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ORIGINAL ARTICLE

Long-term patient-related quality of life outcomes and ICD-10 symptom rating (ISR) of patients with pyogenic vertebral osteomyelitis: What is the psychological impact of this life-threatening disease?

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Abstract

Purpose We aimed to evaluate the long-term impact of the treatment of pyogenic vertebral osteomyelitis (VO) on functional outcomes and patients' quality of life (QoL) with a special focus on psychological well-being.

Methods A total of 156 patients with VO with a minimum clinical follow-up of 12 months were retrospectively identified and asked to participate. Patient-reported outcome measures were evaluated with the EuroQol five-dimension questionnaire (EQ-5D) and German Short-Form 36 (SF-36) outcome instruments as well as with an ICD-10 based symptom rating (ISR) and compared to normative data. Spine-specific outcomes were assessed with the Core Outcome Measure Index and the Oswestry disability index (ODI) or the Neck disability index (NDI), respectively.

Results From $n = 156$ eligible patients, $n = 129$ patients could be contacted and $n = 40$ returned questionnaires, yielding a response rate of 31.0%. The mean time from hospital discharge to follow-up was 83.0 ± 3.8 (13–193) months. Spine-specific outcomes showed mild to moderate disability. The mean physical health component score of the SF-36 (37.1 ± 16.7), the mean mental health component score (38.2 ± 14.0) and the mean EQ-5D VAS rating (57.1 ± 21.5) were significantly lower in comparison with the scores of an age-matched reference population (all $p < 0.05$). The mean total score of the ISR was 0.53 ± 0.23. On average, the cohort did not cross the threshold of clinically relevant symptom burden on any subscale.

Conclusion Even almost seven years on average after completed treatment of VO, patients report impaired QoL. Assessment of psychological disorders should be implemented in clinical practice and future prospective studies.

Keywords ICD-10 symptom rating · Patient-reported outcome measure · Psychological disorders · Quality of life · Vertebral osteomyelitis

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Introduction

Pyogenic vertebral osteomyelitis (VO) is considered the most common hematogenous osteomyelitis in adults in Europe. The annual incidence is steadily increasing. This development may partially be attributable to better detection with improved diagnostic modalities and algorithms [1]. Mainly the increasing age of the population, increasing numbers of patients with multiple comorbidities and thus, increasing rates of medical interventions contribute to the epidemiological development. VO is a potentially life-threatening disease and bears an elevated risk of mortality for elderly and multimorbid patients. High in-hospital mortality rates around 10–20% have been reported [2, 3]. Likewise, the long-term mortality is elevated, mainly due to manifold comorbidities [4]. Especially, healthcare-associated VO (HAVO), often based on bloodstream infections with low-virulent pathogens, result in insidious courses of the disease with a prolonged time to diagnosis and even aggravated morbidity and mortality rates [5]. Particularly, old and frail patients are prone to HAVO and they are more likely to suffer devastating courses of disease with poorer outcomes [5]. This group of elderly patients is further prone to psychiatric disorders, above all depression. In elderly people, depression mainly affects those with chronic medical illnesses and cognitive impairment, which worsens the outcomes of many medical illnesses, and increases mortality [6]. Authors often focused on identifying favorable aspects of in-hospital treatment for the survival and good quality of life (QoL) outcomes [3, 7, 8]. However, whereas some insights into the QoL of VO patients were reported, studies assessing the long-term impact of this disease are scarce [9]. Further, psychological aspects are commonly underrepresented in the assessment of outcomes in orthopedic departments that only recently gained growing attention [10, 11].

Therefore, the aims of the current study were to provide long-term results on the quality of life of patients after the treatment of VO, compared to the normative population, and to evaluate the long-term psychological effect after VO treatment.

Material and methods

Hypothesis We hypothesize that the QoL and psychological well-being of patients, treated for VO is impaired compared to a normative reference population at the long-term follow-up.

Patient identification and characteristics

Adult patients treated for VO at a level 1 trauma center in Germany between January 1, 2000, and March 31, 2021, were retrospectively identified based on the international classification of disease (ICD)-10 diagnosis codes (M46.2, M46.3, M46.4, and M46.5) and selected for the study. Patients' medical charts, surgery protocols, radiological findings, laboratory findings as well as microbiological and histopathological reports were screened for inclusion criteria of VO. Only patients with completed VO treatment for whom treatment completion was documented in the medical charts were included. For subgroup analyses the etiology of VO was differentiated into community-acquired vertebral osteomyelitis (CAVO) and healthcare-associated vertebral osteomyelitis (HAVO), as defined before [12]. Patient characteristics (sex, age, and body mass index (BMI) at the time of admission), smoking status as well as the treatment received (surgery, revision surgery, changes in antibiotic regimes) were assessed by reviewing electronic medical records. Comorbidities were assessed by obtaining the Charlson Comorbidity Index (CCI) and the age-adjusted Charlson Comorbidity Index (ACCI) [13].

Ethic statement

This study was carried out in accordance with the Declaration of Helsinki and approved by the local university ethics committee (Institutional Review Board Number 12-218_2-101; Amendment 08/2021). Written informed consent was obtained from all individual participants included in the study.

Quality of life assessment

All patients whose postal address could be retrieved were sent the QoL questionnaires. Patients were asked to complete and return the questionnaires, including a signed informed consent statement, in a prepaid envelope. Patients, that did not return the questionnaires were contacted by phone and asked for participation. If the participation was denied, the reasons for denial were documented. All patients from whom completed questionnaires and informed consent were available were included in the study. The minimum clinical follow-up period was set at 12 months.

Patient-related outcomes and quality of life were assessed using the German Short-Form 36 (SF-36) and EQ-5D scores as well as an ICD-10-based symptom rating (ISR). The latter is an inventory frequently used in psychosomatic anamnesis. It consists of 29 items and covers various mental syndromes with subscales for depression, anxiety, obsessive/compulsive disorders, somatoform disorders and eating disorders [14] The EQ-5D is a well-established generic quality of life instrument developed by the EuroQol group comprising five questions concerning the functional domains mobility, self-care, everyday life activities, pain/discomfort and anxiety/depression. The items were converted into a single EQ index value using German norm data weights [15]. Additionally, the EQ-5D was evaluated using the visual analogue scale (VAS) method. The widely used SF-36 health survey captures the general health status with 36 questions in eight functional domains: physical function, role physical, bodily pain, general health, vitality, social function, role emotional and mental health. Summary scores for the physical and mental component were calculated using normative data from a German national health interview and examination survey conducted in 1998 with 7124 participants [16]. Quality of life scores were compared to normative data [16, 17].

For the spine-specific QoL and functional analysis, the well-established Core outcome measurement index (COMI-back) and the Oswestry disability index (ODI) were assessed [18]. The COMI-back comprises a series of questions covering the domains pain (back and leg/buttock pain intensity, each measured separately on a 0–10 numeric graphic rating scale), back-related function, symptom-specific well-being, general quality of life, social disability, and work disability (each scored on a 5-point scale). The COMI-back composite score ranges from 0 to 10. For patients suffering from cervical VO, the modified version COMI-neck was applied [19].

The Oswestry disability index (ODI-version 2.1) is a functional score and consists of ten items to assess the extent of the patient's back pain and difficulty in carrying out nine different activities of daily life: personal care, lifting, walking, sitting, standing, sleeping, sex life, social life and traveling. Each item is scored from 0 to 5, with higher values representing greater disability. The total score is multiplied by 2, to give a score from 0 to 100. Correspondingly the neck disability index was assessed for patients suffering from cervical VO [20].

Statistics

Data were analyzed using SPSS statistics version 24.0 (IBM, SPSS Inc., Armonk, NY). Descriptive statistics were calculated for all variables. Continuous variables were expressed as the mean and standard deviation. To facilitate comparison with other studies, the results of the SF-36, ODI, COMI, ISR, and EQ-5D index were also presented as means and standard deviations. Ordinal variables were analyzed using the Mann–Whitney U test (ODI and NDI categories, EQ-5D VAS rating, and EQ-5D index), while the one-sample t-test was applied to the SF-36 outcomes to test against age-matched normative data, which were treated as continuous variables. The level of significance was set at $p<0.05$.

Results

After the initial screening of the database, $n=156$ (67 female, 89 male) patients were eligible for the follow-up (Fig. 1). During the initial hospital stay $n=22$ patients died. Another $n=31$ died during the follow-up period. The mean age at death was of 69.6 (32–89) years. Of the n = 129 patients contacted, $n=40$ returned questionnaires, yielding a response rate of 31.0% and a loss to follow-up of 69.0%. The mean age of included patients was 70.0 ± 12.2 (39–89) years. The mean time to the first follow-up was 83.0 ± 3.8 (13–193) months. The male/female ratio in the study group was 1.2 (22 male, 18 female). Eighteen cases were classified as CAVO and $n=22$ as HAVO (Table 1). Table 1 further displays the median CCI, ACCI, smoking habit, and the treatment procedures.

The mean ODI sum score was 26.8 ± 22.9%, the mean NDI 23.0 ± 17.7%. The distribution of ODI and NDI categories is shown in Table 2. Three patients did not fill the ODI

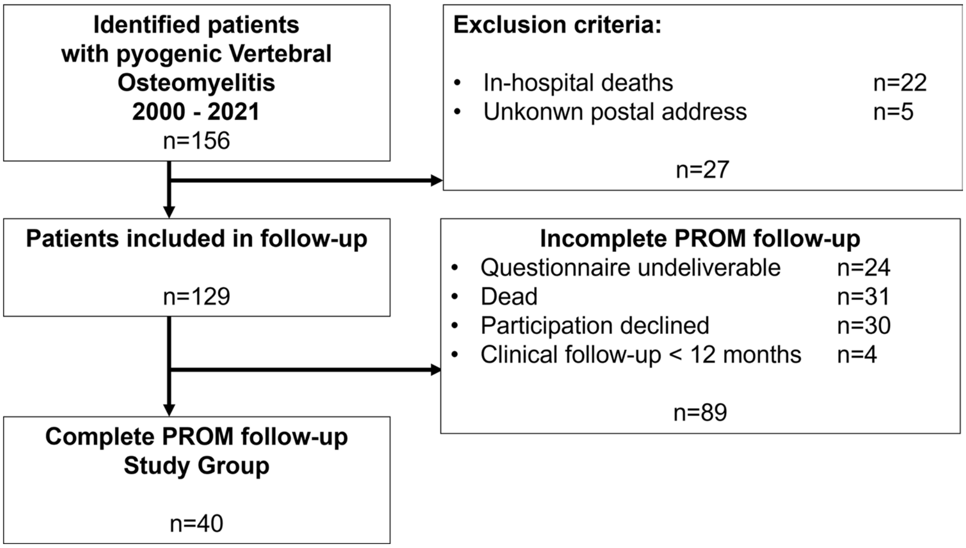


Fig. 1 Flowchart of patient inclusion and follow-up: From 156 eligible patients treated between 2000 and 2021 $n=129$ met the inclusion criteria. $N=40$ patients completed the PROM follow-up

Table 1 Patient demographics and characteristics (with complete PROM follow-up)

Patients	$n=40$
Sex	
Male	$n=22$ (55.0%)
Female	$n=18$ (45.0%)
Age	70.0 ± 12.2 years
BMI	29.2 ± 5.7 kg/m^2
CCI	Median = 1 (0–4)
ACCI	Median = 3.5 (0–6)
Smoking	
No	$n=21$ (52.5%)
Yes, Currently	$n=3$ (7.5%)
Yes, Formerly	$n=16$ (40.0%)
Follow-up time	83.0 ± 3.8 months
Etiology	$n=18$ (45.0%)
CAVO	$n=22$ (55.0%)
HAVO	
Treatment procedure	
Conservative	$n=16$ (40.0%)
Surgery	$n=24$ (60.0%)
Revision surgery	$n=5$ (20.8% of surgically treated patients)
Change in antibiotic treatment	$n=10$ (25.0%)

or NDI questionnaire (missing values). From the patients, that completed the ODI or NDI questionnaire 73.1% reported minimal (56.8%) or moderate (16.3%) disability. The worst possible outcome “bed-bound or exaggeration of symptoms” was reported in no case (Table 2). Subgroup analysis did not identify statistically significant differences in the distribution of ODI and NDI categories (Table 2), when stratified for surgery (yes/no; $p=0.37$), etiology (HAVO/CAVO; $p=0.20$), change in antibiotic treatment (yes/no; $p=0.41$) or revision surgery (yes/no; $p=0.09$). The mean COMI-back sum score was 3.3 ± 2.7/10 (0–9). The mean COMI-neck score of four patients with cervical vertebral osteomyelitis was 4.4 ± 1.5/10 (3–6).

The mean physical health component score (PCS) of the SF-36 was 37.1 ± 16.7, and the mean mental health component score (MCS) of the SF-36 reached a value of 38.2 ± 14.0. In comparison with aged-matched normative data from Germany, patients scored lower in the physical health component ($PCS_{Norm}=43.9 \pm 11.0$, $p<0.001$) as well as in the mental health component of the SF-36 ($MCS_{Norm}=52.8 \pm 8.6$, $p=0.01$), respectively (Fig. 2).

The subdomain analysis resulted in mean values of 50.0 ± 8.5 for physical function 38.2 ± 2.2 for physical role, 39.6 ± 2.9 for bodily pain, 60.2 ± 6.3 for general health, 54.2 ± 6.0 for vitality, 44.7 ± 2.5 for social functioning, 51.0 ± 1.5 for emotional role and 57.5 ± 6.4 for mental health (Fig. 2). Hence, patients reached 67.0% for physical function (74.6 ± 25.5, $p<0.05$), 52.0% for physical role (73.9 ± 39.6, $p<0.05$), 63.0% for bodily pain (62.8 ± 27.4, $p<0.05$), 100.0% for general health (59.3 ± 18.8, $p=0.78$), 88.0% for vitality (61.3 ± 18.9, $p=0.19$), 52.0% for social functioning (86.4 ± 20.5, $p<0.05$), 57.0% for emotional role (89.1 ± 28.7 $p<0.05$) and 79.0% for mental health (73.2 ± 17.4, $p<0.05$) of the normative values (Fig. 3).

The mean EQ-5D VAS rating reached 57.1 ± 21.5 in comparison with a score of 68.6 ± 1.1 obtained from an age-matched reference population ($p<0.05$). The mean EQ-5D index value was 0.85 ± 0.09, which was equal to the age-matched normative value of 0.8. In the subdimensions of the EQ-5D, patients showed limitations, especially concerning pain/discomfort (Fig. 4). There were no differences in the EQ-5D index in the subgroup analysis (Table 3).

The mean total score of the ISR was 0.53 ± 0.23. The mean ISR subdimension scores reached 0.96 ± 0.36 for depression, 0.60 ± 0.20 for anxiety, 0.44 ± 0.13 for obsessive/compulsive disorders, 0.45 ± 0.17 for somatoform disorders and 0.64 ± 0.15 for eating disorders, respectively (Fig. 5). On average, the cohort did not cross the threshold of mild symptom burden meeting criteria for caseness,

Table 2 Distribution of combined ODI and NDI category results and subgroup analysis

ODI and NDI category (sum score range)	Number of patients (n)	Percentage of patients (%)	Subgroups			
			surgery yes/no	CAVO/HAVO	Change in antibiotic treatment yes/no	Revision surgery yes/no
Minimal disability (0–20)	21	56.8	13/8	9/12	6/15	3/10
Moderate disability (21–40)	6	16.3	5/1	5/1	1/5	0/5
Severe disability (41–60)	7	18.9	3/4	2/5	0/7	0/3
Crippled (61–80)	3	8.1	1/2	2/1	1/2	1/0
Bedbound (81–100)	0	0.0	0/0	0/0	0/0	0/0
Missing values	3	–	2/1	0/3	2/1	1/1

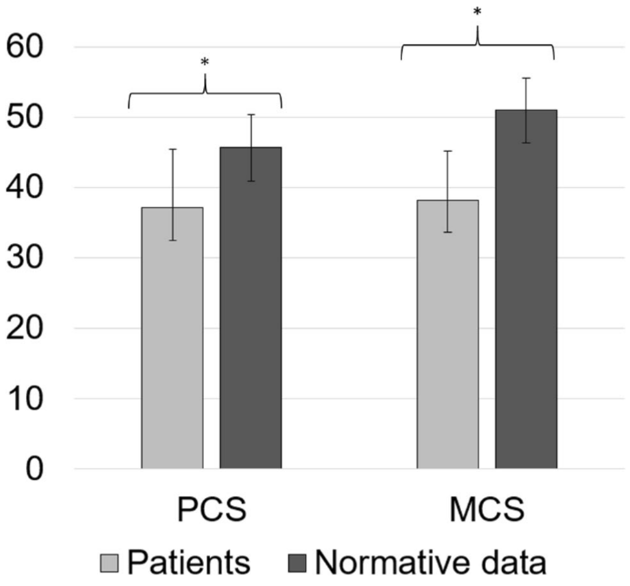


Fig. 2 Mean physical health component score (PCS) and mean mental health component score (MCS) assessed with the SF-36. The results of the patient cohort are shown in light gray. For a comparison the values of the normative data are illustrated in dark gray. * $p<0.05$

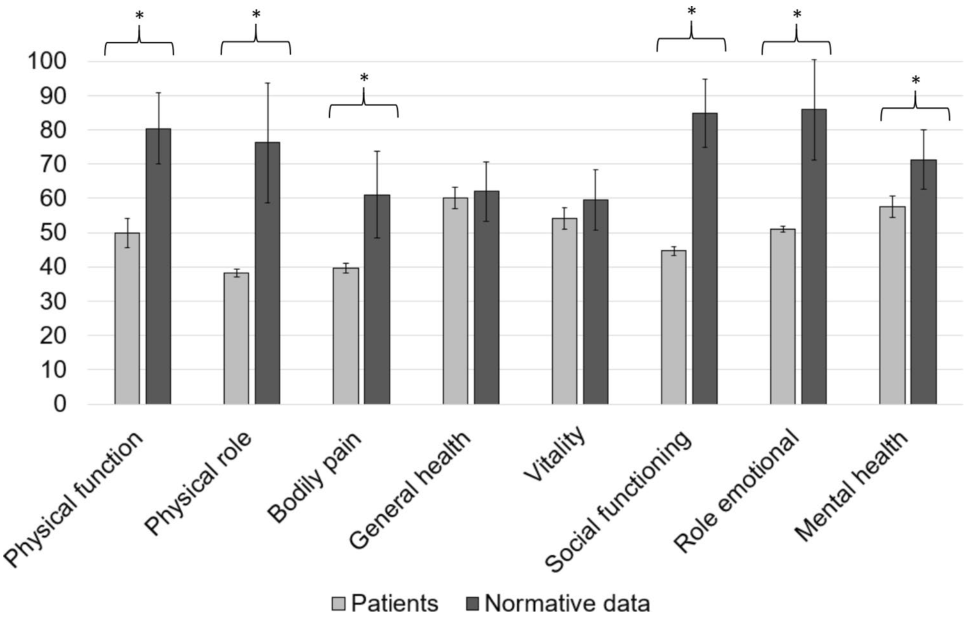
i.e., clinically relevant severity of psychological disorders regarding any scale.

Discussion

The present study included for the first time an explicit investigation of the psychological impact of using instruments such as the ISR in a long-term follow-up for VO patients. The ISR total score suggested a relevant prevalence of mental disorders in the observed cohort but did not cross the threshold for clinically relevant symptom burden. Overall, only minor impairment in terms of the well-established scores ODI, COMI, SF-36 and EQ-5D were observed after a mean follow-up time of 6.9 years. While the cohort did not equal the QoL levels of an age-matched health population in the SF-36 scores in the physical and mental summary component, the subdomains general health and vitality were not significantly lower.

The border for clinical mild symptom burden was not crossed in the observed cohort for any of the ISR subdimensions, nor the ISR total score. Nevertheless, the total score of 0.53 and the subdimension scores of somatization (0.45) and eating disorders (0.64) crossed the thresholds for suspicion of disorders (0.50, 0.33 and 0.33, respectively). The evaluation of psychological symptoms in infectious disease treatment and spine surgery can be assumed to be underrepresented. The current results suggest that mental disorders should be at least suspected during the follow-up of VO patients and may be a relevant supplementation to QoL follow-up regimes. In this stance, several studies reported that patients with psychological comorbidities have worse clinical outcomes after spine surgery including longer hospital stays, higher rates of nonroutine discharge and readmission [11]. In addition, it has been demonstrated that chronic osteomyelitis increases the risk of developing depression [21]. Also, from studies regarding other medical conditions such as periprosthetic joint infection it is known, that the concomitant diagnosis of depression leads to an increased risk of infection after joint replacement and is associated with worse clinical outcomes [22]. Further, in a recent study including 1,078,639 patients from a nationwide database it was shown that patients who undergo spinal surgery have a

Fig. 3 Subdimension scores for patient-related quality of life assessed with the SF-36. The results of the patient cohort are shown in light gray. For a comparison, the values of the normative data are illustrated in dark gray. * $p<0.05$



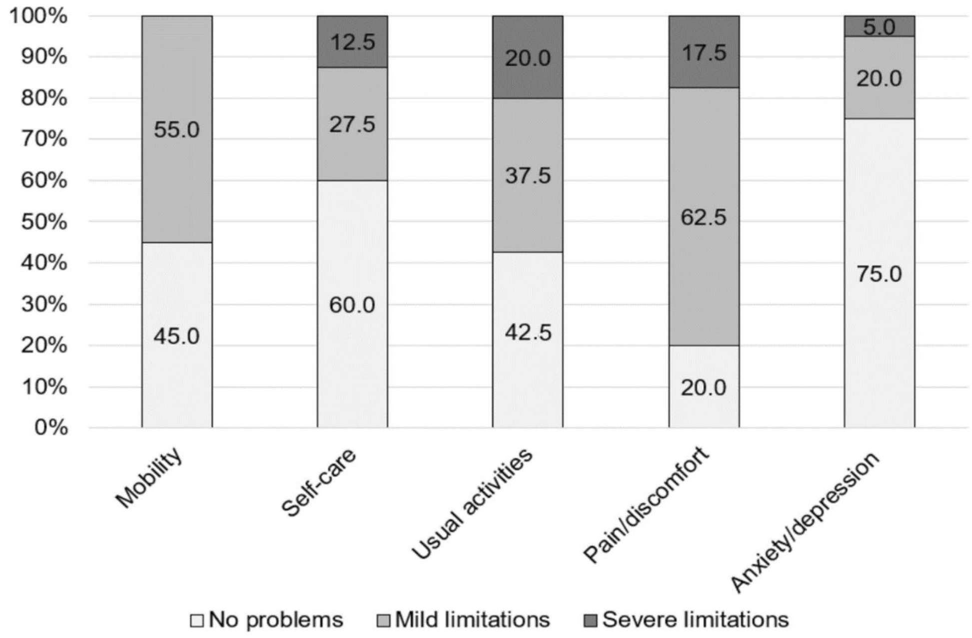


Fig. 4 Percentage of patients showing severe, mild, or no limitations in the EQ-5D subdimensions

Table 3 Subgroup analysis of EQ-5D index results

Category	Stratification	Mean ± SD	Mann–Whitney *U* test
Sex	Male	85.2 ± 9.2	$p = 0.888$
	Female	84.9 ± 10.2	
Etiology	CAVO	82.3 ± 9.0	$p = 0.169$
	HAVO	87.2 ± 9.6	
Surgery	Yes	86.3 ± 9.0	$p = 0.362$
	No	83.6 ± 10.2	
Change in antibiotic treatment	Yes	84.6 ± 9.1	$p = 0.788$
	No	85.2 ± 9.8	
Revision surgery	Yes	91.0 ± 12.7	$p = 0.258$
	No	85.0 ± 7.8	

higher risk for postoperative depression compared to patients hospitalized for coronary artery bypass grafting (hazard ratio: 2.33, 95% CI 2.15–2.54), hysterectomy (hazard ratio: 3.04, 95% CI 2.88–3.21) and congestive heart failure exacerbation (hazard ratio: 2.44, 95% CI 2.28–2.61) among others [10]. In light of these findings, to improve the management and patients' QoL, interdisciplinary collaboration is warranted, and a psychologists or psychiatrists should be a part of the treatment team.

Even though VO is a devastating disease with a relevant in-hospital and 1-year mortality rate, also other studies regularly report good improvement in QoL measures after successful treatment. Yagdrian et al. recently reported on improved QoL of 195 surgically treated VO patients in a 2-year follow-up [2]. They observed significant improvement in the ODI, SF-36, VAS and COMI scores during the study period, but impaired QoL levels compared to the general population. Also comparable with our findings, Dragsted et al., assessed the EQ-5D and the ODI in sixty-five spondylodiscitis patients with a median final follow-up time of two years. The authors reported a mean ODI of 31% and a mean EQ-5D score of 0.64, which was significantly lower compared to the Danish population norm [23]. Further, Stoop and colleagues aimed at evaluating the long-term impact of spondylodiscitis by applying the ODI, the SF-36 and a Visual Analogue Scale for back pain after a median follow-up of 63 months. The loss-of follow-up rate for the QoL questionnaires was 55.2% in their study. Their results revealed a strong correlation between ODI scores and back pain ($\rho = 0.81$, $p < 0.05$). All subdomains of the SF-36 were significantly lower in comparison with a normative Dutch cohort [24]. There is consent, that long-lasting negative effects such as pain and reduction in QoL even after successful management should be considered for accessing the outcome of VO treatment [25]. The recent study did not identify a statistically significant difference in the long-term QoL and psychological outcome scores in subgroup analysis, when stratified for sex, conservative vs. surgical treatment, need for revision surgery, and change in the antibiotic treatment or etiology (CAVO/HAVO). However, the statistical analysis must be considered against the background of the small number of cases.

The main limitation of this study is its retrospective design and thus, that no baseline QoL scores before or during treatment were available. The definition of successful treatment of spinal infections was based on the medical

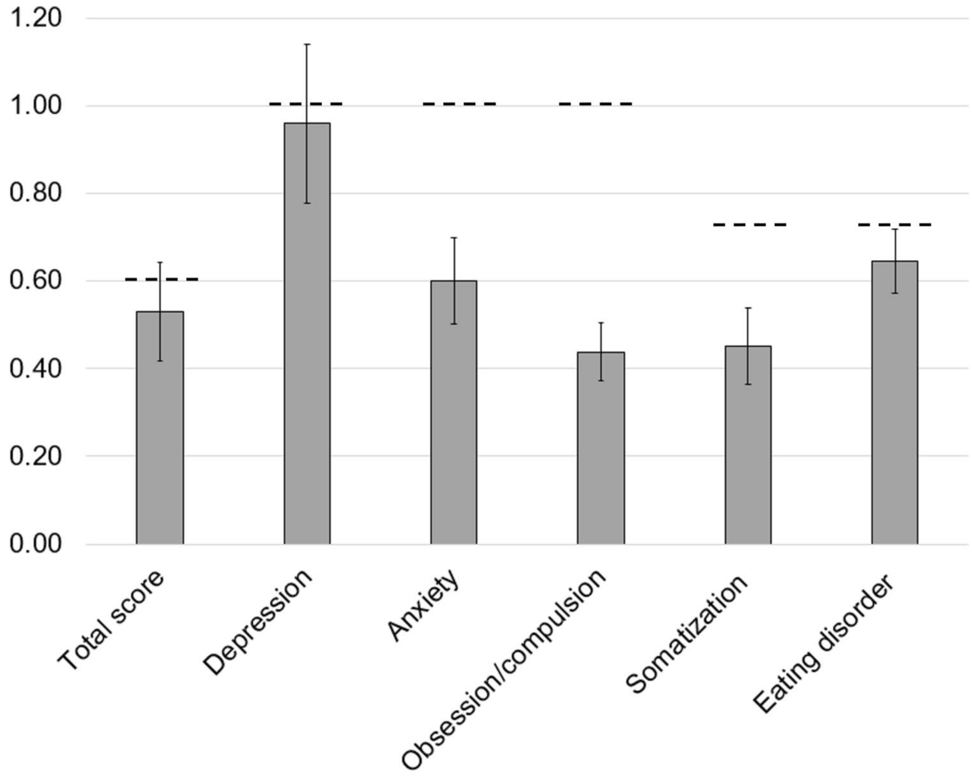


Fig. 5 Mean values of the ISR scores. The black dotted lines depict the border of considered symptom burden (=caseness)

charts and may not capture all aspects of successful treatment as defined in the literature. Further, the generalizability of the results is limited due to the relatively small sample size and the heterogeneity of performed treatment procedures as well as the low response rate.

Conclusion

Even almost seven years on average after completed treatment of pyogenic VO, patients still report significantly lower quality of life in the physical as well as mental domain compared to normative data. Hence, the results demonstrate the seriousness of consequences following pyogenic VO treatment, but also the potential of restoring patients' quality of life. Thus, analyzing patient-reported outcomes after treatment is of clinical relevance as data reflecting the long-term impact of VO can provide valuable insights useful for informing patients about realistic expectations of the burden of disease and improve clinician–patient communication. Especially, assessment of psychological disorders can complete the outcome measures and should be implemented in future, prospective studies.

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Declarations

Conflict of interest All authors declare no competing interests.

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