D after surgery. Both maintained the same neurologic status during follow-up visits.

The sagittal contours of the patients in this group deteriorated with time. There was a $23.6^{\circ} \pm 3.5^{\circ}$ loss of correction in the local kyphosis angle although all patients had solid fusion mass. No recurrence, early or late suppurative infection was noted.

ANTERIOR INSTRUMENTATION IN POTT'S DISEASE

b- Patients who had posterior instrumentation and fusion following anterior radical debridement and strut grafting in the same session :

There were 11 patients in this group with an average of 2.6 ± 1.9 vertebral involvement. Seven patients had thoracic and four patients had lumbar infections. As mentioned above, two patients in this group had thoracolumbar involvement and one of them had destruction in 8 vertebrae. All patients had vertebral collapses which caused local kyphosis between 5° and 49° . When the patient with L5 involvement was excluded, 6 patients had the infection in two and one patient in three consecutive vertebrae. One patient had involvement in 7 consecutive vertebrae (T5 – T11) and L5 and one patient in T7 and L5. Seven patients had preoperative neurologic deficits which were classified as Frankel A, Frankel B, and Frankel C for one, two and four patients, respectively.

Abscess drainage, radical debridement and augmentation with autologous strut grafts were done through anterior approach to the collapsed level. Then posterior instrumentation and fusion was done in the same session (TSRH : 10, ISOLA : 1). In the thoracic region 8.4 ± 2.4 , in the lumbar region 3.5 ± 2.4 , and overall 6.4 ± 2.9 vertebrae were included in the fused area. The preoperative av. $18^\circ \pm 8.3^\circ$ local kyphosis angle was corrected to av. $5.5^\circ \pm 6.3^\circ$ with a correction rate of $76.8 \pm 19.5\%$ (Table I). The correction was statistically significant ($z : -2.93, p < 0.05$).

The patients with thoracic involvement had average $32.6^\circ \pm 9.8^\circ$ and those with lumbar involvement had average $37.5^\circ \pm 9.0^\circ$ sagittal contours preoperatively which were corrected to $30.2^\circ \pm 5.8^\circ$ and $39.8^\circ \pm 1.7^\circ$ respectively. The patient who had hyperkyphotic pattern (64°), and the patients who had hypokyphosis (18° and 20°) in the thoracic region were corrected to physiologic ranges. When all patients in this group are assessed together, it is seen that the preoperative average $35.1^\circ \pm 12.5^\circ$ and $36.6^\circ \pm 7.0^\circ$ thoracic and lumbar sagittal contour values were corrected to average $33.1^\circ \pm 13.5^\circ$ and $35.5^\circ \pm 6.7^\circ$ respectively, but both results were found to be insignificant ($p > 0.05$).

Five of the seven patients with neurologic deficit in this group recovered completely. One patient preoperatively graded Frankel A improved to Frankel D while the other patient preoperatively graded Frankel B remained unchanged because there was a 24 day delay from the onset of the neurologic findings. In this group there was no change in the neurologic status during follow-up. The patient graded as Frankel B became ambulatory due to a

rehabilitation program. Overall 71.4 % of the patients in this group had complete and 14.3 % had partial neurologic recovery.

There was mean $2.5^{\circ} \pm 1.6^{\circ}$ correction loss in the kyphosis angle in 37.1 ± 11.7 months follow-up time. Thoracal and lumbar sagittal contours had loss of correction of $4.7^{\circ} \pm 1.7^{\circ}$ and $3.5^{\circ} \pm 1.5^{\circ}$ respectively although all had solid fusion mass. No recurrence, implant failure, early or late infection or other complication was noted in this group.

c- Patients who had anterior radical debridement and anterior autologous strut grafting with anterior instrumentation :

There were 45 patients (62.5 %) in this group and the average age at the time of operation was 45.1 ± 13.6 years. Eighteen of the patients had partial or complete neurologic deficits at the time of hospitalization. Fourteen patients had thoracal, 14 had thoracolumbar and 17 lumbar involvement. Fourteen patients had destruction in one vertebra , while 30 patients had destruction in two vertebrae and only one patient had destruction in three vertebrae.

Overall , an average of 1.7 ± 0.5 vertebrae were affected and this resulted in vertebral collapse and sagittal contour deterioration and excessive local kyphosis within a range of 14 and 80 degrees.

Following anterior radical debridement and strut grafting, 14 patients were instrumented with Z-plate and 31 patients with CDH system. Averagely 2.4 ± 0.7 vertebrae were included in the fused area. This was 2.3 ± 0.6 , 2.6 ± 0.6 and 2.2 ± 0.8 vertebral segments for the thoracal, thoracolumbar and lumbar areas respectively. Preoperative $23.2^{\circ} \pm 12.5^{\circ}$ local kyphosis angle was lowered to $6.1^{\circ} \pm 6.9^{\circ}$ with a correction rate of 77.4 ± 22.3 %. The differences were found to be significant (z : -5.84 , p < 0.05). When assessed separately, the preoperative local kyphosis angles were $21.8^{\circ} \pm 9.1^{\circ}$, $28.4^{\circ} \pm 18.7^{\circ}$ and $20.1^{\circ} \pm 6.7^{\circ}$ for thoracal, thoracolumbar and lumbar regions and they were corrected by 65.3 ± 24.8 %, 82.9 ± 17.4 % and 82.9 ± 20.7 % respectively. The correction rates were statistically significant (p < 0.05). However, the correction rate was slightly less in the thoracal region.

When the sagittal contours of the involved areas were measured, the preoperative average thoracal kyphosis angle was $44.2^{\circ} \pm 13.7^{\circ}$, the preoperative average thoracolumbar junction angle was $28.4^{\circ} \pm 18.7^{\circ}$ and the

ANTERIOR INSTRUMENTATION IN POTT'S DISEASE

preoperative average lumbar lordosis angle was $25.8^{\circ} \pm 7.6^{\circ}$ and they were reduced to $34.1^{\circ} \pm 16.5^{\circ}$, $6.6^{\circ} \pm 8.4^{\circ}$ and $33.9^{\circ} \pm 7.2^{\circ}$ respectively. The correction rates were statistically significant ($p < 0.05$).

There were 18 patients with neurologic deficits in this group : 3 were Frankel A, 2 Frankel B, 10 Frankel C and 3 Frankel D . Postoperatively three patients (16.7 %) had partial recovery ; one patient with Frankel A and one patient with Frankel B improved to Frankel D, while one patient with Frankel A improved to Frankel C. One patient had been treated for active pulmonary tuberculosis and referred to our hospital 38 days after the onset of the neurologic symptoms . Unfortunately no neurologic recovery was obtained after surgery. The remaining 14 patients (77.8 %) fully recovered after the operation. None of the patients showed changes in the neurologic status during follow-up.

There was an average of $2.9^{\circ} \pm 2.7^{\circ}$ correction loss in the local kyphosis angle in mean 32.6 ± 9.5 months follow-up. The correction loss in the thoracal , thoracolumbar and lumbar regions were $2.8^{\circ} \pm 2.2^{\circ}$, $3.6^{\circ} \pm 2.8^{\circ}$ and $2.5^{\circ} \pm 3.0^{\circ}$ respectively. All patients had solid fusion mass at the last follow-up ,and there was not any implant failure, early or late recurrence or any kind of infection.

Two patients among the earlier cases of our series had major complications with blood vessels. One patient with T9 involvement developed aortic aneurism after anterior plate instrumentation. It was diagnosed at the 20th postoperative day and the patient was immediately operated in collaboration with vascular surgeons . No recurrence was seen. The other patient had L4 - L5 destruction and the iliac vein which had an adhesion to the L5 corpus was torn during the dissection . The vein was repaired intraoperatively with teflon graft. There was no problem with the venous system postoperatively, but afterwards, this bad experience, when considered together with the abscess formation and distorted anatomy, made us prefer posterolateral drainage and posterior instrumentation especially for the involvements near lumbosacral junction .

d- Patients who had posterolateral drainage and posterior instrumentation :

There were 8 patients in this group and the average age at the time of operation was 42.8 ± 10.1 years. Five of the patients had radicular pain in

addition to the general tuberculosis symptoms. None had neurologic deficits. Vertebral involvement was lumbar or junctional (lumbosacral junction). Two patients had one level involvement (L3 and L4) while the remaining patients had two level involvement (one patient L2 -3 , 1 patient L4 -5 and 4 patients L5 – S1) , and they had vertebral collapse and local kyphosis ranging from 3° to 24°. Posterolateral decompression and drainage was done, the destroyed material was curetted through the disc space and posterolateral interbody fusion was achieved with autologous grafts. Later on, averagely 3.0 ± 1.1 mobile segments were instrumented with TSRH in 6 patients , ISOLA in one patient and CCD in one patient.

The preoperative average local kyphosis angle was $10.3^\circ \pm 7.4^\circ$, and it was reduced to $3.4^\circ \pm 5.5^\circ$ with a correction rate of $80\% \pm 24.5$. The difference was significant ($z : -2.52$, $p < 0.05$). Lumbar sagittal contour was average $34.9^\circ \pm 7.9^\circ$ preoperatively, and it was found to be mean $40.6^\circ \pm 8.2^\circ$ after surgery. This difference was significant as well and all patients had contours in the physiologic range ($p < 0.05$).

Postoperatively no neurologic deterioration was noted while all radicular pain symptoms settled. There was a $2.9^\circ \pm 1.6^\circ$ correction loss in the local kyphosis angle during an average follow-up period of 40.8 ± 11.1 months. All patients had solid fusion while no implant failure was observed . There was also no recurrence or nonspecific infection . Additionally, debridement through disc space did not result in any meningeal infection.

e- General assessment :

This series showed that when anterior drainage, debridement and fusion was done without instrumentation the correction rate of the local kyphosis angle was less ($8.6\% \pm 17.1$) (Table I) and the correction loss was high ($23.6^\circ \pm 3.5^\circ$) at the last follow-up visit. When the other three groups which had been instrumented were compared, the correction rates in the local kyphosis angle values were not statistically different ($p > 0.05$) and the variation in loss of correction at the last follow-up was also statistically insignificant ($p > 0.05$). When all patients were included , the preoperative average $19.6^\circ \pm 12.3^\circ$ local kyphosis angle was corrected to $6.0^\circ \pm 6.9^\circ$ with a correction rate of $69.9\% \pm 30.4$ and this result was found to be significant ($z : -7.21$, $p < 0.05$).

The sagittal contour of the involved vertebra's region did not change in the uninstrumented group, while it did so in instrumented groups which had

ANTERIOR INSTRUMENTATION IN POTT'S DISEASE

normal range values postoperatively. When all patients were included, the preoperative $37.0^{\circ} \pm 12.9$ thoracal and $33.7^{\circ} \pm 8.9^{\circ}$ lumbar sagittal contours were corrected to $33.4^{\circ} \pm 11.9^{\circ}$ and $36.5^{\circ} \pm 6.7^{\circ}$ postoperatively with a significant correction rate ($p < 0.05$).

Overall an average of 2.8 ± 2.1 mobile segments were instrumented in adult patients. The difference between instrumentation techniques was significant (Table - I) ($p < 0.05$). The highest number of mobile segments (6.4 ± 2.9) were instrumented in combined anterior fusion – posterior instrumentation cases, while the least (2.4 ± 0.7) were instrumented in only anterior approached cases. An average of 8.4 ± 2.4 mobile segments were instrumented in the thoracal region. Almost the same number of segments were instrumented in both posterior instrumentation groups in lumbar region (3.0 ± 1.1 and 3.5 ± 1.3) ($p > 0.05$). An average of 2.2 ± 0.8 mobile segments were instrumented anteriorly in the lumbar region.

Overall, 27 patients had neurologic deficits preoperatively. Twenty of these (74.1 %) had complete, and 5 (18.5 %) had partial recovery with a combined 92.6 % neurologic improvement. There was no difference in neurologic recovery between anterior and posterior instrumentations ($p > 0.05$).

All patients developed solid fusion, no pseudoarthrosis was observed. However, in patients who had only anterior debridement and fusion there was a loss in strut graft length which resulted in increasing local kyphosis.

DISCUSSION

Vertebral column is one of the most common sites of involvement for tuberculosis which is still a problem of high morbidity and mortality in the developing countries¹. Microabscess formation may then progress, causing bony destruction and clinical symptoms. Primary involvement of the posterior arches is uncommon, occurring in less than 0.5 % of the cases. The thoracic spine is most frequently involved, followed by the lumbar spine². In our series the site of involvement was 39.7 % thoracal and 33.1 % lumbar, which is congruent with the literature. However, the vertebra most involved was L3 and 13.6 % of the 136 infected vertebra was at this level. The frequency of involvement decreased up to the cervical and down to the sacral regions.

Spinal tuberculosis is reported to be evenly distributed among all age groups. Still, spinal involvement is less in infants and children². There are four

children in this series at an average age of 10.3 years. The remaining 72 patients were 19 years old or older, with an average age of 42.5 years. The most severely affected age group was the 5th decade with a rate of 26.4 % and the incidence fell down over 49 and under 40 years old.

Classic , constitutional symptoms such as fever , chills and weight loss may not be present but the vast majority of patients complain of slowly progressive back pain ³³. All patients in this series had back pain and the patients who had lumbosacral involvement had radicular pain as well. There was an active pulmonary infection in one of the children and 15.3 % of adults , while 2.8 % of adults had an active gastrointestinal involvement. Two patients had miliary tuberculosis and poor general condition . None of the patients were HIV positive , there was not any alcoholic or drug abuser but all had low socioeconomic status.

In addition to classical radiograms and laboratory tests, MRI is an important method in diagnosing tuberculosis ¹ . In his series of 24 patients Desai reported that diagnosis of the disease was possible in the very early stages with MRI ³³. Hoffmann et al. reported that MRI was necessary and very useful for surgical planning and diagnosing canal compromise ³⁴. All 76 patients in our series were scanned with MRI for vertebral destruction and cold abscess formation. Seventy - two of them had vertebral collapse and canal compromise.

Antituberculous therapy brought about great improvement in the treatment of spinal tuberculosis which has serious complications such as paraplegia and death. At the beginning, antituberculous therapy was nonambulatory, but long time bed rest effected serious systemic complications. Then, chemotherapy with plaster jackets seemed more successful, but these patients had kyphotic deformities and frequent recurrences ^{1,23,36}.

Moula et al. reported that in a series of 220 patients, the average 53° local kyphosis angle became average 140° with conservative therapy and the surgical treatment resulted in average 68 % correction rate ²².

Posterior laminectomy and fusion improved the neurologic status of the cases with deficits , but this was not adequate to solve the aforementioned problems. Harrington rod applications improved the fusion and correction rates, adding instrumentation to the treatment of Pott's disease ¹. Hodgson and Stock reported anterior debridement of the destroyed vertebra and abscess drainage with anterior strut grafting and this method rapidly gained popularity ²³.

ANTERIOR INSTRUMENTATION IN POTT'S DISEASE

According to Moon ; in the vertebral tuberculosis , the indications for surgery are presence of a paraspinal abscess, the presence of severe bone destruction and kyphotic deformity, neurologic deficit with spinal cord compression , and refractory to conservative treatment ². Medical Research Council Working Party on Tuberculosis of the Spine , reported in two series with 10 and 15 years follow-up that when ambulatory chemotherapy were compared with nonambulatory chemotherapy, with debridement and chemotherapy with Hong-Kong procedure, anterior radical debridement and anterior strut grafting is the most successful procedure for neurologic recovery, fusion and preventing kyphotic deformity ^{34,35} . Extrapleural approach rather than classical thoracotomy is proposed to give a better exposure and prevent tuberculous empyema ^{1,12} . In our series we did not encounter tuberculous empyema although we used classical thoracotomy approach.

For anterior strut grafting, iliac crest and costa are used as autograft and fibula is used as allograft. Fusion rate with autogenic iliac grafts is over 95 % ^{2,36}. Govender and Parbhoo reported full cooperation of the allograft to the vertebra at the 30th postoperative month in a series of 47 children ³⁶. Some authors reported that costal grafts were not good for stabilization because they migrate through the end-plates or have breakage problems ^{2,9,37}. Some authors suggest vascular rib grafts for the solution of this problem because they fuse in a very short time, at an average of 3.3 months ^{1,37,38}. In our study we just used autografts. We used at least three parts of ribs for the patients with thoracolumbar involvement, and there was no migration or graft breakage. Tricortical iliac crest grafts were used in the lumbar region .

Kim et al. reported that there was no difference in anterior fusion of the infected or noninfected areas, whereas there was complete fusion in 66.6 % and incomplete fusion in 21.6 % of the infected cases ³⁹. Acaroğlu et al. reported a series of 100 patients either with posterior or anterior fusion only and more kyphotic deformity developed after anterior fusion ⁹. Rajasekaran and Soundarapendian reported 59 % kyphotic deformity with anterior fusion ²³. Mallet et al. reported that kyphotic deformity is inevitable in growing small children ²². Schulitz et al. assessed the 5th and 10th year follow-up lateralographies of 117 two to 6 year old children with Pott's disease. Though there was a solid anterior block in patients with anterior fusion only, there was an average of 15° hyperkyphosis with growth, which seemed to be less in patients with combined anterior and posterior fusion ²⁵.

There were four children in our series. A 12 year old patient was instrumented with TSRH following anterior radical debridement and strut

grafting. The 20° local kyphosis angle was corrected by 100 %. In two of the children with vertebral collapse , the average correction rate obtained was 12.2 %. At the last control visit there was a 23.3° correction loss in the remaining three patients, while the patient with posterior instrumentation had no loss of correction. One of the patients had 40° correction loss and neurologic deficit, and he was reoperated both anteriorly and posteriorly in the same session which resulted in 64.3 % correction rate. Our study also supports the belief that kyphosis increases with growth.

There are reports that suggest using posterior approach alone or combined with anterior surgery ^{2,24}. Güven et al. reported a series of 10 cases with posterior instrumentation, in which there was a 3.4° correction loss in the correction of local kyphosis ⁶. Domaniç et al. reported that in their series with anterior drainage, correction of the kyphosis was more successful in patients who had additional posterior CD instrumentation ⁸. Yau et al. reported higher success rate with anterior fusion and posterior instrumentation in the same session ²⁰.

In our study 72 adult patients with different surgical procedures were assessed. Eight patients had only anterior debridement and fusion, with 8.6 % correction rate and av. 23.6° correction loss during follow-up. In four patients local kyphosis developed although there was no vertebral collapse at the beginning. Eleven patients had posterior instrumentation following anterior radical surgery in the same session. Ten were instrumented with TSRH and one with ISOLA system. There are several reports on the three dimensional correction capability of both systems in scoliotic patients ^{41 - 43}. Our study is the first report using these systems in spinal tuberculosis. In these 11 patients preoperative average 18° local kyphosis angle was corrected averagely by 76.8 %, and the mean correction loss was 2.5° at the last follow-up visit. There was a high, statistically significant correction rate in the sagittal contours .

Güven et al. reported successful results in a small series of posterior transpedicular drainage and posterior instrumentation ⁷. This method has various risks such as in adequate drainage of the abscess, deficiency in the debridement of destroyed bone tissue and the transmission of the infection to posterior components. In our study, 8 patients with lumbosacral junctional involvement and vertebral destruction without cold abscess had posterolateral drainage and posterior instrumentation in order to decrease morbidity. They had posterolateral decompression through disc space and the instrumentation used was TSRH in six, Isola in one and CCD in one patient. The preoperative average 10.3° local kyphosis angle was corrected averagely by 80 %, and the

ANTERIOR INSTRUMENTATION IN POTT'S DISEASE

correction loss was average 3° at the last follow-up visit. Similar to the new method of Güven et al, the same risks apply to our method as well. Yet, in follow - up, infection in posterior components and tuberculosis meningitis was observed in no patients. However, this method is more advantageous than that of Güven et al, in that it enables a circumferential fusion in lumbosacral junction, satisfactory debridement of destroyed tissue in anterior corpus and easier drainage of abscess.

Kostuik reported a series of 79 patients with anterior decompression and anterior internal fixation in 1983, in which 51 patients had neurologic deficits⁴⁴. He reported two patients having deformity because of spinal tuberculosis. Aydın et al. reported one patient who had been anteriorly instrumented with Z-plate in a series of 24 patients with spinal tuberculosis¹⁴. Our study is the largest series ever reported, using anterior instrumentation following anterior radical debridement and strut grafting. Many authors do not recommend instrumentation at anterior fusion level in the patients with Pott's disease². In the patients in whom surgery was indicated owing to the presence of spinal instability, local kyphosis deformity, spinal channel compression and neurological deficit, due to vertebral collapse and pathological fractures, radical debridement, anterior strut grafting and anterior instrumentation was employed. In our series 45 patients with spinal tuberculosis were anteriorly instrumented with titanium Z-plates designed by Zdeblick and that gave satisfactory results in scoliosis treatment or CDH instrumentation refined by Hopf, following anterior radical debridement and strut grafting⁴⁵⁻⁴⁷. There was an average of 23.2° local kyphosis angle preoperatively, and it was corrected by 77.4 % after surgery. All had physiologic sagittal contours, and the correction loss of the local kyphosis angle at the last follow-up visit was 2.9° .

All patients in the three different groups had solid fusion and no pseudoarthrosis was observed. The difference in correction rates and loss of correction at the last control visits were statistically insignificant. Averagely 2.4 mobile segments were instrumented anteriorly and this was significantly less than the other surgical methods.

The compression of the cold abscess or bony fragments, acute local kyphosis, vascular collapse and ischemic necrosis due to edema or direct meningeal involvement may cause neurologic deficit^{1,31}. Bailey et al. reported a rate of 70 % neurologic deficit²¹. Pattison et al. reported 79 % neurologic improvement with conservative therapy in their series of 89 patients but 46 % of these patients deteriorated neurologically in two months²⁶. Açıkgöz et al¹² reported 25 %, Aydın et al¹⁴ reported 100 % (71.4 % complete, 28.6 %

partial), Loembe ²⁷ reported 82 %, Moon ³⁰ reported 89.6 %, Rezai et al. ²⁸ reported 100% neurologic improvement and Korkusuz ¹¹ reported neurologic recovery in 24 cases in a series of 185 cases. In our series there was 92.6 % neurologic improvement (74.1 % complete, 18.5 % partial), and the patients who did not benefit from surgery had referred late . Hsue et al. reported complete or nearly complete neurologic recovery in 15 of the 18 patients although all referred late ³¹. The type of instrumentation system did not have any effect on the neurologic outcome ($p > 0.05$). There was 77.8 % complete , 16.7 % partial recovery in the posterior instrumentation group and 71.4 % complete, 14.3 % partial recovery in the anterior instrumentation group.

The recommendation of the Medical Research Council was ambulant chemotherapy with 6 or 9 month regimen of Isoniazid and Rifampicin as treatment of choice in developing countries ³⁶. In our study Rifampicin and Isoniazid were used for 12 months while Streptomycin, Ethambutol and Pyrazinamid were replaced respectively, in keeping with three-drug regimen. This was preferred to avoid drug resistance and side-effects. No recurrence was observed with this regimen and there was no side effect except in one patient who had mild temporary seeing problem. There was no early or late infection either specific or nonspecific. Additionally no implant failure was observed.

CONCLUSION

According to the results of 76 cases with spinal tuberculosis, the most common age group for involvement is 40 – 49 years, and the most common site of infection is thoracal. In children the local kyphosis deformity increases with growth , and this can be avoided by adding posterior instrumentation to anterior fusion especially in patients near adolescence. Anterior debridement and fusion alone is not sufficient in correcting local kyphosis and this may also result in serious correction losses.

Posterior fusion and instrumentation following anterior debridement and anterior strut grafting in thoracal and lumbar regions and posterior instrumentation following posterolateral debridement and interbody fusion in lumbosacral junctional involvements yielded good results with high fusion rates.

When there is long or multiregional involvement, in such cases as osteoporosis where it was not possible to achieve stability by anterior instrumentation per se and if adequate correction could not be obtained by anterior instrumentation, posterior instrumentation is the first choice of

ANTERIOR INSTRUMENTATION IN POTT'S DISEASE

treatment to correct local kyphosis and to establish physiologic sagittal contours. Neural decompression improved the neurologic symptoms at a rate as high as 92.6 %. Additionally, contrary to the common belief, anterior instrumentation following anterior radical debridement and anterior autologous strut grafting can be a good treatment option with low complication rate, high correction rate in acute local kyphosis, and high fusion rate.

REFERENCES

1. Slucky, A.V. and Eismont, F.J. : In : Bridwell KH, DeWald RL, Eds., The Textbook of Spinal Surgery (Lippincott - Raven Publishers, Philadelphia). 1997. 2141/2183. Spinal infections.
2. Moon, M.S. : Spine. 1997. : 22 (15 . 1791/1797. Spine update : tuberculosis of the spine.
3. Nemir, R.L. and Krasinski, K. : Pediatr. Infect. Dis. J. 1988. 7 (6). 375/379. Tuberculosis in children and adolescents in the 1980s.
4. Janssens, J.P. and de Haler, R. : Clin. Orthop. 1990. 257. 67/75. Spinal tuberculosis in a developed country. A review of 26 cases with special emphasis on abscess and neurologic complications.
5. Ellinas, P.A. and Rosner, F. : N.Y. State J. Med. 1990. 90(12). 588/591. Pott's disease in urban populations. A report of five cases and review of the literature.
6. Güven, O., Kumano, K., Yalçın, M., and Tsuji, S. X. : Spine. 1994. 19(9). 1039/1043. Pott's disease in urban populations. A report of five cases and review of the literature.
7. Güven, O., Yalçın, S., Karahan, M., and Esemeli, T. : Am. J. Orthop. 1995. 24(5). 421/425. Transpedicular drainage of Pott's abscess. A report of two cases.
8. Domaniç, Ü., Hamzaoğlu, A., Şar, C., and Yavuzer, Y. : J. Turkish Spine Surg. 1993. 4(1). 16/19. Posterior fusion and instrumentation after anterior radical debridement and fusion in the surgical treatment of Pott's disease.
9. Surat, A., Acaroğlu, E., Özdemir, N., Yazıcı, M., and Memikoğlu, Ş. : J. Turkish Spine Surg. 1991. 2(2). 16/18. Pott's disease. Analysis of one hundred cases followed longer than twelve months.
10. Korkusuz, Z., Binnet, M.S., and Işıklar, Z.U. : Arch. Orthop. Trauma. Surg. 1989. 108(6). 349/359. Pott's disease and extrapleural anterior decompression. Results of 108 consecutive cases.

11. Korkusuz, F., İslam, C., and Korkusuz, Z. : World J. Surg. 1997. 21(5). 524/528. Prevention of postoperative late kyphosis in Pott's disease by anterior decompression and intervertebral grafting.
12. Açıkgöz, B., Özcan, O.E., Belen, D., Erben, A., and Özgen, T.: Paraplegia. 1991. 29(8). 537/541. Surgery for progressive Pott's paraplegia (Tuberculous paraplegia).
13. Benli, İ.T., Aydın, E., Kış, M., Akalın, S., Tüzüner, M., and Baz, A.B. : J. Turkish Spine Surg. 1996. 7(3). 98/101. The results of anterior instrumentation in vertebral tuberculosis.
14. Aydın, E., Kış, M., Benli, İ.T., Solak, Ş., Gider, M., and Yücesoy, C. : J. Turkish Spine Surg. 1994. 5(4). 166/169. Pott's disease. Retrospective evaluation of results.
15. Bosworth, D.M., Pietra, A.D., and Farrel, R.F. : J. Bone Joint Surg. 1950. 32-A. 103/107. Streptomycin in tuberculous bone and joint lesions with mixed infection and sinuses.
16. Hodgson, A.R. and Stock, F.E. : Clin. Orthop. 1994. 300. 16/23. Anterior spinal fusion. A preliminary communication on the radical treatment of Pott's disease and Pott paraplegia.
17. Hodgson, A.R., Stock, F.E., Forg, H.S.Y., and Ong, G.B. : Br. J. Surg. 1960. 48. 172/178. Anterior spinal fusion : the operative approach and pathological findings in 412 patients with Pott's disease of the spine.
18. Hodgson, A.R., Yau, A., Kwan, J.S., and Kim, D. : Clin. Orthop Rel. Res. 1964. 36. 128/150. A clinical study of one hundred consecutive cases of Pott's paraplegia.
19. Kemp, H.B.S., Jackson, J.W., Jeremiah, J.D., and Cook, J. : J. Bone Joint Surg. 1973. 55-B. 715/734. Anterior fusion of the spine for infective lesions in adults.
20. Yau, A.C.M.C., Hsu, L.C.S., O'Brain, J.P., and Hodgson, A.R. : J. Bone Joint Surg. 1974. 56-A. 1419/1434. Tuberculosis kyphosis : correction with spinal osteotomy halopelvis distraction and anterior and posterior fusion.
21. Bailey, H.L., Gabriel, M., Hodgson, A.R., and Shin, J.S. : J. Bone Joint Surg. 1972. 54-A. 1633/1657. Tuberculosis of the spine in children. Operative findings and results in one hundred consecutive patients treated by removal of lesions and anterior grafting.
22. Moula, T., Fowles, J.V., Kassab, M.T., and Sliman, N. : Int. Orthop. 1981. 5(1). 23/29. Pott's paraplegia : a clinical review of operative and

ANTERIOR INSTRUMENTATION IN POTT'S DISEASE

conservative treatment in 63 adults and children.

23. Rajasekaran, S. and Soundarapendian, S. : J. Bone Joint Surg. 1989. 71-A. 1314/1323. Progression of kyphosis in tuberculosis of the spine treated by anterior arthrodesis.

24. Tuli, S.M. : Int. Orthop. 1995. 19. 327/331. Current concept. Severe kyphotic deformity in tuberculosis of the spine.

25. Schulitz, K.P., Kothe, R., Leong, J.C.Y., and Wehling, P. : Spine. 1997. 22(10). 1150/1155. Growth changes of solid fusion kyphotic bloc after surgery for tuberculosis.

26. Pattison, P.R. : Paraplegia. 1986. 24(2). 77/91. Pott's paraplegia : an account of the treatment of 89 consecutive patients.

27. Loembe, P.M. : Paraplegia. 1995. 33(10). 579/584. Medical - surgical treatment of progressive tuberculous (Pott's) paraplegia in Gabon.

28. Rezai, A.R., Lee, M., Cooper, P.R., Errico, T.J., and Koslow, M. : Neurosurgery. 1995. 36(1). 87/97. Modern management of spinal tuberculosis.

29. Felländer, M. : Paraplegia. 1975. 13. 75/88. Paraplegia in spondylitis : results of operative treatment.

30. Moon, M.S., Ha, K.Y., Sun, D.H., Moon, Y.W., and Chung, J.H. : Clin. Orthop. 1996. 323. 122/128. Pott's paraplegia. 67 cases.

31. Hsu, L.C., Cheng, C.L., and Leong, J.C. : J. Bone Joint Surg. 1988. 70 (4)-B. 534/538. Pott's paraplegia of late onset. The cause of compression and results after anterior decompression.

32. Frankel, H.L., Hancock, D.O., Hyslop, G., Melzah, J., Michaelis, L.S., Ungar, G.H., Vernon, J.D., and Walsh, J.J. : Paraplegia. 1969. 7. 179/192. The value of postural reduction in the initial management of closed injuries of the spine with paraplegia and tetraplegia.

33. Desai, S.S. : J. Bone Joint Surg. 1994. 76-B(6). 863/869. Early diagnosis of spinal tuberculosis by MRI.

34. Hoffman, E.B., Crusier, J.H., and Cremin, B.J. : J. Bone Joint Surg. 1993. 75-B(2). 233/239. Imaging in children with spinal tuberculosis. A comparison of radiography, computed tomography and magnetic resonance imaging.

35. Medical Research Council Working Party on Tuberculosis of the Spine. : J. Bone Joint Surg. 1985. 67-B. 103/110. A 10 year assesment of controlled trials of the patient and outpatient treatment and plaster of Paris jackets for tuberculosis of the spine in children on standard chemotherapy studies in Pusan and Mason, Korea.

36. Thirteenth Report of the Medical Research Council Working Party on Tuberculosis of the Spine. : J. Bone Joint Surg. 1998. 80-B(3). 456/462. A 15 - year assessment of controlled trials of the management of tuberculosis of the spine in Korea and Hong Kong.
37. Govender, S. and Parbhoo, A.H. : J. Bone Joint Surg. 1999. 81-B(1). 106/109. Support of the anterior column with allograft in tuberculosis of the spine.
38. Bradford, D.S. and Daher, Y.H. : J. Bone Joint Surg. 1986. 68-B. 357/361. Vascular rib graft for stabilization of kyphosis.
39. Louw, J.A. : J. Bone Joint Surg. 1990. 72-B. 686/693. Spinal tuberculosis with neurologic deficit. Treatment with anterior vascularized rib grafts, posterior osteotomies and fusion.
40. Kim, N.H., Lee, D.H.M., Choi, C.H., and Park, S.J. : J. Turkish Spine Surg. 1994. 5(2). 49/58. The comparison of the fusion rate in anterior interbody fusion between noninfectious and infectious disease of the spine.
41. Asher, M.A. : In : Bridwell, K.H., DeWald, R.I. Eds. The Textbook of Spinal Surgery. (Lippincott - Raven Publishers, Philadelphia). 1997. 569/609. Isola spinal instrumentation system for scoliosis.
42. Johnston, C.E. II, Ashman, R.B., Richards, B.S., and Herring, J.A. : In : Bridwell, K.H., DeWald, R.I. Eds. The Textbook of Spinal Surgery. (Lippincott - Raven Publishers, Philadelphia). 1997. 535/567. TSRH Universal Spine Instrumentation.
43. Richards, B.S., Herring, J.A., Johnston, C.E., Birch, J.G., and Roach, J.W. : Spine. 1994. 19. 1598/1605. Treatment of adolescent idiopathic scoliosis using Texas Scottish Rite Hospital Instrumentation.
44. Kostuik, J.P. : Spine. 1983. 8 (5). 512/531. Anterior spinal cord decompression for lesions of the thoracic and lumbar spine, techniques, new methods of internal fixation results.
45. Zdeblick, T.A. : American Academy of Orthopaedic Surgeons Annual Meeting. February 22 - 26. Atlanta. Georgia. 1996. Thoracolumbar fractures. New anterior instrumentation.
46. Hopf, C., Eysel, P., and Dubousset, J. : Eur. Spine J. 1995. 4. 194/199. CDH : Preliminary report on new anterior spinal instrumentation.
47. Hopf, C., Eysel, P., and Dubousset, J. : Spine. 1997. 22(6). 618/628. Operative treatment of scoliosis with Cotrel - Dubousset - Hopf instrumentation.

ANTERIOR INSTRUMENTATION IN POTT'S DISEASE

Table - I. Mean follow - up time (months), average number of instrumented mobile segments (IM) and preoperative (PR) and postoperative (PO) average values of local kyphosis angle (LK) of the adult patients operated with different surgical approaches (Only anterior drainage and debridement and fusion : AD + AF, anterior radical debridement and anterior strut grafting and posterior instrumentation and fusion in the same session : AD + PI, posterolateral drainage and posterolateral fusion and posterior instrumentation : PL + PI and anterior radical debridement and anterior instrumentation : AD+AIN) and correction percentages (CP) and loss of correction (LC) values in the last visit (n : number of the patients).

	FOLLOW UP	IM	PRLK	POLK	z	P	CP	LC
AD + AF (n : 8)	51.5 ± 30.5	0	11.1° ± 11.5°	8.9° ± 8.7°	(-1.34)	< 0.05	8.6 ± 17.1	23.6° ± 3.5°
AD + PI (n : 11)	37.1 ± 11.7	6.4 ± 2.9	18.0° ± 8.3°	5.5° ± 6.3°	(-2.93)	< 0.05	76.8 ± 19.5	2.5° ± 1.6°
PL + PI (n : 8)	40.8 ± 11.1	3.0 ± 2.9	10.3° ± 7.4°	3.4° ± 5.5°	(-2.52)	< 0.05	80.0 ± 24.5	2.9° ± 1.6°
AD + AIN (n : 45)	32.6 ± 9.5	2.4 ± 0.7	23.2° ± 12.5°	6.1° ± 6.9°	(-5.84)	< 0.05	77.4 ± 22.3	2.9° ± 2.7°
TOTAL (n : 72)	36.3 ± 14.7	2.8 ± 2.1	19.6° ± 12.3	6.0° ± 6.9°	(-7.21)	< 0.05	69.9 ± 30.4	5.2° ± 7.1°

Table - II. According to different type of the surgical methods, the number of the patients and their percentages of postoperative neurologic complete healing (C) and partial improvement (P) and non - improvement (NI), deterioration of neurologic status in early and late postoperative period (D) .

(Only anterior drainage and debridement and fusion : AD + AF, anterior radical debridement and anterior strut grafting and posterior instrumentation and fusion in the same session : AD + PI, posterolateral drainage and posterolateral fusion and posterior instrumentation : PL + PI and anterior radical debridement and anterior instrumentation : AD+AIN)
(nd : number of the patients with neurologic deficit, n : number of the patients)

	C		P		NI		D	
	nd	%	nd	%	nd	%	nd	%
AD + AF (n : 8)	1	50	1	50	0	0	0	0
AD + PI (n : 11)	5	71.4	1	14.3	1	14.3	0	0
AD + AIN (n : 45)	14	77.8	3	16.7	1	5.6	0	0
TOTAL (n : 72)	20	74.1	5	18.5	2	7.4	0	0

Figure - 1. Breakdown of the ages of adult patients according to decade .
(No. : number of the patients)

DECADE	No.	%
19 - 29	14	19.4
30 - 39	16	22.2
40 - 49	19	26.4
50 - 59	12	16.7
60 - 69	11	15.3
70 +	0	0
TOTAL	72	100

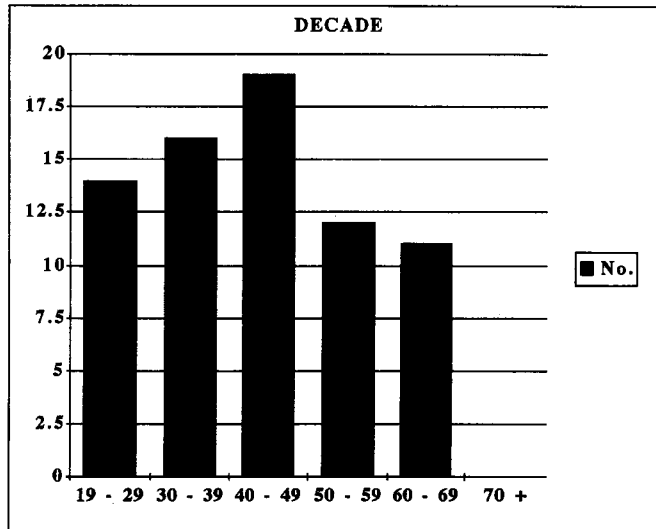
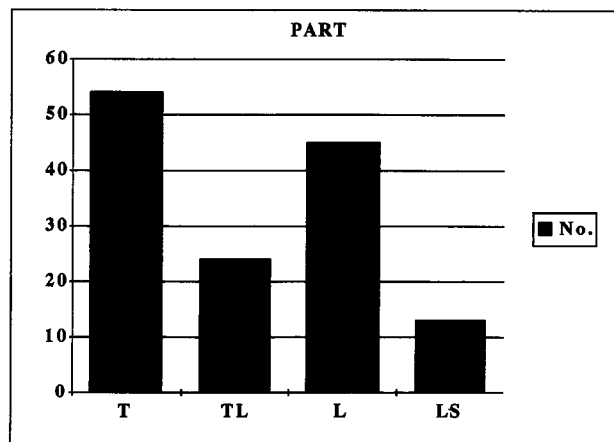


Figure - 2. Breakdown of the affected vertebra with tuberculosis of the adult patients according to region of the spinal column.(No. : number of the affected vertebrae, T : thoracal, TL: thoracolumbar, L : lumbar, LS : lumbosacral)

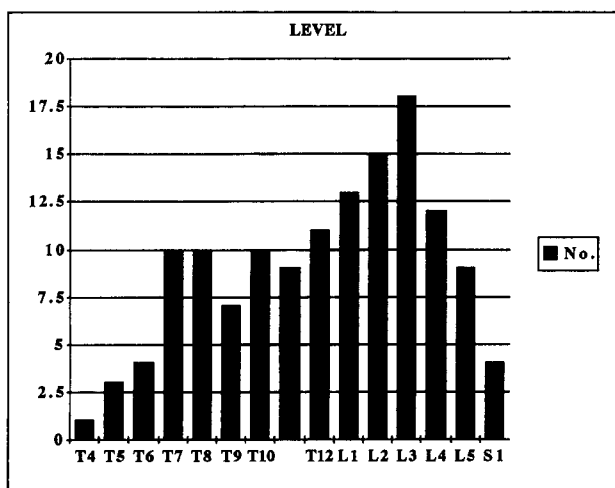
PART	No.	%
T	54	39.7
TL	24	17.6
L	45	33.1
LS	13	9.6
TOTAL	136	100



ANTERIOR INSTRUMENTATION IN POTT'S DISEASE

Figure - 3. Breakdown of the affected vertebra with tuberculosis of the adult patients according to level of vertebra. (No. : number of the affected vertebrae, T : thoracic, TL : thoracolumbar, L : lumbar, S : sacral)

LEVEL	No.	%
T4	1	0.7
T5	3	2.2
T6	4	2.9
T7	10	7.4
T8	10	7.4
T9	7	5.1
T10	10	7.4
T11	9	6.6
T12	11	8.1
L1	13	9.6
L2	15	11
L3	18	13.2
L4	12	8.8
L5	9	6.6
S1	4	2.9
TOTAL	136	100



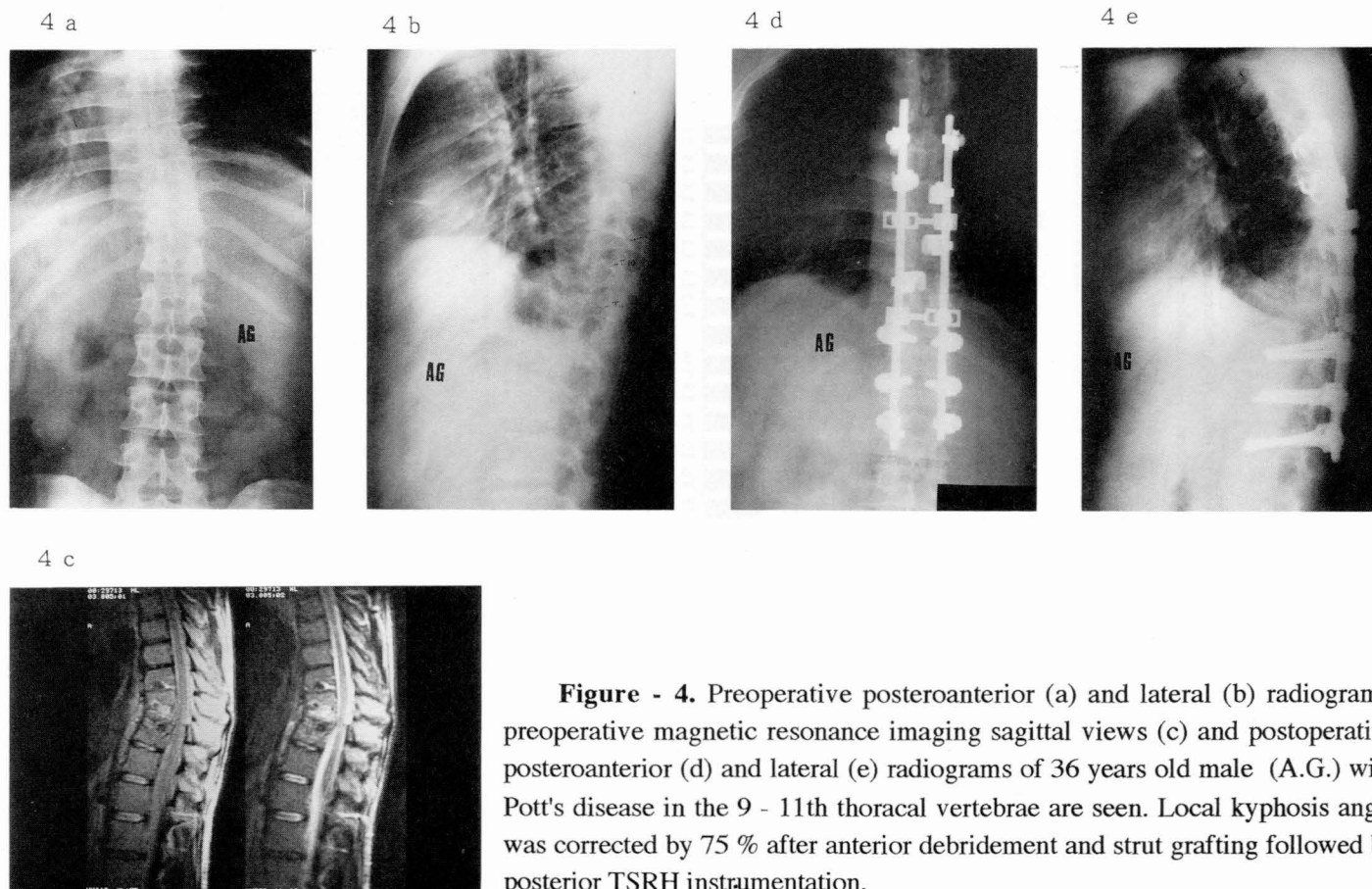


Figure - 4. Preoperative posteroanterior (a) and lateral (b) radiographs, preoperative magnetic resonance imaging sagittal views (c) and postoperative posteroanterior (d) and lateral (e) radiographs of 36 years old male (A.G.) with Pott's disease in the 9 - 11th thoracal vertebrae are seen. Local kyphosis angle was corrected by 75 % after anterior debridement and strut grafting followed by posterior TSRH instrumentation.

ANTERIOR INSTRUMENTATION IN POTT'S DISEASE

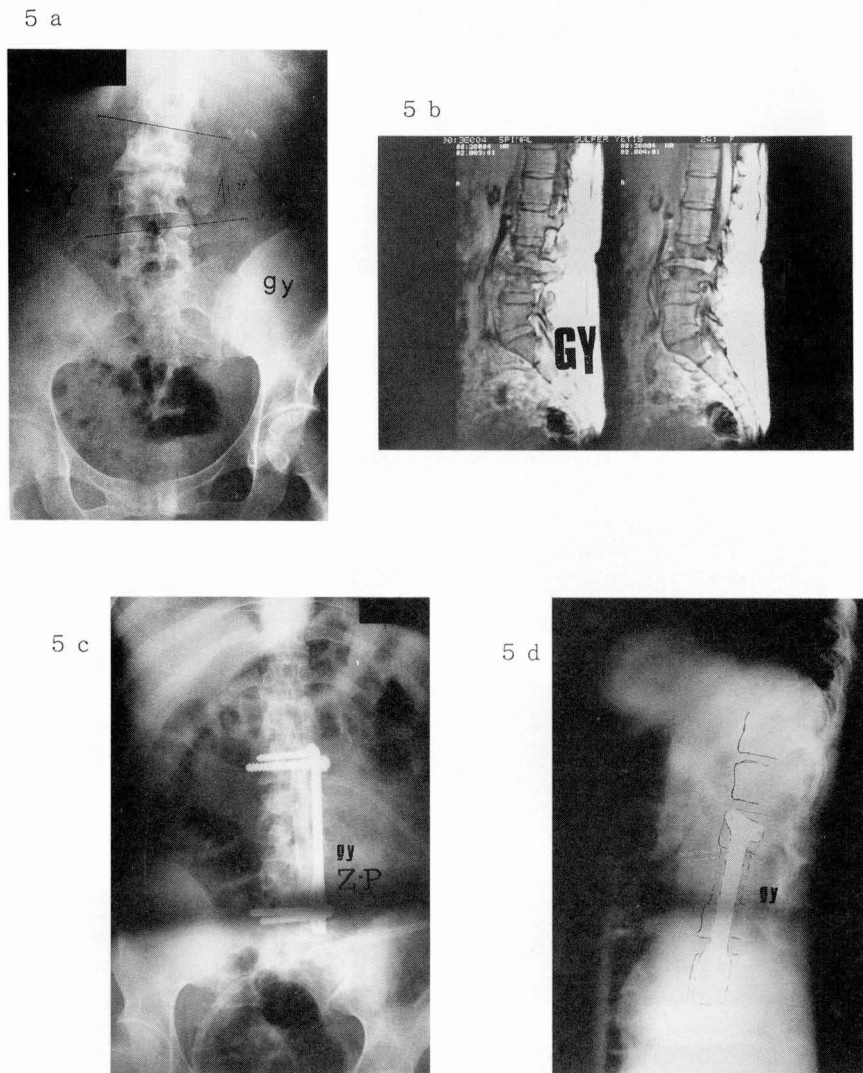


Figure - 5. Preoperative posteroanterior (a) and preoperative magnetic resonance imaging frontal and sagittal views (b, c) and postoperative posteroanterior (c) and lateral (d) radiograms of 31 years old female (G.Y.) with Pott's disease in the lumbar 4 vertebrae are seen. Two mobile segment were instrumented with anterior Z - plate and 78 % of correction rate was obtained after anterior radical debridement and strut grafting.

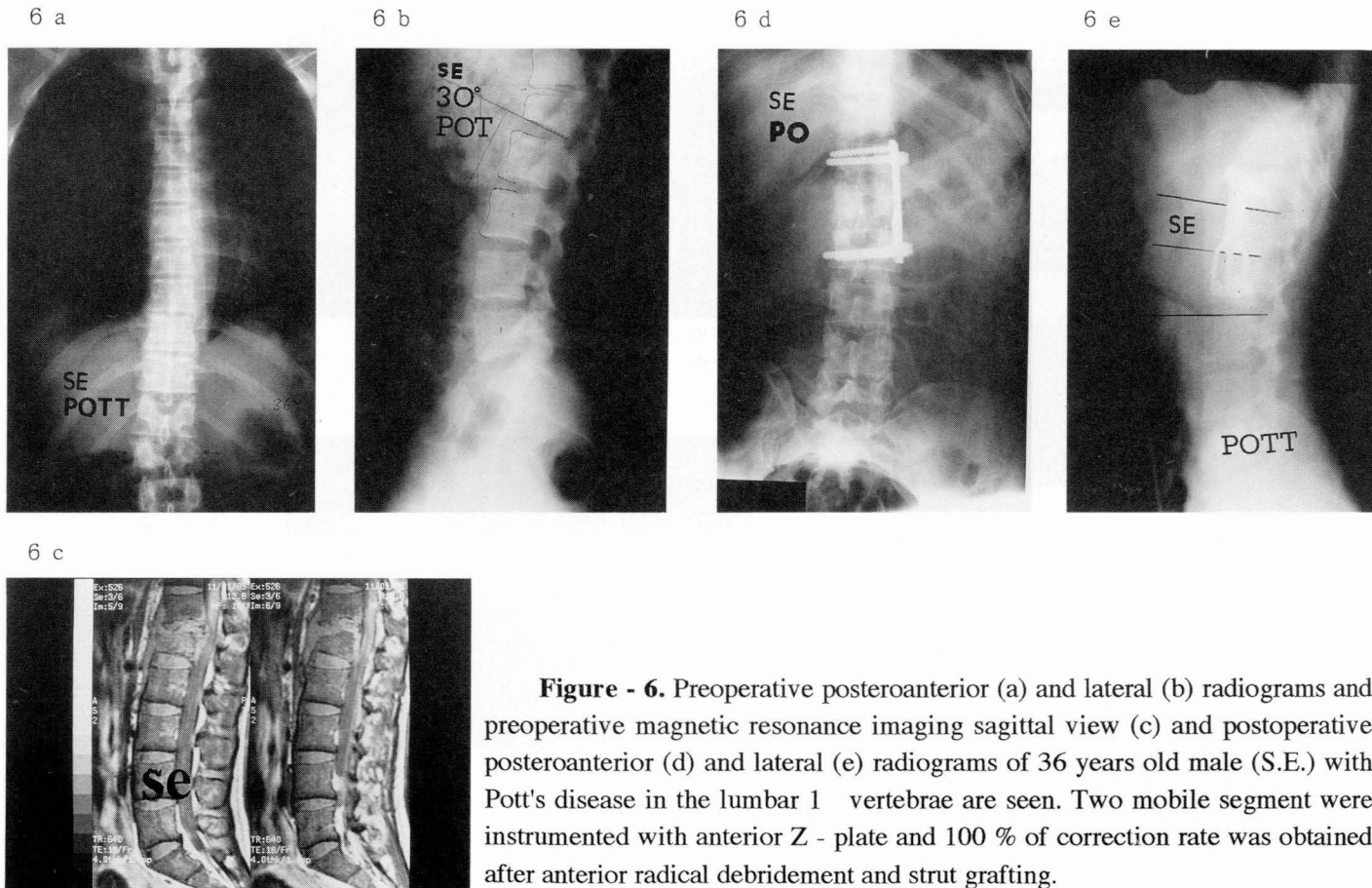


Figure - 6. Preoperative posteroanterior (a) and lateral (b) radiographs and preoperative magnetic resonance imaging sagittal view (c) and postoperative posteroanterior (d) and lateral (e) radiographs of 36 years old male (S.E.) with Pott's disease in the lumbar 1 vertebrae are seen. Two mobile segment were instrumented with anterior Z - plate and 100 % of correction rate was obtained after anterior radical debridement and strut grafting.

ANTERIOR INSTRUMENTATION IN POTT'S DISEASE

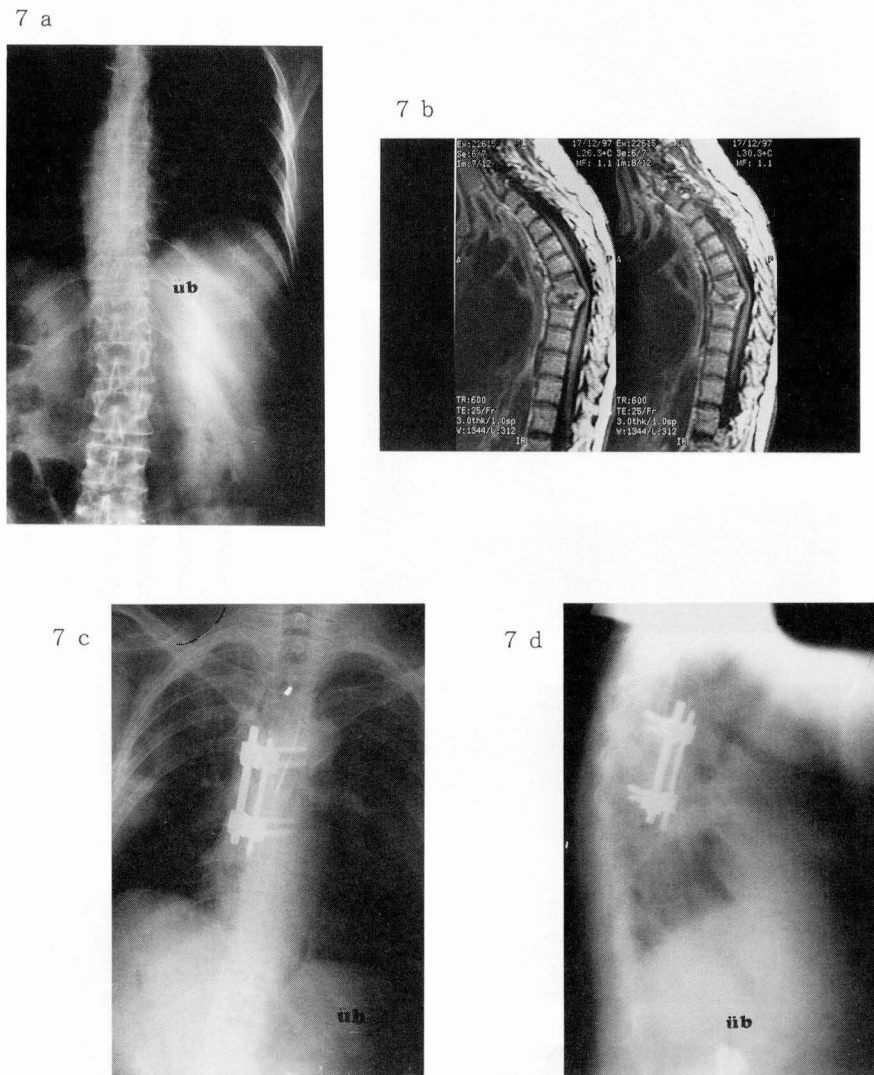


Figure - 7. Preoperative posteroanterior (a) and preoperative magnetic resonance imaging sagittal views (b) and postoperative posteroanterior (c) and lateral (d) radiograms of 29 years old male (Ü.B.) with Pott's disease in the 7th - 8th thoracal vertebrae are seen. In the local kyphosis angle, 100 % of correction rate was obtained after anterior debridement and strut grafting followed by anterior CDH instrumentation.

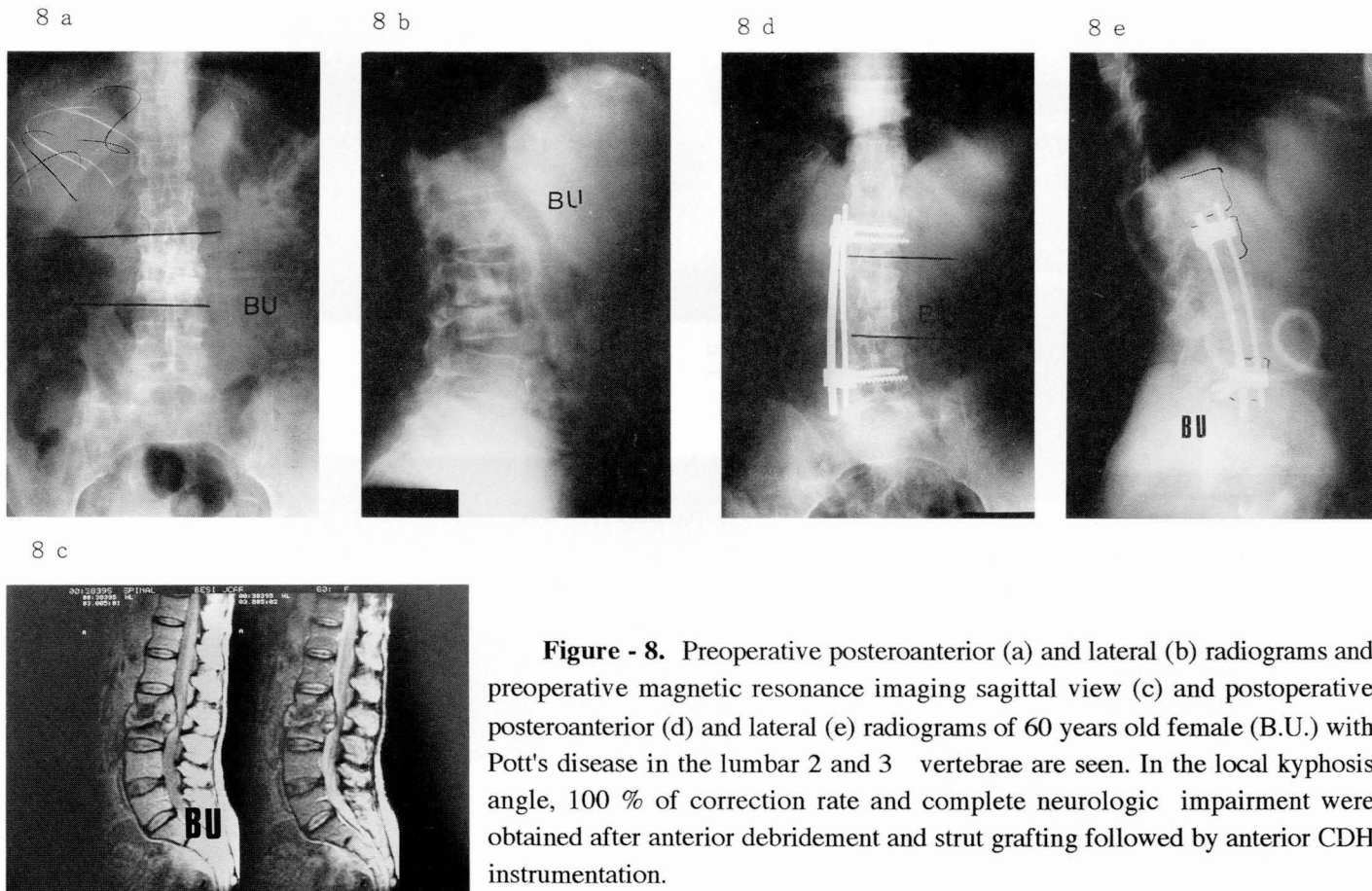


Figure - 8. Preoperative posteroanterior (a) and lateral (b) radiograms and preoperative magnetic resonance imaging sagittal view (c) and postoperative posteroanterior (d) and lateral (e) radiograms of 60 years old female (B.U.) with Pott's disease in the lumbar 2 and 3 vertebrae are seen. In the local kyphosis angle, 100 % of correction rate and complete neurologic impairment were obtained after anterior debridement and strut grafting followed by anterior CDH instrumentation.