Injuries of the cervical spine in patients with ankylosing spondylitis: experience at two trauma centers

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Object. The cervical spine in a patient with ankylosing spondylitis (AS) (Bechterew disease) is exposed to maximal risk due to physical load. Even minor trauma can cause fractures because of the spine’s poor elasticity (so-called bamboo spine). The authors conducted a study to determine the characteristics of cervical fractures in patients with AS to describe the standard procedures in the treatment of this condition at two trauma centers and to discuss complications of and outcomes after treatment.

Methods. Between 1990 and 2006, 37 patients were surgically treated at two institutions. All patients were examined preoperatively and when being discharged from the hospital for rehabilitation. Single-session (11 cases) and two-session anterior–posterior (13 cases), anterior (11 cases), posterior (two cases), and laminectomy (one case) procedures were performed. The injury pattern, segments involved, the pre- and postoperative neurological status, and complications were analyzed.

Preoperative neurological deficits were present in 36 patients. All patients experienced improvement postoperatively, and there was no case of surgery-related neurological deterioration. In patients in whom treatment was delayed because of late diagnosis, preoperative neurological deficits were more severe and improvement worse than those treated earlier. The causes of three deaths were respiratory distress syndrome due to a rigid thorax and cerebral ischemia due to rupture of the vertebral arteries. There were 12 perioperative complications (32%), three infections, one deep venous thrombosis, five early implant failures, and the three aforementioned fatalities. There were no cases of epidural hematoma. In all five cases in which early implant failure required revision surgery, the initial stabilization procedure had been anterior only. A comparison of complications and the outcomes at the two centers revealed no significant differences.

Conclusions. The standard intervention for these injuries is open reduction, anterior decompression and fusion, and anterior–posterior stabilization; these procedures may be conducted in one or two stages. Based on the early implant failures that occurred exclusively after single-session anterior stabilizations (five of 10—a failure rate of 50%), the authors have performed only posterior and anterior procedures since 1997 at both centers. Diagnostic investigations include computed tomography scanning or magnetic resonance imaging of the whole spine, because additional injuries are common. The causative trauma may be very slight, and diagnosis may be delayed because plain radiographs can be initially misinterpreted. In cases in which diagnosis is delayed, patients present with more severe neurological deficits, and postoperative improvement is less pronounced than that in patients in whom a prompt diagnosis is established. Because of postoperative pulmonary and ischemic complications, the mortality rate is high. In the present series the mortality rate was lower than the mean rate reported in the literature.

Key Words • ankylosing spondylitis • implant failure • cervical spine • anterior–posterior stabilization

Ankylosing spondylitis is an inflammatory rheumatic disease affecting the skeleton, particularly the thorax and spine. The spine is frequently kyphotic and has lost its flexibility. This is caused by a generalized, paravertebral benign ossification that bridges primarily the small vertebral joints, the costotransverse joints, and the sacroiliac joint. The disease progresses in a caudal-to-cranial direction and, in its most severe form, finally affects the entire spine. Etiologically, an association with the human leukocyte antigen–B27, exogenous factors (such as viral, chlamydial, or Klebsiella infections) and, as a cofactor, alcohol abuse are implicated in the ori-
gin of the disease. Ankylosing spondylitis affects 0.5% of the population (with clinical signs developing in only half of those affected), and is 10-fold more common in men than in women. In patients with AS, a spinal injury poses serious dangers because of the completely different responses of the spine to mechanical load. The authors of experimental and clinical studies involving the reaction of the healthy cervical spine to a trauma have shown that physical loads lead to an elastic distortion and resulting lesions (whiplash injury). A fracture is only produced when this mechanism fails as a result of a major trauma. By contrast, the cervical spine in patients with Bechterew disease reacts differently—because the elasticity has been lost, the spine behaves in a similar way to a tubular bone.

The most common precipitating mechanisms are flexion–distraction injury or hyperextension injury. Torsional shear traumas are rare, but when they occur they cause extreme instability.

In patients with AS, the detection of cervical fractures is frequently delayed, such as following the manifestation of neurological complications; the reason is that minor trauma produces only moderate pain. Neurological deterioration is frequently a secondary development. Additionally (especially when radiodiagnostic examinations are insufficient), fractures are difficult or almost impossible to detect in anatomy that has sometimes been grotesquely changed by the disease.

Consequently, CT and/or MR imaging assessments of the whole spine have been recommended even when a fracture is only suspected because concomitant injuries in the lumbar spine are common. Hard cervical collar or halo brace therapy is problematic because a cervical collar that is worn for too long frequently causes skin ulcerations, whereas the halo brace is associated with serious pulmonary complications. In general, surgical treatment is indicated, especially when neurological deficits are present.

The available methods include anterior fusion (for example, the Smith–Robinson technique in which a rectangular iliac bone graft is placed) and instrumentation spanning the appropriate number of vertebrae (one unaffected VB above and below the injury must be included). Some authors have recommended additional bonding using cement to increase the bonding potential. If, as in most cases, there is an additional posterior instability and rupture of the interspinous ligaments, posterior stabilization must encompass a sufficient number of segments. Suitable implants for posterior instrumentation include hook-based plates, wire loops, and internal fixation devices such as flexible internal fixators or plates. Implantation of an autologous bone graft may also be undertaken. Whether the anterior–posterior stabilization is performed in one or two sessions depends on the individual case and on the surgeon’s standard procedure. Laminectomy is reserved for exceptional cases in which spinal instability is absent.

The aim of this study was to pinpoint the defining characteristics of cervical fractures in patients with AS, to describe the standard procedures in the surgical treatment of these fractures in the two centers, and to discuss complications, outcomes, and lessons learned.

Clinical Material and Methods

Patient Population

We retrospectively evaluated data obtained in 37 patients (33 men and four women) with AS who had been treated for a cervical fracture at two institutions (25 cases at one and 12 at the other) during a 16-year period. The two examination intervals were before surgery and at the time of discharge from the hospital for rehabilitation. One month postsurgery, three patients died of complications related to their injuries.

Assessment Variables

Neurological deficits were classified according to the Frankel grading system, and pre- and postoperative Frankel grade changes were documented (Fig. 1). Concomitant medical disorders (arterial hypertension, diabetes mellitus, cardiac insufficiency, and alcohol abuse) were evaluated. Injury levels, the number of levels involved, fracture patterns (fracture–dislocation, nondislocated fracture, and neurological deficit without imaging-based detectable fracture), and the presence of simultaneous lumbar injuries were noted. Patients with fractures caused by only a very slight trauma (such as twisting the head or falling from a low height) were evaluated. The time point of diagnosis was noted; one case in which a cervical fracture was correctly diagnosed more than 24 hours postinjury was classified as “delayed diagnosis” (Fig. 1). The complications were categorized as general (infection, DVT, and death) and surgical (early implant failure with the need of revision and restabilization). The causes of early implant failures and the consequences in relation to treatment were assessed. The causes of death in the three fatalities were also analyzed.

Statistical Analysis

The results obtained at the two different centers were compared using the paired t-test and the Wilcoxon test.

Surgical Procedures

All 37 patients underwent surgery. Because of the differing individual factors (location of lesion; number of involved segments; anterior, posterior, or complete instability; fracture pattern with or without spinal cord compression (Table 1); spondylitic changes of spine [bone bridging]; or neurological deficit without detectable fracture), five procedures were performed at different stages during the study period (1990–2006).

Anterior decompression and placement of instrumentation (at least one segment above and below the injury level) were conducted in the period between 1990 and 1997 (of the 10 anterior-only procedures performed during this period, early implant failure occurred in five cases; after 1997, anterior fusion alone was no longer performed); combined single-session anterior–posterior stabilization with the placement of suitable implants (minimum one level above and below the lesion) (1990–2006); two-stage anterior–posterior fixation (1990–2006); laminectomy in cases involving neurological deficit without instability and without detectable fracture (1990); and posterior stabilization and instrumentation in cases of pri-

The anterior fusion technique was performed according to the original method described by Smith and Robinson. The posterior approach was conducted according to the standard procedure described by Frykholm.

In patients undergoing anterior stabilization, we used Morscher plates (titanium-hollow-locking screw plate; Synthes/Zimmer, Solothurn, Switzerland) (locking screws/angle-stable screws were used after 2002) and Wolter plates (Litos, Hamburg, Germany).

Implants used for additional posterior stabilization were Wolter plate fixators (Litos), normal 1/3 tubular plates (AO/ASIF; Synthes/Zimmer), and flexible internal fixing systems (the NEON device, [Ulrich, Ulm, Germany] and Cervifix [Synthes/Zimmer]). In case of single posterior fixation, hook plates (according to the Magerl technique) and/or wire loops were used.

Results

Clinical Data

Clinical data are summarized in Table 2. The mean age of the 33 men and four women was 65.3 years (range 36–82 years). At Center 1, 25 patients were treated, and at Center 2, 12 patients were treated. In 31 patients (84%) one cervical segment was involved and in six (16%) two segments were involved. The C6–7 level was the most frequently injured (19 patients [51%]). In 17 patients (50%), the traumatic injury resulting in a fracture was very slight (falling from a low height such as out of the bed, or twisting the head). These cases were classified as slight (or mild) causative load.

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Eighteen patients (49%) suffered from concomitant medical disorders (Table 3). In 13 patients (35%) who were treated more than 48 hours after trauma, diagnosis was classified as delayed.

Five patients (14%) suffered from a simultaneous lumbar fracture that did not manifest clinically and could only be demonstrated on MR imaging or CT scanning. All 37 patients underwent MR imaging or CT scanning of the entire spinal column.

Although often described in the literature, epidural hematoma was not observed in any case.

Surgical Data and Outcome

Surgical data are shown in Table 4. There were 26 fracture dislocations (70%), 10 fractures without dislocation (27%), and one case of Frankel B neurological dysfunction with no detectable fracture on plain radiographs and MR images.

Ten patients (27%) underwent only an anterior procedure (in five [50%] an early implant failure occurred and required revision), 11 (30%) underwent single-session anterior–posterior surgery, 13 (35%) underwent two-session anterior–posterior fixation, one (Case 29) with neurological deficit and no radiologically detected fracture underwent laminectomy alone, and two (5%) underwent posterior stabilization alone. After 1997, only combined anterior–posterior procedures were performed.

Preoperative neurological deficits were classified according to the Frankel grade. In nine patients (24%) the deficit was classified Frankel Grade A, in 11 (30%) as Grade B, in six (16%) as Grade C, and in 10 (27%) as Grade D; in one patient (Case 36) there was no preoperative neurological deficit.

<table>
<thead>
<tr>
<th>Fracture Type</th>
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<tr>
<td>A</td>
<td>compression fracture</td>
</tr>
<tr>
<td>B</td>
<td>injury of ant &amp;/or pst column w/ distraction (pst) or hyperextension (ant)</td>
</tr>
<tr>
<td>C</td>
<td>shear trauma (A &amp; B &amp; rotation)</td>
</tr>
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</table>

* Ant = anterior; pst = posterior.
At the time of discharge, an analysis of neurological deficits showed improvement in all patients; there were no cases of deterioration. We observed a postoperative improvement of one Frankel grade in 17 patients (46%), of two grades in 11 patients (30%), of three grades in six patients (16%), and of four grades in two (5%); in the patient (Case 36) without preoperative dysfunction, the status (Frankel Grade E) remained the same.

In the 13 patients in whom diagnosis was delayed, preoperative neurological deficits were more severe and postoperative improvement was less pronounced. Preoperatively there were eight cases of Frankel A dysfunction, four Grade B, and one Grade D, whereas postoperatively there were three cases of Frankel Grade B dysfunction, one Grade C, seven Grade D, and two Grade E. Neurological improvement was as follows: an increase of one Frankel grade in four patients, two in five patients, three in three patients, and four in only one patient.

Because we only could obtain short-term follow-up data, long-term radiographic analysis pertaining to fusion rates could not be analyzed. Nonetheless, when patients were discharged from the hospital for rehabilitation, corrected cervical kyphosis was documented in 31 patients (84%) including those who underwent revision surgery for implant failure, whereas pathological cervical kyphosis was demonstrated in six (16%).

Osteoporosis was detected in x-ray films as well as CT and MR images in 12 patients (32%).

Summary of Complications

The complications are summarized in Table 4. The

| TABLE 2  | Summary of clinical data obtained in 37 patients with AS and cervical fractures*

<table>
<thead>
<tr>
<th>Case No.</th>
<th>Age (yrs), Sex</th>
<th>Center No.</th>
<th>Fracture Injured Segment</th>
<th>Pattern</th>
<th>Mild Causative Load?</th>
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</table>

* Lux = fracture–dislocation; nfr = neurological deficit without fracture; nlux = nondislocated fracture.
† A delayed diagnosis was one established after 24 hours.
‡ See Table 3 for summary of concomitant disorders.

Summary of medical comorbidities

The complications are summarized in Table 4. The
surgery-related complications included five cases of early implant failure requiring restabilization; general complications were two cases of deep wound infection requiring revision, one case of DVT, and three perioperative deaths up to 1 month after the operation. All implant failures occurred in five of the 10 patients who underwent anterior stabilization alone (these surgeries were performed between 1990 and 1997) and required revision surgery. In the cases in which fatality occurred, the causes of death were typical of those in patients with Bechterew disease: two cases of adult respiratory distress syndrome and pulmonary failure (Cases 19 and 33) and one case of bilateral VA rupture with cerebral ischemia after 4 weeks (Case 35). Excessive spinal correction, often described as a reason for this complication, was not observed in this case.

The statistical comparison (paired t-test) of the Frankel grades showed no significant differences between the two centers (p = 0.352). Additionally the Wilcoxon test comparison of the intercenter incidence of complications showed no significant difference (p = 0.255).

Illustrative Cases


This 70-year-old woman had a 10-year history of Bechterew disease. A slight injury was sustained at home after a fall. She experienced immediate bilateral leg and arm paresis and incomplete bilateral leg paresis (Frankel Grade C). Radiography and CT scanning revealed a severe C5–6 instability (Fig. 2); the radiographs in Fig. 3 show the outcome after emergency (two-session) anterior stabilization in which an eight-hole Morscher plate system was placed from C-5 to T-1; the remaining minimal mis-alignment did not cause vertebral canal constriction. In a second session NEON system–based posterior stabilization was undertaken from C-5 to C-7 without any additional graft material (Figs. 3 right and 4). After 30 days, neurological dysfunction was absent (Frankel Grade E), and the patient was discharged to the rehabilitation unit after the placement of a soft cervical collar.

Case 17: Long Anterior–Posterior Fusion (2001)

This 63-year-old man had a 9-year history of Bechterew disease. He had fallen out of bed and suffered an injury. He underwent intubation and ventilation; sensorimotor paraplegia (Frankel Grade A) was documented. Cervical radiography and MR imaging revealed a fracture of the C-6 and C-7 VBs and the most severe form of Bechterew disease–related changes: anterior and posterior instability.

### TABLE 4

<table>
<thead>
<tr>
<th>Case No.</th>
<th>Preop</th>
<th>Postop</th>
<th>Improvement (grades)</th>
<th>Op</th>
<th>General</th>
<th>Surgical</th>
<th>X-Ray</th>
<th>Complication</th>
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* Ant = anterior approach only; AP1 = one-stage anterior–posterior; AP2 = two-stage anterior–posterior; EAF = early implant failure and revision needed; inf = infection and revision needed; lam = laminectomy; pst = posterior approach only.

comparison of the intercenter incidence of complications showed no significant difference (p = 0.255).
and cord compression–induced vertebral canal constric-
tion (because of changes caused by AS, fractures cannot 
be detected on plain radiographs) (Fig. 5). We undertook 
a two-stage procedure: emergency C6–7 fusion in which a 
graft and plate were placed one segment above and one 
below the fusion site; in the second session, a plastic 
tracheotomy tube was placed for ventilatory support, and 
long-segment posterior C5–T1 stabilization was perform-

Fig. 3. Case 13. Anteroposterior (left) and lateral (right) radiographs demonstrating outcome after a two-session ante-
rior–posterior stabilization. The anterior procedure involved placement of a Morscher plate system from C-5 to C-7. The 
posterior procedure involved C5–7 stabilization without a graft.

Fig. 4. Case 13. Postoperative MR images obtained after the two-session anterior–posterior C5–7 procedure.
ed after instability caused by ruptured ventral ligaments was found intraoperatively. The images in Fig. 6 show the postoperative results. After weaning from the ventilatory dependence, the patient regained the ability to sit and stand, but partial arm and leg paresis persisted. Neurological rehabilitation was initiated 4 weeks after admission to the hospital. At this time, the patient was able to stand and walk a few steps with the walker, but he sat in the wheelchair most of the time; his status was considered to be Frankel Grade C.


This 45-year-old man had an 8-year history of Bechterew disease. He suffered distortion trauma when getting out of a car. Cervical radiography was performed at the neurologist’s office because the patient was experiencing severe neck pain and pins and needles in both hands as well as subjective leg weakness bilaterally (Frankel Grade D) (Fig. 7). Because radiological findings were obscured by major anatomical changes caused by Bechterew dis-

Fig. 5. Case 17. Plain radiographs (A and B) and MR images (C and D) obtained in a patient with primary sensorimotor paraplegia due to a C6–7 fracture. Note the considerable changes in the anatomy of the cervical spine on the plain radiographs; the fracture is practically undetectable.
ease, the patient was immediately transported to our unit while wearing a stiff cervical collar. A sagittally reconstructed CT scan demonstrated a fracture–dislocation of the C5–6 VBs (Fig. 8A), with the fracture running from anterior to posterior. Rupture of the posterior ligament structures was found intraoperatively (Fig. 8B and C, [arrows]). A two-stage anterior–posterior stabilization was performed and the patient’s neurological deficits completely resolved (Frankel Grade E). The results of the anterior iliac graft fusion are shown in Fig. 8D. Complete stabilization was achieved (Fig. 9).


This 78-year-old man had a 20-year history of AS. He sustained an injury in a slow-speed car accident while wearing a safety belt. During emergency room examination, subtotal C-6 paraplegia was observed (biceps brachii muscle). Plain radiography (Fig. 10A) and conventional tomography (Fig. 10B) demonstrated C5–6 instability with severe ankylosis, which was also shown on lumbar radiographs (Fig. 10C and D). Magnetic resonance imaging (Fig. 11) confirmed the presence of a C5–6 fracture–dislocation as well as an intraspinal fragment. After removal of the intraspinal fragment, we conducted an anterior graft and plate–augmented fusion. Two weeks later the plate dislodged despite the fact that the patient was wearing a soft collar (Fig. 12); additional posterior wiring was attempted as a salvage procedure (Fig. 13). Instability persisted and a posterior wound infection developed. The patient’s status remained Frankel Grade E with plegia of his arms. After transfer of the patient to Center 2, the patient underwent a two-stage salvage procedure in which the initial anterior plate and posterior wire were removed, and a new anterior graft and plate–augmented C4–6 fusion was conducted (Fig. 14). Posterior debridement of the infected wound was performed. One week later posterior NEON system–assisted C4–7 stabilization was under-
taken (Fig. 15). The wound healed without incident; neurological dysfunction was absent (Frankel Grade E).

**Case 20: Initial Anterior Fusion, Implant Failure, and Bone Cement–Based Anterior–Posterior Stabilization (1991)**

This man fell 2 m in his garden, sustaining a mild trauma. He suffered paraplegia and bowel and bladder dysfunction (Frankel Grade B). Initial anterior stabilization involving the placement of a four-hole plate and graft resulted in early implant dislocation (Fig. 16). In a revision procedure the graft was removed, cement was placed anteriorly, and an additional posterior plate system and a bone chip graft were implanted. Despite the radiographic demonstration at 8 weeks of partial screw loosening (Fig. 17A–C), the patient had only mild neurological dysfunction (Frankel Grade D). When this patient was treated in 1991, angle-stable implants were not available.

**Discussion**

In the present study, 37 patients with AS (Bechterew disease) and a cervical fracture underwent anterior, posterior, or combined anterior–posterior stabilization at two centers. Frankel grades improved in all patients after surgery. There were three deaths and five implant-related failures.

There are only a few hundred documented cases in the literature of cervical fracture in patients with AS, which contributes to the paucity of knowledge about these injuries. Various authors have demonstrated that these fractures were caused by only mild load in almost half the cases, which is confirmed in our total study population (17 cases or 45%). In comparable studies investigators have described delayed diagnoses, days and weeks after the trauma, in as many as 65% of cases. In most cases, the patients did not have any symptoms until abrupt (secondary) neurological deterioration occurred. This phenomenon is referred to as a “fatal pause” because of the delayed development of deficits. In our study population, there were 13 patients in whom the correct treatment was definitely delivered as a result of the manifestation of secondary neurological deterioration.
Additionally postoperative improvement was not as pronounced in cases in which the diagnosis was delayed. In the literature, a higher than coincidental incidence of these problems has been ascribed to alcohol abuse, but this was only documented in three patients (8%) in our series.

Because of the major anatomical changes caused by AS, several authors have strongly recommended the use of MR imaging and/or CT scanning of the whole spine as asymptomatic secondary injuries, particularly of the lumbar spine, have been found in up to 40% of cases. In our population, there are also five (13%) additional secondary fractures of the lumbar spine that could be demonstrated only on whole-spine MR imaging or CT scanning.

Although conservative treatment options for cases of Bechterew disease fractures not involving a dislocation or neurological deficit have been described, they are associated with significant problems—for instance, prolonged immobilization with rigid cervical collars leads to local (skin ulcerations) and general (pulmonary) problems. In cases of halo brace immobilization, there is the combined risk of local septic and respiratory problems. Secondary neurological deterioration due to fracture–dislocation at a later time has been noted in as many as 60% of cases by all authors who have reported on a reasonable number of conservatively treated patients. It is for that reason that we had no control group receiving conservative treatment—the surgeons at each of the involved centers regard these types of injuries as strictly solved by surgery.

Depending on where in the spine the instability is located, the procedures have been described in the literature: anterior fusion and instrumentation, posterior stabilization, and anterior–posterior surgery. At present, locking-screw systems (angle-stable implants) offer greater stability without screw loosening. Anterior–posterior stabilization has become established as the procedure of choice in cases involving marked three-column instabilities. Whether the anterior–posterior...
procedure is performed in one or two sessions depends on the general condition of the patient and the extent of the spinal instability. Although two-stage intervention has the disadvantage of requiring two separate sessions of anesthesia and a frequently difficult fiberoptic intubation, the single-session procedure involves a long operating time and placing the patient at an increased risk of infection.\textsuperscript{19} Patients with Bechterew disease and a cervical fracture are extremely prone to complications when surgical intervention is necessary. The following phenomena have been reported: loosening of the hardware or implant failure in 40 to 50\%,\textsuperscript{3,19,21} septic problems in as many as 30\%,\textsuperscript{12,19,21} and death in as many as 30 to 75\%.\textsuperscript{1,6,9,17,19} The high rate of implant failures is due to the underlying problematic anatomy and to the consecutive mechanical stress imparted by the process of implanting the final construct: luxation fractures of the lower cervical spine (the C5–6, C6–7, and C7–T1 segments) are involved in more than half of the reported cases.\textsuperscript{1,3,8,9,21} The condition of the usually rigid, osteochondritis-changed kyphotic cervical spine, which is additionally disturbed in its configuration by the so-called bamboo spine luxation that can hardly be set, is worsened by the already difficult anterior surgical approach.

Thus, implant failure cannot be attributed only to difficult anatomy, but often to the surgeon’s misunderstanding of biomechanics.\textsuperscript{19,21} In most cases three-column instability is present; posterior instability and ruptured posterior ligaments are often not detectable on radiography, as was evident in Cases 12 and 17 of our study. Relying only on anterior stability has often led to implant loosening due to stress forces from the posterior part of the spine. Because initial anterior approach surgery failed in 50\% of our patients, surgeons at treatment ceased to perform exclusively anterior or posterior procedures in 1998.

When revision was required after failed anterior stabilization, reinstrumentation always encompassed at least one additional uninjured segment. The rate of implant failure in our study was lower than that reported in the literature.\textsuperscript{2,14,19}

In conducting the anterior–posterior procedure, the steps usually involve the placement of an anterior autologous iliac bone interbody fusion graft at the appropriate segment(s) and suitable instrumentation. For example, anteriorly a Morscher plate, Wolter plate, or Caspar plate would be used, whereas posteriorly a Cervifix system, hook plate, wire loops, or NEON system would be used.\textsuperscript{21}

\textbf{Cervical injuries in spondylitis deformans}

!!Fig. 13. Case 12. Radiograph demonstrating the failure of additional dorsal wire fixation performed as a salvage procedure; spinal instability remains.!!

!!Fig. 14. Case 12. \textit{Left} and \textit{Right}: All implants were removed after the wire caused infection; a longer (C4–6) anterior fusion stabilization was undertaken.!!
The choice of implant is not as important as the correct fixation of all columns and the inclusion of at least one uninjured segment posteriorly and anteriorly in the fusion mass.\(^8,9\) Cement augmentation, which is regularly used by some authors,\(^21\) is an adjunctive measure in individual cases and is not usually necessary when the hardware encompasses enough of the spine. Osteoporosis is rarely the problem in patients with Bechterew disease, where the former condition involves too little bone and the latter too much bone.\(^3\) In our study population, however, osteoporosis was found in 12 patients.

All three fatalities in the present series were typical of those occurring in Bechterew disease: two patients died of pulmonary failure (rigid thorax), and one died of critical ischemia of the cerebrum after rupture of both VAs—a complication not associated with the spine.

Conclusions

Patients with AS (Bechterew disease) are highly susceptible to cervical fracture even after only mild trauma. Because these lesions often lead to secondary neurological deficits, CT or MR imaging of the whole spinal column is recommended regardless of whether mild initial clinical findings are present. If a cervical fracture is detected, hardware-based stabilization is necessary, and anterior–posterior stabilization after anterior decompression is the standard procedure. Anterior approach stabilization alone is not adequate because instability of the posterior column may go undetected; this was borne out in the present series and evidenced by the high rates of implant failures following anterior-only approaches. Further follow-up study is necessary to confirm these early results.

Acknowledgment

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Cervical injuries in spondylitis deformans

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