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Spondylodiscitis in the elderly patient: clinical mid-term results and quality of life

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Abstract
Introduction Focusing on spondylodiscitis in elderly patients current literature does not contain much information.
Method We performed a retrospective case series ($n = 32$) comparing conservative (group 1; $n = 16$) versus operative (group 2; $n = 16$) treated spondylodiscitis patients aged ≥65 years (mean age 74.9 years) from January 2002 to April 2004. The review of the medical records provided information about the pre-hospital time, the inpatient course and the time after discharge. At follow-up (FU) (mean 3.6 years) disease specific and general quality of life (QOL) questionnaires (COMI back patient self-assessment, ODI and SF-36) were administered.
Results Altogether, 71.9% of the patients could be contacted; 12.5% had died since hospitalisation and 15.6% could not be contacted anymore. At FU based on the visual analogue scale, patients indicated an average of 3.2 for back pain and 2.5 for leg pain. ODI scoring yielded minimal disability for 38.9%, a moderate disability for 22.2%, a severe disability for 22.2% and for 11.1% a crippled situation; 5.6% were bed-ridden or exaggerated their symptoms. The SF-36 PCS amounted to an average of 38.2, the MCS 50.6. Owing to additional surgery-associated risks, operative treatment of spondylodiscitis feature a complication rate twice as high in the respective group, but general complications do not differ. At FU, no statistically remarkable difference concerning QOL and remaining pain became evident between the groups, the operated patients being more satisfied with regard to the treatment of spondylodiscitis.
Conclusion Ultimately, if surgery is indicated the operative risks should be borne in mind, but advanced age should not be the crucial factor in decision-making.

Keywords Spondylodiscitis · Vertebral osteomyelitis · Complications · Spinal surgery · Elderly patient

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Introduction

The incidence of pyogenic spondylodiscitis is about 1:250,000 corresponding to about 3–5% of all cases of osteomyelitis. Men are up to three times more often affected

than women [2, 17, 21, 26, 28, 30, 33]. The frequency of spondylodiscitis after lumbar disc operations depends on the invasiveness of the operation and is given as between 0.1 and 0.6% for microsurgical operations and from 1.4 to 3% for macrosurgical operations [10, 14, 22]; 10–15% of all vertebral infections can be ascribed to exogenous spondylodiscitis [2, 9, 17]. Predisposing factors include age, multi-morbidity, diabetes mellitus, cardiovascular diseases, obesity, renal failure, chronic hepatitis, rheumatic diseases, chronic steroid intake, cancer, administration of immunosuppressives, preceding systemic diseases, old tuberculosis, prior visceral operations, sickle cell anaemia, drug abuse and HIV [2, 21, 26, 28, 30, 31].

Infections of the spine are frequently recognised and treated too late. In older patients, there is often a long history of back pain, with multiple therapies that fail to reduce symptoms. The literature reports an average period of 2–6 months between first occurrence of symptoms and the diagnosis of spondylodiscitis [2, 19, 21, 26, 28, 30].

One possible explanation for this delay is that symptoms are rather non-specific. Generally, presenting patients are presumptively treated for degenerative disease. Unfortunately, a belated diagnosis of spondylodiscitis correlates with unfavourable treatment outcomes [19].

Depending on the chosen procedure, surgical repair can be more or less invasive. The risks of surgery must be weighed against the presumed benefits. In this respect, the patient's age can become a crucial factor in choosing appropriate treatment. There are conflicting opinions in the literature regarding outcomes and complications from spinal surgery on the elderly patient and disagreement whether surgery on the aged spine is more risky than that on a younger one [6, 23, 24, 27].

Methods

This consecutive study reviewed the medical records of spondylodiscitis patients aged ≥65 years treated from January 2002 to April 2004 at our hospital. Thirty-two patients were identified in our databases. There were 16 patients treated conservatively (group 1) and 16 treated operatively (group 2). Initially, this distribution was 19 and 13 patients, respectively. Owing to clinical deterioration, however, three conservatively treated patients went to surgery and were included in the surgical group. Criteria for emergency operative intervention were the development of neurological deficits or sepsis. Further absolute indications for operation were instability, impending or existing deformities and intraspinal abscess formation. Conservative treatment was considered when clinical symptoms and destructions were relatively mild. To assess the extent of infection and spinal destruction plain X-ray, MRI and CT scan were used as diagnostic tools. ART® instrumentation of advanced medical technologies AG (Kasteler Str. 11, 66620 Nonnweiler, Germany) was implemented for posterior spondylodesis. For anterior stabilisation, we used either a Pyramesh-Cage of Medtronic GmbH (2600 Sofamor Danek Drive, Memphis, TN 38132, USA) or autologous tricortical iliac bone.

Medical records were reviewed with particular emphasis on information regarding the course of disease prior to hospital admission, possible causes of delayed diagnosis, aetiology of disease, radiologic and clinical findings on admission, hospital course and follow-up (FU). In addition, the recovery of microorganisms from blood cultures and/or biopsy specimen of the disc and/or vertebral body were registered and the spectrum of pathogens analysed.

At FU, the following disease specific and general quality of life (QOL) questionnaires were administered: COMI back patient self-assessment, ODI and SF-36 [18].

For patients who could not be examined in our outpatient clinic, the questionnaires were mailed with a letter requesting return in provided postage-free envelopes.

Patient-based data were gathered using Spine Tango, a unique documentation system for spinal surgery launched in 2000 under the auspices of the EuroSpine, the Spine Society of Europe, in collaboration with the Institute for Evaluative Research in Orthopaedics [25].

With regards to actual scale levels as well as distributional characteristics, explorative comparisons between groups were performed using appropriate parametric and non-parametric test statistics [e.g. *t* test, ANOVA, rank statistics (Wilcoxon–Mann–Whitney) and contingency table analysis], as well as measures of stochastic association (e.g. correlation analyses). Dimensional demographic variables (e.g. age) and diseases were summarised by mean, median, standard deviation, minimum and maximum if appropriate. Qualitative demographic variables (e.g. gender) and disease characteristics as well as potential prognostic categories were summarised by counts and percentages. Differences were considered to be significant at a probability level of 95% ($P < 0.05$). Statistical evaluation was done using SPSS 16.0.

Results

43.8% of the patients were transferred from other hospitals, where they had already been admitted for an average of 9.7 ± 13.0 days. The rest had either sought outpatient treatment elsewhere with a well-known diagnosis (12.5%) prior to admission or had been seen at our emergency outpatient clinic (43.8%) (Table 1).

Invasive procedures (2 surgical and 4 epidural injections) had been previously performed at the same vertebral level in 18.8% of cases, indicating exogenous spondylodiscitis.

Table 1 General data [mean ± standard deviation (range)]

	Group 1 + 2	Group 1	Group 2
Age (years)	74.9 ± 6.9 (65–87)	77.3 ± 6.8	72.6 ± 6.4
Gender ratio (m:f)	1.9:1	4.3:1	1:1
Hospital admission (days)	25.3 ± 14.4 (4–62)	15.1 ± 8.3[a]	35.4 ± 11.7[a]
Number of secondary diagnoses	2.34 ± 1.6 (0–6)	2.8 ± 1.4	1.9 ± 1.7
Delay of diagnosis (days)	65.0 ± 65.0 (2–209)	46.33 ± 52.2	83.8 ± 73.2

[a] Statistically significant ($P < 0.005$)

Nineteen patients had all together 33 previous operations (excluding spine surgery). Of these operations, six were performed within 12 months before the diagnosis of spondylodiscitis (see Table 2). In five cases, the date of previous operations was not documented. In addition to the patients with a recent history of operative procedures, intravascular catheters had been administered to at least three other patients to treat electrolyte disturbances or cardiac arrhythmias.

An average 65.0 ± 65.0 days (range 2–209) elapsed between the first appearance of symptoms and the eventual diagnosis and an average 13.3 ± 19.8 days (range 0–80) between the initial work up and diagnosis of spondylodiscitis. These delays can be attributed to non-specific symptomatology as well as absent/unclear radiographic changes on initial films. On admission, 53.1% of cases were acute and 46.9% chronic.

Of diagnostic techniques, MRI led most frequently to the diagnosis with 72.0%, followed by CT with 20.0% and plain X-rays and bone scintigraphy with 4.0% each.

Lower extremity paresis (muscle strength 3–4/5) was detected in 25.9% of cases on admission. Lasègue's sign was positive in 42.3%, muscle reflexes of the lower extremity were abnormal in 45.0% and in 9.1% of the cases a positive Babinski's sign was present. Patients (43.5%) complained of both pain at rest and on weight bearing, 34.8% of pain at rest only, 21.7% of pain on weight bearing only. Of the patients, 38.5% suffered from sciatic pain. Pain on percussion was present in 70.6% of cases, on compression in 47.1% and on heel strike in 12.5%. Of the patients, 19.4% were febrile on admission.

On admission, C-reactive protein (CRP) was elevated in 100%, white blood cell count (WBC) in 27% and thrombocytes in 20%. Anaemia was present in 77% of patients. Average CRP was significantly higher ($P < 0.001$) on admission (107.6 ± 90.3, median 89.0) than at discharge (62.8 ± 58.1, median 40.0). White blood cell count averaged 9.8 ± 4.5 (median 8.5) on admission and 8.5 ± 4.7 (median 7.3) at discharge. This decrease was not significant. Average values of erythrocytes, haematocrit, haemoglobin and thrombocytes did not significantly change between admission and discharge.

Table 2 Risk factors

Risk factors	*n*/%
Diabetes mellitus	6/18.8
Cardiovascular	19/59.4
Hypertension	12
Arrhythmia	5
Coronary disease	5
Previous MI	5
Cardiac insufficiency	2
Endocarditis	2
Aortic valve replacement	1
Aortic stenosis	1
Clotting disorders/warfarin	3
Urinary tract diseases	9/28.1
Infection	2
Renal insufficiency	3
Other	4
Gastrointestinal disorders	9/28.0
Respiratory disorders	4/12.5
Obesity	14/63.6 (unknown 10)
Body mass index (BMI)	Mean 26.9 ± 6.7
Stroke	4/12.5
Infections	10/31.3
Previous	8
Current (excluding spondylodiscitis)	2
Patients with previous operations (excluding spine surgery)	19/59.4
Within 12 months	6/22.2 (unknown 5)
Within 6 months	5/18.5 (unknown 5)
Patients with previous spine surgery/injections (within 12 months)	6/18.8
Surgical	2
Epidural injections	4
Healed fracture of the affected vertebra	2/6.3

All cases affected the thoracolumbar or lumbar regions and 87.5% the lumbar spine. Multi-segmental spondylodiscitis was identified in 12.5% of cases (3 cases with 2 segments, one case with 4 segments). There were no cases of multi-level infection. Imaging showed paravertebral

Table 3 Frequency distribution of pathogens

Pathogens	*n*/%
Staphylococcae	14/44
Staphylococcus aureus	9/28
Staphylococcus epidermidis	3/9
MRSA	1/3
Coagulase negative	1/3
Streptococcae	2/6
Streptococcus mitis	1/3
Streptococcus species	1/3
Enterococcus faecalis	2/6
Proteus mirabilis	1/3
Proprioni bacterium	1/3

abscesses in 68.8% of cases and epidural abscesses in 37.5%.

Blood cultures were taken in 62.5% of patients (average 2.1 per patient); 47.6% of these identified a pathogen. CT-guided fine-needle aspiration was performed in 40.6% of cases; 46.2% of these identified a pathogen. Biopsy was taken in 15.6% of cases; pathogen was identified in 45.5% of these. Altogether, pathogens were identified in 58.6% of cases. Mixed infections were observed in three cases (Table 3).

Three patients were treated conservatively for long duration (mean 4 months) and eventually turned septic and required surgery. These patients were included in the surgically treated group.

Of the surgically treated patients, 44% were treated with a two-stage posterior and anterior approach, 44% were operated from posterior only and 12% from anterior only. The entire operative time (one or two stage) averaged 201.4 ± 102.5 min per patient (median 165.0; range 105.0–390.0) and average blood loss was 1,650.0 ± 1,691.5 ml (median 1,050.0, range 300.0–6,400.0). Regardless of the treatment, patients spent an average 27 ± 85.7 h in the intensive care unit. For complications see Table 4.

Mean time of FU was 3.6 ± 1.3 years (range 2–6). Altogether, 71.9% of patients were contacted. Of the patients, 59.4% completed questionnaires. Clinical evaluation was performed in 43.8% of cases. Of the patients, 12.5% died after hospitalisation and 15.6% were lost to FU.

Of patients undergoing clinical FU examinations, only one case of paresis (dorsiflexion of the foot 4/5) was identified, although five cases continued to have hypaesthesia. Pain on percussion continued in 68.7% and pain radiating to the lower extremities was reported by 60.0%. Using a visual analogue scale (VAS), patients reported average back pain scores of 3.2 ± 2.5 (min–max 0–7) and leg pain scores of 2.5 ± 2.3 (min–max 0–8).

Fusion of the affected segments was not observed radiologically in any patients at 6 weeks FU. Fusion occurred in 14.3% of patients at 6 months, 75.0% of patients at 12 months and 100% of patients at 24 months. Although at the last FU, a mean increase of 6.8° ± 8.8° in kyphosis was measured, there was no significant difference observed between the two treatment groups.

On the ODI, 38.9% of respondents scored minimal disability, 22.2% moderate disability, 22.2% severe disability and 11.1% complete disability. Of the respondents, 5.6% were either bed-ridden or exaggerated their symptoms (see Fig. 1).

Respondents' scores on the physical component of SF-36 (PCS) averaged of 38.2 ± 11.4 (range 14.6–58.9) and on the mental component (MCS) 50.6 ± 14.4 (range 23.1–69.1).

Answering the question: "Please reflect on the past week. How would you rate your QOL?", 10.5% of patients estimated their QOL as "very good", 26.3% as "good", 36.8% as "moderate", 15.8% as "bad" and 10.5% as "very bad". To the question "During the past 4 weeks, how many days did you cut down on the things you usually do (work, housework, school and recreational activities) because of your back problem?", 63.2% of the patients answered "none", 5.3% "between 1 and 7 days", 10.5% "between 8 and 14 days" and 21.1% "more than 22 days". Asked "Overall, how much did treatment in our hospital help your back problem?", 47.4% answered that it "helped a lot", 31.6% that it "helped", 5.3% that it "helped very little", 15.8% that it "didn't help" and 0% that it "made things worse".

Patients in group 2 suffered more pain than those in group 1. However, the difference was not significant. SF-36 results also yielded no statistical validity (see Table 5).

The answer to the question "Overall, how much did the treatment in our hospital help your back problem?" is remarkable. All operated patients responded that treatment "helped" or "helped a lot." In contrast, 40% of conservatively treated patients claimed that treatment "helped very little" or "didn't help" (see Fig. 5).

Regarding limitations experienced in the previous 4 weeks ("During the past 4 weeks, how many days did you cut down on the things you usually do because of your back problem?"), conservatively treated patients seemed to be a bit more satisfied with no big differences between the groups (see Figs. 2, 3, 4).

Discussion

Spondylodiscitis most frequently occurs in the 5–7th decades of life [29, 30]. To the best of our knowledge, few articles [3, 16] and only one study [1] have been published to date examining this disease in the elderly.

Table 4 Complications

11 patients developed a total of 20 complications					
Group 1		Group 2			
Inpatient	FU	Inpatient		FU	
		Surgical	General	Surgical	General
1 × pleural effusion on both sides	1 × death after 4 months (cardiovascular)	1 × screw pull out	1 × pseudomembranous colitis	1 × adjacent level instability after 16 months	1 × death after 3 years (cardiovascular)
3 × worsening with conservative therapy, so surgery proved necessary[a]	1 × death after 1 month due to spondylodiscitis and prostatic carcinoma	1 × screw breakage	1 × temporary renal insufficiency	1 × malunion from necrotic tricortical iliac crest bone graft	
1 × decubitus ulcer grade II		2 × revision due to wound healing disturbance	1 × pleural effusion	1 × incisional hernia	
		1 × revision because of postoperative haemorrhage	1 × death after septic shock		
		5 (16.6%)	4 (12.5%)	3 (9.4%)	1 (3.1%)
5 (16.6%)	2 (6.3%)	9 (28.1%)		4 (12.5%)	
7 (21.9%)		13 (40.6%)			

[a] Postoperative complications of these three converted patients are given with group 2

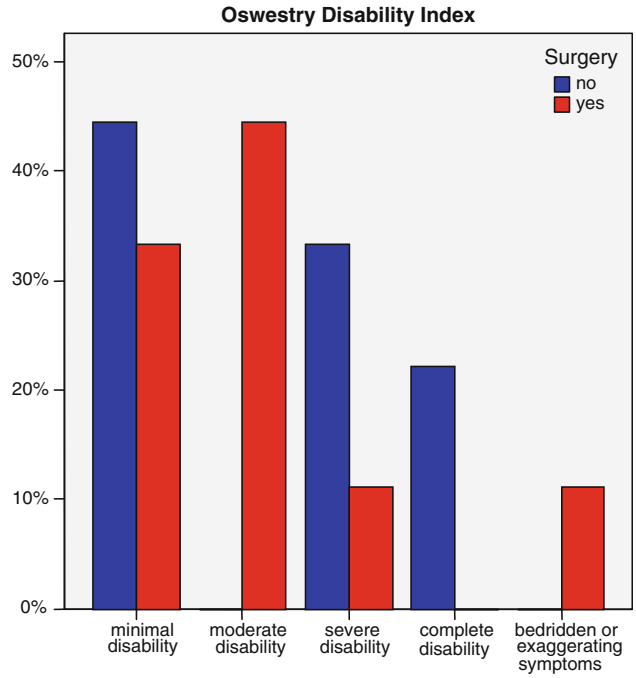

Fig. 1 ODI according to form of treatment

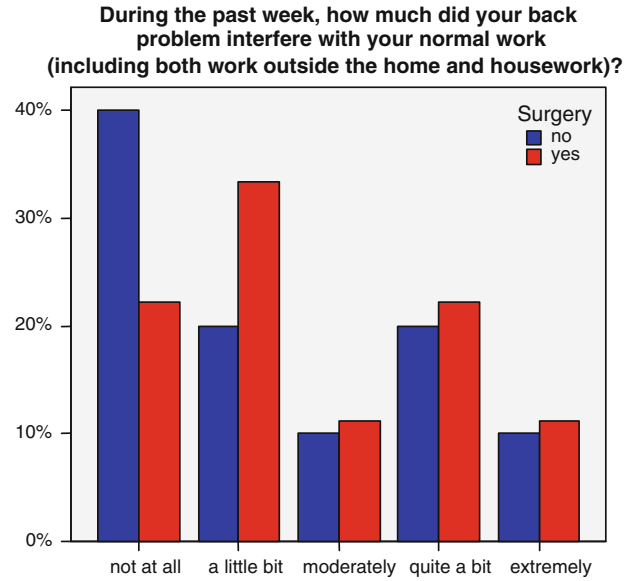

Fig. 2 Disability due to back pain during the past week

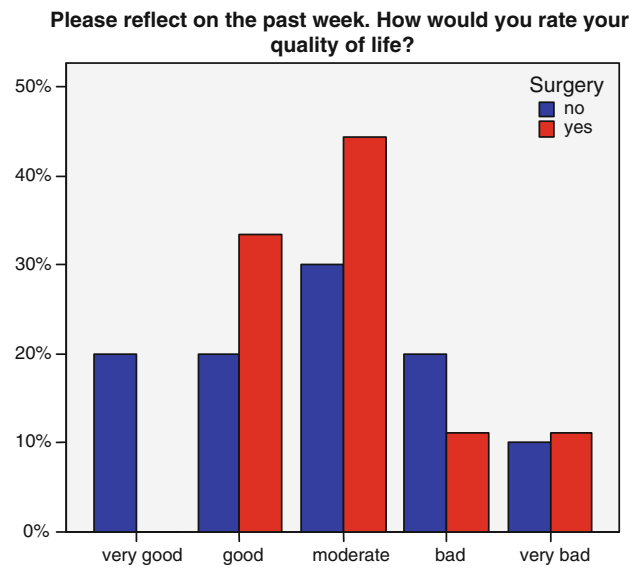

Fig. 3 Quality of life during the past week

Table 5 Visual analogue scale (VAS) and quality of life compared in the two groups (mean ± standard deviation)

	Group 1	Group 2
VAS leg pain (0 = no pain, 10 = worst pain that I can imagine)	1.8 ± 2.1	3.2 ± 2.4
VAS back pain (0 = no pain, 10 = worst pain that I can imagine)	2.7 ± 2.5	3.8 ± 2.4
SF-36 PCS	39.2 ± 12.5	37.1 ± 10.8
SF-36 MCS	47.1 ± 16.7	54.5 ± 11.1

Elderly persons with spondylodiscitis should be considered high risk patients due to their age and concomitant health problems; such patients generally have a long history of back pain, often reaching back several weeks, if not months.

One reason for delay in diagnosis is that degenerative changes of the spine are most common in older populations, and initial treatment is usually aimed at pain relief. Lack of visible changes on X-ray at initial presentation also complicates diagnosis. Therefore, if spondylodiscitis is strongly suspected, MRI scans should be performed even when clear indications are not present on plain films. With a sensitivity of 90–100% and a specificity of 85–92%, MRI is the method of choice for diagnosis [17, 30, 32].

Because older patients typically have concomitant medical conditions and weakened immune systems [16], delays in the diagnosis of spondylodiscitis can lead to the rapid clinical deterioration. The delay in diagnosis, on average 3 months, must have been at least partially responsible for the acute decline in health status observed in 53% of our patients at the time of admission. Abscesses were present in 68.8% of cases, epidural abscesses in 37.5%, neurologic deficits in 25.9% and pathologic reflexes in 45.0%. Other publications examining the disease without age selection have reported lower extremity paresis in 11–29% of patients and acute decline in health status of 13–26% [2, 13, 28].

In addition to the general risk factors for spondylodiscitis in the elderly, generalised arteriosclerosis, diabetes mellitus, infections of the urinary tract and respiratory

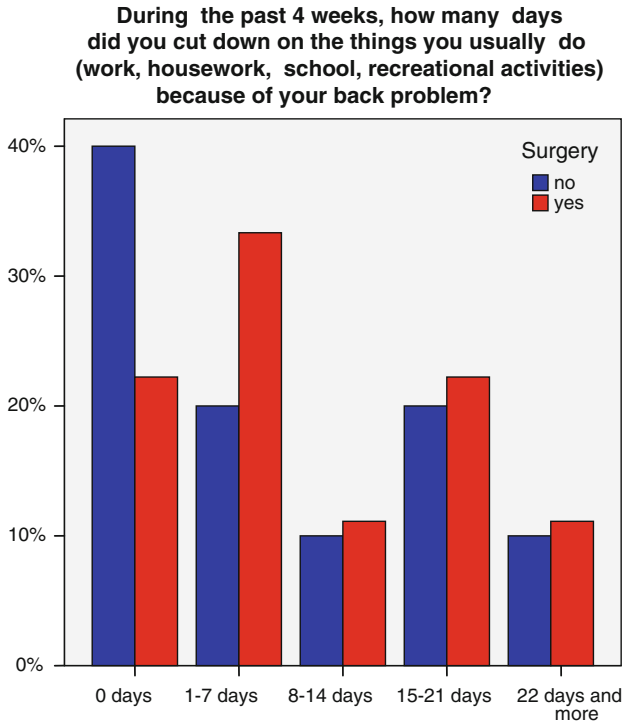

Fig. 4 Days of disability during the past 4 weeks

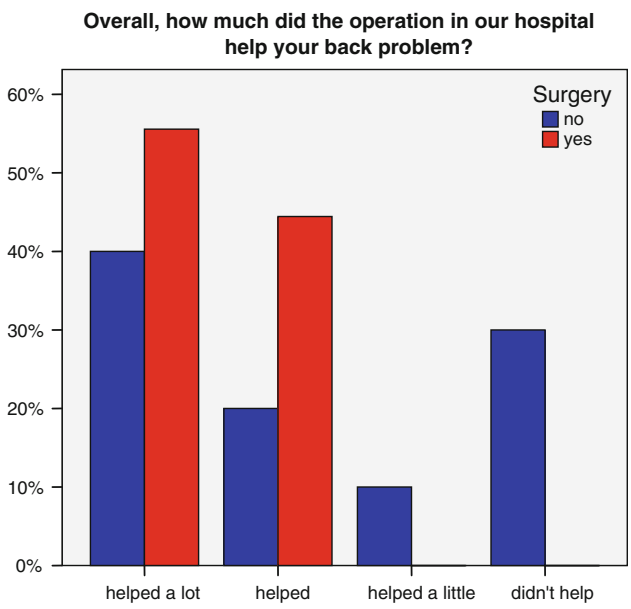

Fig. 5 Treatment of back pain

infections, infections due to intravenous catheters, tooth infections, endocarditis, wound infections and previous surgical interventions are being discussed as specific risk factors [1, 3, 16]. In our patient collective as well, there was a remarkably high rate of cardiovascular problems and disorders of the urinary tract.

However, although some publications have reported a correlation between spondylodiscitis and urinary tract disease, which is frequently accompanied by chronic bacterial infection, the association remains questionable, particularly in view of the frequency distribution of the identified pathogens [1, 3]. Of our patients with acute or chronic urinary tract infections, no pathogens or Staphylococcae could be identified as the agents of spondylodiscitis. Moreover, patients with spondylodiscitis due to *Enterococcus faecalis* did not have infections of the urinary tract. In studies on vertebral osteomyelitis in the elderly, a shift in the frequency distribution of pathogens to gram-negative bacteria has been observed [1, 3]. Because gram-negative bacteria are frequently responsible for infections of the urinary tract, a correlation was assumed [1]. The pathogen most frequently identified in our study was *Staphylococcus aureus,* in 50% of cases and we, therefore, did not see a shift to gram negative. This value corresponds to the age-independent data found in the literature (30–80%) [28, 30].

With 22.2%, the proportion of patients with a history of surgery (excluding spine surgery) or invasive procedures within 12 months of the diagnosis of spondylodiscitis was remarkably high (see Table 2). Belzunegui et al. [1] compared two age groups of patients with spondylodiscitis and found that within the group of patients older than 63 years, 20.6% had undergone surgery (excluding spine surgery) shortly before the onset of spondylodiscitis. In contrast, none of the patients under 63 years of age had had recent surgery. Another frequently discussed risk factor is recent application of an intravascular catheter [1, 3]. In our study, in addition to the patients with a recent history of invasive procedures, intravascular catheters had been administered to at least three other patients to treat electrolyte disturbances or cardiac arrhythmias; so in total (including patients with previous spine surgery that led to exogenous spondylodiscitis), at least 50.4% of our patients had some kind of risk-carrying medical procedure within 12 months of the diagnosis of spondylodiscitis.

The rate of exogenous spondylodiscitis in our study, amounting to 18.8%, is higher than the values cited in literature (10–15%) for patients with spondylodiscitis regardless of age [28, 30].

No extra risk factors were identified in 14.3% of patients. In these cases (mean age 79.3 years), then, age can be claimed as the only predisposing factor.

Owing to the extreme heterogeneity of patients and the abundance of available therapies, the feasibility of devising uniform therapy guidelines for the treatment of spondylodiscitis is rather limited [11]. So far, no prospective randomised controlled trial exists, and the level of evidence does not exceed level C [11]. Regarding principles of treatment, there is actually no difference between patients based on the age. Basic prerequisites for curing spondylodiscitis

are immobilisation of the concerned vertebral segments, an antibiotic therapy adapted to the chemoresistance of the pathogen, and, depending on the extent of the illness, debridement from anterior [12, 30]. Debridement and optional internal stabilisation are associated with high operative risk, especially for elderly patients. Conservative therapy, however, is not only a long, drawn out process, but because of pain and immobilisation, is also onerous. A conservative approach should be considered when there are no absolute operative indications, when clinical symptoms and destruction of the spine are mild, or when the operative risk appears too high [26, 28]. Because patients with spondylodiscitis are usually elderly and in diminished general condition, conservative treatment is all too frequently opted for. The main problem with this is achieving sufficient immobilisation of the spinal segment. Application of a rigid brace forcing the spine into retroflexion can prove useful. However, in cases showing marked destruction of the ventral column, or where the lower lumbar or lumbosacral regions are concerned, the necessary immobilisation can be achieved only with several weeks of bed rest accompanied by well-known comorbidity. In addition to these risks, there is a high rate of pseudarthrosis (16–50%), from which eventual hyperkyphosis and chronic pain syndromes can result [28]. When fusion has not occurred, there is a progressive destruction, or a clinical change for the worse, conservative therapy should not be continued beyond 4–6 weeks of time [26, 28].

Surgical therapy is not associated with higher hospital mortality for the elderly than for younger patients. However, there is a higher complication rate with regards to internal fixation and bony fusion in the elderly, which might be due to an age-related decrease in bone density (see Table 4). In current studies, mean hospital mortality regardless of age is reported as 2–17% [2, 15, 26, 33]. In our study, it was 3.1% and total mortality over FU was 12.5%.

Several publications have alluded to increased risks of spine surgery with increasing age [4, 6]. Complication rates after lumbar spine surgery in older patients have been quoted on a spectrum from 8 to 80%. However, when the complications were further differentiated, minor complications not impacting the length of hospital stay accounted for the large majority of these [4, 6, 23, 24, 27]. Complication rates for our study during inpatient stay were 16.6% in group 1 and 28.1% in group 2. Over the full period of treatment to final FU, the complication rate was almost twice as high in group 2 (40.6%) as in group 1 (21.9%). The number of general complications was lower in group 2 than in group 1. When we compared this complication rate with those in the literature, which generally deal with younger patients and amount to 13–71% [8, 9, 26], we see that older patients treated surgically for spondylodiscitis do not have higher complication rates than younger ones. Overall, a relapse of spondylodiscitis is unlikely to occur, with rates ranging 0–7% [15, 20, 28]. We had no cases of relapse.

In a retrospective study of 118 patients over 70 years of age undergoing any type of spinal surgery, Ragab et al. [24] found a complication rate of 20% and very good or good results at long-term FU (7 years) in 92%. When comparing their results with those in the literature, they concluded that advanced age is not associated with increased morbidity or mortality, and that operative results and complication rates are comparable in older and younger collectives. In the end, it appears that instead of age itself, it is comorbidity (diabetes mellitus, peripheral vascular disease, obesity and arthritis) and other factors such as depression, female gender and low educational level that negatively impact complication rates and the overall surgical result. Admittedly, however, complication rates do appear to increase with more complex spinal procedures and advancing age [4, 5, 7, 29].

Residual ailments tend to exist after conservative as well as surgical therapy for spondylodiscitis, due to remaining destruction and degenerative sequelae in adjacent segments once inflammation is resolved. In a retrospective study, Woertgen et al. examined neurologic outcomes and QOL (SF-36) in 62 spondylodiscitis patients with an average age of 64.3 years after 16.4 months. Of the patients, 45% had been treated conservatively, 55% surgically. In those patients with presurgical neurologic deficits, motor deficits persisted in 30% and hypoaesthesia in 90%. In our study, motor deficits persisted in 14% and hypoaesthesia in 63%. In addition, Woertgen et al. found that the QOL for spondylodiscitis patients is much less than that of a normal population. Surgically treated patients reported a slightly higher QOL and a significantly higher level of patient satisfaction [33]. In our study as well, values of SF-36 PCS (38.2 ± 11.4) were clearly below those of the normal population, but as to mental condition (SF-36 MCS 50.6 ± 14.4), interestingly enough, we had good results. ODI scoring of our patients yielded minimal disability for 38.9% of the responding patients, moderate disability for 22.2%, severe disability for 22.2% and complete disability for 11.1%; 5.6% were bedridden or exaggerated their symptoms. Assessing their QOL in the past week, 10.5% of our patients judged it as "very good", 26.3% as "good", 36.8% as "moderate", 15.8% as "bad" and 10.5% as "very bad". On VAS and SF-36, no significant differences emerged between the two groups after 3.6 ± 1.3 years. However, all operated patients indicated that their treatment had helped, while 40% of the conservatively treated patients stated that treatment had helped only a little or not at all (see Fig. 5). With regard to the physical restrictions within the previous 4 weeks, we found no big differences between the groups (see Fig. 4).

On comparing our results with those in the literature, the current study shows that the complication rate for

spondylodiscitis does not increase for older patients. As well, there is no apparent relevant difference regarding clinical result and QOL. Because of the additional risks associated with surgery, the complication rate for operative treatment was double that of those treated conservatively, but general complications did not differ. At FU, there was no significant difference between the groups regarding QOL and residual pain, and the operated patients were ultimately more satisfied with their treatment and remaining physical limitations. In the end, if surgery is indicated, the operative risks should be borne in mind, but advanced age should not be the crucial factor in decision-making.

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References

1. Belzunegui J, Intxausti JJ, De Dios JR, del Val N, Figueroa M (2000) Haematogenous vertebral osteomyelitis caused by *Staphylococcus epidermidis*: report of 4 cases. Clin Exp Rheumatol 18(1):115–116
2. Butler JS, Shelly MJ, Timlin M, Powderly WG, O'Byrne JM (2006) Nontuberculous pyogenic spinal infection in adults: a 12-year experience from a tertiary referral center. Spine 31(23):2695–2700
3. Cahill DW, Love LC, Rechtine GR (1991) Pyogenic osteomyelitis of the spine in the elderly. J Neurosurg 74(6):878–886
4. Carreon LY, Puno RM, Dimar JR, II, Glassman SD, Johnson JR (2003) Perioperative complications of posterior lumbar decompression and arthrodesis in older adults. J Bone Joint Surg 85-A(11):2089–2092
5. Daubs MD, Lenke LG, Cheh G, Stobbs G, Bridwell KH (2007) Adult spinal deformity surgery: complications and outcomes in patients over age 60. Spine 32(20):2238–2244
6. Deyo RA, Cherkin DC, Loeser JD, Bigos SJ, Ciol MA (1992) Morbidity and mortality in association with operations on the lumbar spine: the influence of age, diagnosis, and procedure. J Bone Joint Surg 74(4):536–543
7. Deyo RA, Mirza SK (2006) Trends and variations in the use of spine surgery. Clin Orthop Relat Res 443:139–146
8. Eysel P, Hopf C, Vogel I, Rompe JD (1997) Primary stable anterior instrumentation or dorsoventral spondylodesis in spondylodiscitis? Results of a comparative study. Eur Spine J 6(3):152–157
9. Frangen TM, Kalicke T, Gottwald M et al (2006) Surgical management of spondylodiscitis: an analysis of 78 cases. Der Unfallchirurg 109(9):743–753
10. Fraser RD, Osti OL, Vernon-Roberts B (1987) Discitis after discography. J Bone Joint Surg Br 69(1):26–35
11. Grados F, Lescure FX, Senneville E, Flipo RM, Schmit JL, Fardellone P (2007) Suggestions for managing pyogenic (nontuberculous) discitis in adults. Joint Bone Spine 74(2):133–139
12. Hodgson AR, Stock FE, Fang HS, Ong GB (1960) Anterior spinal fusion: the operative approach and pathological findings in 412 patients with Pott's disease of the spine. Br J Surg 48:172–178
13. Jensen AG, Espersen F, Skinhoj P, Frimodt-Moller N (1998) Bacteremic *Staphylococcus aureus* spondylitis. Arch Intern Med 158(5):509–517
14. Lindholm TS, Pylkkanen P (1982) Discitis following removal of intervertebral disc. Spine (Phila Pa 1976) 7(6):618–622
15. Linhardt O, Matussek J, Refior HJ, Krodel A (2007) Long-term results of ventro-dorsal versus ventral instrumentation fusion in the treatment of spondylitis. Int Orthop 31(1):113–119
16. Mader JT, Shirtliff ME, Bergquist S, Calhoun JH (2000) Bone and joint infections in the elderly: practical treatment guidelines. Drugs Aging 16(1):67–80
17. Maiuri F, Iaconetta G, Gallicchio B, Manto A, Briganti F (1997) Spondylodiscitis clinical and magnetic resonance diagnosis. Spine 22(15):1741–1746
18. Mannion AF, Elfering A, Staerkle R et al (2005) Outcome assessment in low back pain: how low can you go? Eur Spine J 14(10):1014–1026
19. McHenry MC, Easley KA, Locker GA (2002) Vertebral osteomyelitis: long-term outcome for 253 patients from 7 Cleveland-area hospitals. Clin Infect Dis 34(10):1342–1350
20. Muckley T, Schutz T, Schmidt MH, Potulski M, Buhren V, Beisse R (2004) The role of thoracoscopic spinal surgery in the management of pyogenic vertebral osteomyelitis. Spine 29(11):E227–E233
21. Nolla JM, Ariza J, Gomez-Vaquero C et al (2002) Spontaneous pyogenic vertebral osteomyelitis in nondrug users. Semin Arthritis Rheum 31(4):271–278
22. Osti OL, Fraser RD, Vernon-Roberts B (1990) Discitis after discography: the role of prophylactic antibiotics. J Bone Joint Surg Br 72(2):271–274
23. Raffo CS, Lauerman WC (2006) Predicting morbidity and mortality of lumbar spine arthrodesis in patients in their ninth decade. Spine 31(1):99–103
24. Ragab AA, Fye MA, Bohlman HH (2003) Surgery of the lumbar spine for spinal stenosis in 118 patients 70 years of age or older. Spine 28(4):348–353
25. Roder C, Chavanne A, Mannion AF, Grob D, Aebi M (2005) SSE spine tango–content, workflow, set-up. www.eurospine.org-Spine Tango. Eur Spine J 14(10):920–924
26. Schinkel C, Gottwald M, Andress HJ (2003) Surgical treatment of spondylodiscitis. Surg Inf 4(4):387–391
27. Shabat S, Arinzon Z, Folman Y et al (2008) Long-term outcome of decompressive surgery for lumbar spinal stenosis in octogenarians. Eur Spine J 17(2):193–198
28. Sobottke (2008) Spondylitis and spondylodiscitis. In: C.B. Käfer W, Mattes T, Reichel H (ed) Orthopaedic spine surgery. Steinkopff
29. Sobottke R, Csecsei G, Kaulhausen T et al (2008) Spinal surgery in the elderly: does age have an influence on the complication rate? Der Orthopade 37(4):367–373
30. SH Sobottke R, Fätkenheuer G, Schmidt M, Goßmann A, Eysel P (2008) Current diagnosis and treatment of spondylodiscitis. Dtsch Arztebl Int 105(10):181–188
31. Sobottke R, Zarghooni K, Seifert H et al (2008) Spondylodiscitis caused by *Mycobacterium xenopi*. Arch Orthop Trauma Surg 128(10):1047–1053
32. Uchida K, Nakajima H, Yayama T, et al. (2009) Epidural abscess associated with pyogenic spondylodiscitis of the lumbar spine; evaluation of a new MRI staging classification and imaging findings as indicators of surgical management: a retrospective study of 37 patients. Arch Orthop Trauma Surg [Epub ahead of print]
33. Woertgen C, Rothoerl RD, Englert C, Neumann C (2006) Pyogenic spinal infections and outcome according to the 36-item short form health survey. J Neurosurg Spine 4(6):441–446