World J. Surg. 21, 524–528, 1997

WORLD
Journal of
SURGERY

Prevention of Postoperative Late Kyphosis in Pott's Disease by Anterior Decompression and Intervertebral Grafting

Feza Korkusuz, M.D.,[1] Cihangir İslam, M.D.,[2] Zeki Korkusuz, M.D.[3]

[1]Medical Center, Middle East Technical University, İnönü Bulvarı, 06531 Ankara, Turkey
[2]Department of Orthopedic Surgery and Traumatology, Van 100, Yıl University Medical School, Van, Turkey
[3]Department of Orthopedic Surgery and Traumatology, Ankara University Medical School, İbn-i Sina Hospital, Ankara, Turkey

Abstract. A total of 185 patients with Pott's disease were operated on between 1973 and 1992. Anterior decompression by preserving the pleura (extrapleural approach) was the preferred method in the thoracic spine. In the lumbar spine the approach was retroperitoneal, and interbody fusion was performed in both for the thoracic and the lumbar regions. Anterior decompression and intervertebral grafting comprised the treatment. In five patients, internal fixation accompanied anterior decompression and intervertebral grafting. The aim of instrumentation was to enhance anterior spinal stability, and Alıcı spinal instrumentation was the preferred device. Graft destruction and a late increase in kyphosis was prevented by this means. The mean follow-up period was 7.5 years. Thirty-two of the cases were admitted to the clinic because of Pott's paraplegia: 19 of the cases recovered completely following anterior decompression; partial recovery was observed in 5 cases; but 8 cases did not recover. Various complications, including seven deaths, were observed in 42 of the cases.

Paraplegia and progressive kyphosis are the most common complications of Pott's disease. Because of the changing pattern of the disease, such as subsidence of the clinical and laboratory findings, late diagnosis is a common pitfall. The final outcome of late diagnosis is multilevel involvement, and maintenance of spinal stability needs to be investigated in these cases [1].

Hodgson et al. in 1960 reported successful results with anterior decompression and spinal fusion in 418 patients [2]. Clinical studies performed in Turkey are in accordance with that study and reveal the importance of anterior decompression and interbody fusion, especially when the mechanical stability of the spinal column is concerned [3–6]. Alıcı performed anterior decompression surgery in 227 patients with Pott's disease [7]. The level of involvement in most of the cases was the thoracolumbar region. Alıcı stressed the drawbacks of conservative treatment as: (1) progression of kyphosis; (2) maintenance of the abscess; and (3) increased risk of paraplegia. The preferred method of treatment was anterior decompression and grafting in all of the cases [7]. Findings in 108 cases of Pott's disease treated by extrapleural anterior decompression revealed the advantage of early postoperative rehabilitation [8]. Nevertheless, without internal fixation a significant increase in kyposis is observed during long-term follow-up. Tabakım et al. presented 24 cases with 32 months follow-up [9]. Resorption of the grafts and progression of spinal instability were significant in all of the cases. Stabilization by anterior or posterior instrumentation (or both) is recommended to prevent the occurrence of spinal instability and gibbosity, especially in children and young adults.

The aim of management in Pott's disease is eradication of the infection and preventing neurologic deficits and spinal deformity [10]. Although prospective long-term follow-up studies of randomized clinical trials reveal that there is no significant increase in the gibbus angle [11], we believe that spinal destruction in Pott's disease should be evaluated with the same exacting criteria used for the assessment of stability of vertebral fractures. We therefore recommend anterior decompression, intervertebral fusion, and internal fixation in cases with findings of: (1) multilevel involvement; (2) young patients with possible progression of gibosity; and (3) significant criteria (i.e., increased angulation in the sagittal plane) of instability.

Clinical Material

Of the 185 patients, 99 (53.5%) were female and 86 (46.5%) were male. The youngest patient was 4 and the oldest 84 years old (mean 36.2 years). The level of involvement is presented in Table 1. A total of 119 patients had a single level lesion; 55 patients had two levels involved; and 11 patients had more than two levels of involvement. Eighty-three patients (44.9%) had an abscess formation radiologically, and three patients (1.6%) presented with an opening to the abscess clinically. Altogether 31.4% of the cases presented various neurologic findings: 32 patients had complete paraplegia when admitted to the hospital. In 28 patients (15.1%) tuberculosis was present in other organ systems. The diagnosis is verified histopathologically in all the cases. All patients received chemotherapy according to a standard protocol (Table 2). Eleven cervical Pott lesions (5.9%) were treated surgically by the modified Cloward technique. Thoracotomy through removal of the third rib was the approach to lesions in seven (3.8%) cases in which the level of the lesion was between the thoracic first and fourth vertebrae. In 77 lesions (41.6%) of the T4–11 level,

Correspondence to: F. Korkusuz, M.D.

Table 1. Distribution of the level of spinal involvement (n = 185).

Level	No. of patients	%
C4–7	11	5.9
T1–4	7	3.8
T5–11	77	41.6
T11–L1	50	27.0
L2–5	40	21.6

Table 2. Chemotherapy protocol.

Medicine	Application period (months)	Dosage (mg/kg/day)
Streptomycin	0–2	20
Rifampicin	0–6	10–20
Isoniazid	1–12	10–20
Pyrazinamide	0–3	30

exposure to the infection area was by removal of the one above rib to the apex of the lesion. Fifty lesions (27.0%) between the T11 and L1 level were exposed by the retroperitoneal approach as described previously [8], and 40 lumbar lesions (21.6%) were divulged via the anterior retroperitoneal approach. The retropleural approach was preferred in 20 cases (10.8%) with a limited pulmonary capacity.

In patients with thoracic involvement the excised rib was preferred as the grafting material. In the cervical and lumbar cases bicortical iliac grafts were endorsed. External bracing for 10 to 12 months was advised in all the cases except for cases where internal fixation was performed (Fig. 1). Postoperative rehabilitation started on day 2, and patients were mobilized for at least 2 weeks. The mean hospital stay was 19 days.

Preoperative mean kyphosis was 16.2 degrees (Table 3). A 9.1-degree correction was obtained during the immediate postoperative period, which then ended in 19.3 degrees of angulation during follow-up. In the thoracic and thoracolumbar region the mean preoperative kyphosis was 20.7 degrees, which improved to 11.2 degrees during the early postoperative period. The final angulation for these levels was 25.8 degrees. The loss of correction was minimum in cases of internal fixation.

Complications included seven deaths during the early postoperative period due to pulmonary embolism in three, myocardial infarction in one, and other reasons in three cases. Four patients had a superficial infection that recovered with proper antibiotic treatment. Neurologic deterioration due to surgery occurred in one case that resolved spontaneously in 2 weeks. In one patient the iliac vein was lacerated during surgery and was repaired immediately. In two patients who were operated on by the extrapleural method, pleural infusion occurred and thoracic synthesis was performed. Graft resorption occurred in 19 patients (10.3%). Destruction of the graft was present in 11 cases (5.9%) and sliding of the graft in four patients (2.2%).

Discussion

In 1985 the Medical Research Council Working Party on Tuberculosis of the Spine reported favorable results in cases treated nonoperatively with standard chemotherapy and spinal immobilization [11]. Ninety-seven percent of the patients treated for 9 months with chemotherapy alone had an auspicious outcome in 3 years, whereas only 85% of the surgically treated patients achieved satisfactory results [12].

Moon et al. presented their conservative treatment results of tuberculosis of the thoracic and lumbar spine in adults and children [13]. The outcome of chemotherapy alone was 95% satisfactory in 75 cases. The gibbus angle improved from 25.6 degrees to 11.0 degrees in children and from 17.1 degrees to 7.3 degrees in adults in 3 years. Although adult patients presented a limited improvement of kyphosis (5 degrees or less), children with involvement of more than three vertebral bodies improved up to 20 degrees. The mechanism of improvement of the gibbus angle by medical treatment is not clearly defined.

Even though antituberculous chemotherapy alone has definitive advantages, the presence of kyphosis remains a major problem. Konstam and Blesovsky used chemotherapy on an ambulatory basis, but, spinal deformity remained a problem [14]. Spontaneous posterior fusion may occur in medically treated patients, but it does not necessarily arrest the progression of kyphosis [15]. Dickson described worsening of the gibbus angle in many of his patients [16]. The final angulation was higher in patients with severe initial kyphosis. When two or more vertebral bodies are involved the destruction may terminate with significant angulation. Thoracic deformity may restrict pulmonary activity and impair cardiac function. Severe kyphosis may also affect the patient cosmetically and should be prevented as early as possible.

The middle-path regimen of surgical intervention only when medical management fails is described by Tuli [17]. The first step of treatment begins with chemotherapy followed by decompression when medical treatment fails or when patients are affected neurologically. Surgery is the initial method of treatment in patients with a doubtful diagnosis, posterior spinal lesions, instability after healing, or recurrence of the disease. Adult patients with mild neurologic findings may not need to undergo surgery [18]. This concept may also be true for those with mild kyphosis, as the increase in kyphosis in children was not present in adults treated medically.

Increased spinal deformity, recurrence of the disease, and development of paralysis are significantly less in patients when surgery is performed in combination of chemotherapy [19]. The recovery rate of the neurologic impairment is also high in patients undergoing surgery [10]. Hsu and Leong preferred a combination of the modified Hong Kong operation and chemotherapy [15]. Surgical removal of infection and anterior stabilization by grafting eliminate late complications such as paraplegia, progressive kyphosis, recurrence of the disease, and amyloidosis [15].

Surgical indications include the need for diagnosis, the presence of abscess formation, spinal cord compression, excessive vertebral destruction, spinal instability, and failure of medical treatment. In the absence of neurologic symptoms, involvement of more than one vertebra significantly increases the risk of kyphosis. Severe kyphosis with active disease, symptoms of cord compression, progressive impairment of pulmonary function, collapse, and progressive kyphotic deformity are other indications for surgery [20]. Surgery for the treatment of tuberculosis of the spine is performed to drain the abscess and débride the sequestered bone and infected soft tissues. Decompressing the spinal cord or stabilizing the spinal column to prevent or correct the deformity are the other aims of surgery. The results of surgery are superior

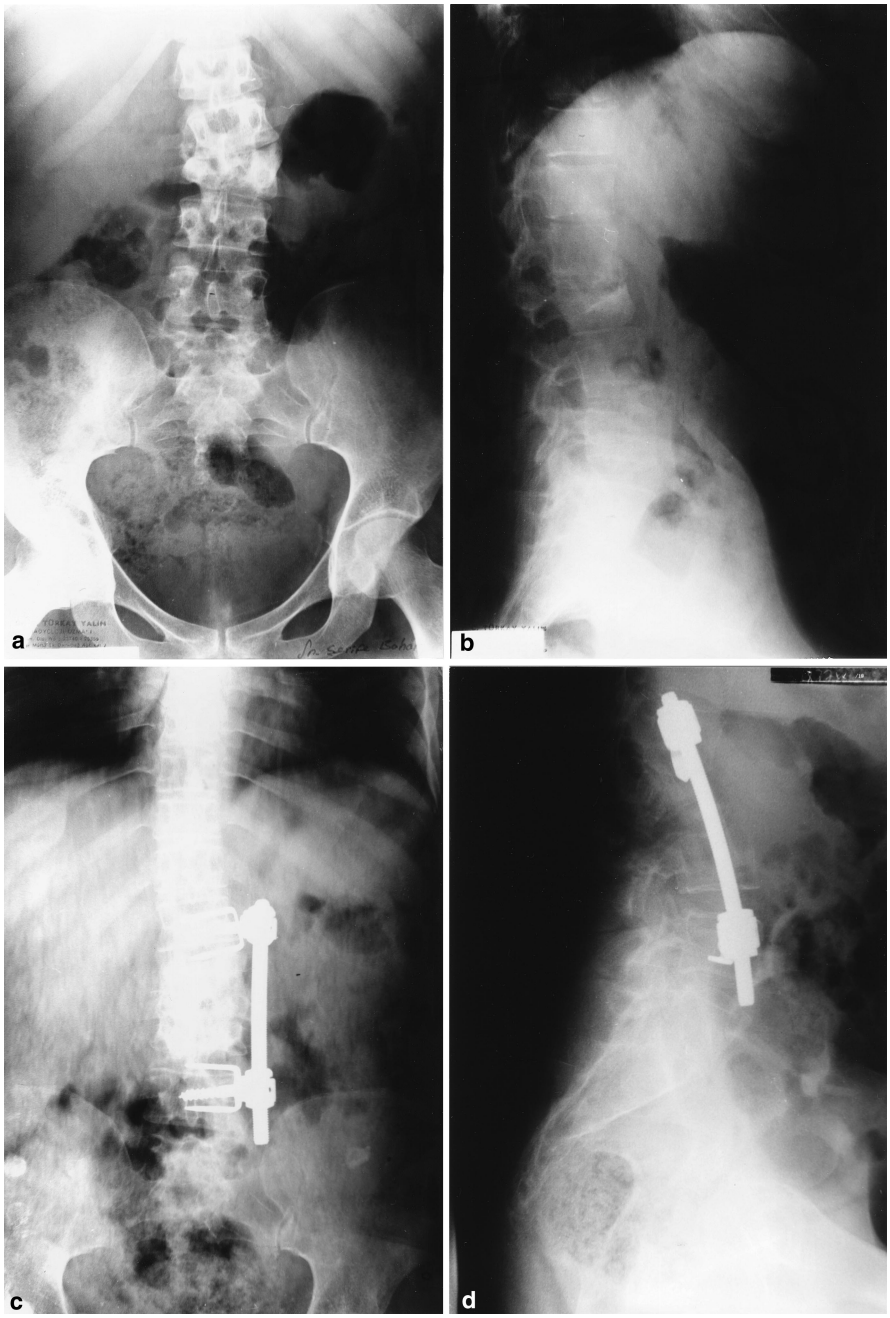

Fig. 1. Single level (L3) destruction due to Pott's disease in a 27-year-old woman patient. Preoperative anteroposterior (**a**) and lateral (**b**) radiographic findings of the patient reveal instability of the spine. Anterior decompression, intervertebral grafting, and internal fixation comprised the method of treatment. Postoperative anteroposterior (**c**) and lateral (**d**) radiologic findings reveal satisfactory results using the Alıcı spinal system.

Table 3. Preoperative kyphosis measurements in 185 patients.

Preoperative kyphosis	No. of patients
Mild (0–30°)	116 (62.7%)
Moderate (30–60°)	52 (28.1%)
Severe (> 60°)	17 (9.2%)

to conservative treatment for Pott's paraplegia [21], and fusion rates are higher in the surgically treated patients [22].

Costotransversectomy is an alternative method in the surgical treatment of Pott's disease. The advantages of modified lateral rachotomy are as follows: (1) exposure of the anterior and posterior spinal structures in one incision; (2) anterior, posterior, and lateral decompression of the spinal cord; (3) exposure of three or four spinal levels; and (4) maintenance of stability due to the integrity of the countralateral side of the spinal column [23].

Hsu et al. stated that patients with mild or moderate paraplegia may be treated by stabilization alone [24], and anterior decompression should be preserved for patients with severe paralysis. Anterior surgery is also recommended for adequate extirpation of infection [16]. Despite a solid anterior fusion, progressive kyphosis occurs in some cases.

For most of the surgeries the angular deformity is corrected by inserting an anterior strut graft. Most commonly autogenous iliac crest or ribs are used for grafting. Fibular grafts, especially

vascularized ones, are preferred if the lesion involves two or more levels. Whatever the site of the graft obtained; the mechanical effectiveness of these grafts is in doubt. Experimental studies reveal that fibular grafts weaken at 6 weeks to 6 months [25]. Despite the fact that the strength of the graft is nearly normal at 1 year, total incorporation may take several years. In adults, 32% of the rib grafts fractured and kyphosis increased about 20% [26]. The possibility of graft resorption, graft fracture, and progressive kyphosis leads to a search for other methods that improve the stability of the spinal column. It can be either posterior fusion [13, 27] or anterior instrumentation [28]. Posterior fusion, with or without spinal instrumentation, is indicated after anterior decompression and grafting to prevent late collapse and the occurrence of stress fractures of the graft. High incidences of failure and late progression of kyphotic deformity, with or without fatigue fracture of the fusion, have followed posterior fusion alone. The latter does not necessarily control progressive kyphosis [29].

Tuberculous spondylitis typically involves the vertebral bodies and characteristically destroys the body with little or no new bone formation [30]. Different from staphylococcal infections, in which adhesion to the implant and biofilm production is observed [31], *Mycobacterium* species have no affinity for implants. If such a risk would be present, the application of graft material to the infection site would also be contraindicated. Rao et al. used spinal instrumentation to enhance anterior intervertebral fusion [28]. Of the 88 patients treated by the IVBF Dual-Plate application, 35 had tuberculosis in the spine. The 2- to 4-year follow-up revealed satisfactory results. One patient had a sinus at the surgical incision 2 years after operation.

Treatment of Pott's disease depends mainly on the facilities available and the experience of the surgeon. When the socioeconomic level is fair, chemotherapy with or without immobilization is highly recommended. When the expectancy of the patient is the major concern and surgical facilities are well developed, the recommended treatment is anterior decompression and grafting [32]. Our experience with surgical treatment of Pott's disease revealed that 75% of the patients totally or partially recovered from paraplegia. Anterior decompression, intervertebral grafting, and anterior instrumentation have been the preferred method at our institution since 1992.

Résumé

On a opéré 185 patients ayant un mal de Pott entre 1973 et 1992. La technique préférée en cas d'atteinte rachidienne thoracique a été une décompression antérieure par une approche extra-pleurale (en conservant la plèvre). Au niveau du rachis lombaire, on a utilisé une approche rétropéritonéale. Dans les deux localisations, on a pratiqué une fusion intercorporelle comportant une décompression antéricure et une greffe intercorporelle. Chez cinq patients, la fixation interne a été accompagnée d'une décompression vertébrale antérieure et une greffe intervertébrale. Le but de l'instrumentation étant d'améliorer la stabilité antérieure, on a utilisé alors l'instrumentation Alici. On a ainsi évité une dégénérescence du greffon et l'apparition tardive d'une cyphose. Le suivi moyen a été de 7.5 ans. Une paraplégie en rapport avec le mal de Pott a été notée chez 32 patients. Dix-neuf des ces cas ont récupéré complètement suivant la décompression antérieure. Une récupération partielle a été observée dans cinq cas. Huit patients, cependant, n'ont pas récupéré. D'autres complications, y compris sept décès, ont été observées chez 42 des patients.

Resumen

Ciento ochenta y cinco (185) pacientes con enfermedad de Potts fueron operados entre 1973 y 1992. La descompresión anterior conservando la pleura (abordaje extrapleural) fue el método preferido para la enfermedad ubicada en la columna torácica. En la columna lumbar el abordaje fue retroperitoneal y, se practicó fusión intercorporal tanto en la región torácica como en la lumbar. El método de tratamiento consistió en la descompresión anterior e injerto intervertebral. En cinco pacientes se practicó fijación interna junto con la descompresión anterior y el injerto intervertebral. El propósito de la instrumentación fue incrementar la estabilidad vertebral anterior; la instrumentación vertebral de Alici fue el métodos preferido, con lo cual se previno la destrucción del injerto y el aumento tardío de la citosis. El período de seguimiento promedio fue de 7.5 años. Treinta y dos de los casos fueron hospitalizados por paraplejía de Potts, y diecinueve tuvieron recuperación completa luego de la descompresión anterior. Se observó recuperación parcial en cinco casos. Sin embargo, en ocho pacientes no se logró recuperación. Diversas complicaciones, 7 de ellas fatales, se registraron en 42 casos de esta serie.

References

1. Ingalhalikar, V.T.: T.B. spine. J. Turk. Spinal Surg. *5*:82, 1994
2. Hodgson, A.R., Stock, F.E., Forg, H.S.Y., Ong, G.B.: Anterior spinal fusion: the operative approach and pathological findings in 412 patients with Pott's disease of the spine. Br. J. Surg. *48*:172, 1960
3. Altınmakas, M., Aydoğan, N., Şehirlioğlu, A., Solakoğlu, C.: Tuberculosis of the spine. J. Turk. Spinal Surg. *5*:124, 1994
4. Aydın, E., Kış, M., Benli, İ.T., Solak, S., Gider, M., Yücesoy, C.: Pott's disease: retrospective evaluation of results. J. Turk. Spinal Surg. *5*:166, 1994
5. Biçimoğlu, A., Ağaoğlu, S.: Evaluation of anterior fusion cases (in Turkish). In XI Annual Meeting of the Turkish Orthopaedic Surgery and Traumatology Association, Abstract Book. Ankara, THK Press, 1990, pp. 387–390
6. Canikoğlu, M., Azar, N., Mirzanlı, C., Karamehmetoğlu, M., Gülhan, H.: Our clinical concept of treatment of vertebral tuberculaosis. J. Turk. Spinal Surg. *3*:10, 1992
7. Alıcı, E.: Spinal Diseases and Deformities (in Turkish). İzmir, Dokuz Eylül University Publications, 1991, pp. 469–482
8. Korkusuz, Z., Binnet, M.S., Işıklar, U.: Pott's disease and extrapleural anterior decompression. Arch. Orthop. Trauma Surg. *108*:349, 1989
9. Tabakım, A.Y., Uçaner, A., Çulhaoğlu, M., Biçimoğlu, A., Günel, U.: The balance problem of patients treated with anterior fusion in Pott's disease. J. Turk. Spinal Surg. *3*:14, 1992
10. Currier, B.L., Eismont, F.J.: Infections of the spine. In The Spine (3rd ed.) H.N. Herkowitz, S.R. Grafin, R.A. Balderston, F.J. Eismont, G.R. Bell, S.W. Wiesel, editors. Philadelphia, Saunders, 1992, pp. 1319–1380
11. Medical Research Council Working Party on Tuberculosis of the Spine: A 10 year assessment of controlled trials of inpatient and outpatient treatment of and of plaster of Paris jackets for tuberculosis of the spine in children on standard chemotherapy: studies in Masan and Pusan, Korea. J. Bone. Joint. Surg. [Br.] *67*:103, 1985
12. Medical Research Council Working Party on Tuberculosis of the Spine: A comparison of 6 or 9 month course regime of chemotherapy in patients receiving ambulatory treatment or undergoing radical surgery for tuberculosis of the spine. Indian J. Tuberc. *36*(Suppl.):1, 1989
13. Moon, M.S., Kim, I., Woo, Y.K., Park, Y.O.: Conservative treatment

of tuberculosis of the thoracic and lumbar spine in adults and children. Int. Orthop. *11*:315, 1987
14. Konstam, P.G., Blesovsky, A.: The ambulant treatment of of spinal tuberculosis. Br. J. Surg. *50*:26, 1960
15. Hsu, L.C.S., Leong, J.C.Y.: Tuberculosis of the spine. In Surgery of the Musculoskeletal System (2nd ed.), C. McCollister Evarts, editor. New York, Churchill Livingstone, 1990, pp. 2299–2314
16. Dickson, R.A.: Spinal Surgery. London, Butterworth, 1990, pp. 496–505
17. Tuli, S.M.: Results of treatment of spinal tuberculosis by "middle-path" regime. J. Bone Joint Surg. [Br.] *57*:13, 1975
18. Lifeso, R.M., Weaver, P., Harder, E.H.: Tuberculous spondylitis in adults. J. Bone Joint Surg. [Am.] *67*:1405, 1985
19. Wood, G.W., II: Infections of spine. In Campbell's Operative Orthopaedics (8th ed.), A.H. Crenshaw, editor. St. Louis, Mosby-Year Book, 1992, pp. 3791–3823
20. Yau, A.C.M.C., Hsu, L.C.S., O'Brien, J.P., Hodgson, A.R.: Tuberculous kyphosis: correction with spinal osteotomy, halo-pelvic distraction, and anterior and posterior fusion. J. Bone Joint Surg. [Am.] *56*:1419, 1974
21. Guirguis, A.R.: Pott's paraplegia. J. Bone Joint Surg. [Br.] *49*:658, 1967
22. Neville, C.H., Davis, W.L.: Is surgical fusion still desirable in spinal tuberculosis? Clin. Orthop. *75*:179, 1971
23. Yonenobu, K., Korkusuz, F., Hosono, N., Ebara, S., Ono, K.: Lateral rhachotomy for thoracic spinal lesions. Spine *15*:1121, 1990
24. Hsu, L.C.S., Cheng, C.L., Leong, J.C.Y.: Pott's paraplegia of late onset: the cause of compression and results after anterior decompression. J. Bone Joint Surg. [Br.] *70*:534, 1988
25. Enneking, W.F., Burchardt, H., Phul, J.J., Piotrowski, G.: Physical and biological aspects of repair in dog cortical-bone transplants. J. Bone Joint Surg. [Am.] *57*:237, 1975
26. Kemp, H.B.S., Jackson, J.W., Jeremiah, J.D., Cook, J.: Anterior fusion of the spine for infective lesions in adults. J. Bone Joint Surg. [Br.] *55*:715, 1972
27. Kirkaldy-Willis, W.H., Thomas, T.G.: Anterior approaches in the diagnosis and treatment of infections of the vertebral bodies. J. Bone Joint Surg. [Am.] *47*:87, 1965
28. Rao, S.C., Mou, Z.S., Hu, Y.Z., Shen, H.X.: The IVBF dual-blade plate and its application. Spine *16*:112, 1991
29. Halpern, A.A., Rinsky, L.A., Fountain, S., Nagel, D.A.: Coccidioidomycosis of the spine: unusual roentgenographic presentations. Clin. Orthop. *140*:78, 1979
30. Greenbarg, P.E., Eismont, F.J.: Spine infections. In Orthopaedic Infections, R.D. D'Ambrosia, R.L. Marier, editors. Thorofare, New Jersey, Slack Inc., 1989, pp. 439–476
31. Gristina, A.G., Costerton, J.W., Webb, L.X.: Microbial adhesion, biofilms, and the patophysiology of osteomyelitis. In Orthopaedic Infections, R.D. D'Ambrosia, R.L. Marier editors, Thorofare, New Jersey, Slack, 1989, pp. 49–69
32. McGuire, R.A., Eismont, J.F.: Spine infections. In The Lumbar Spine, M. Camins, P. O'Leary, editors. New York, Raven, 1987, pp. 341–356