

Research Article

Treatment and Long-term Quality of Life in Patients with Long Bone Osteomyelitis: A Systematic Review

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Abstract

Introduction: Chronic osteomyelitis (COM) is a debilitating infectious conditions associated with persistent bone destruction, functional impairment, and significant psychosocial burden. There is a paucity of data on long-term impact on patient-reported quality of life (QoL) in adult patients with long-bone osteomyelitis, particularly regarding physical and mental health, and the current work aims to provide more data on this musculoskeletal infection entity.

Methods: We performed a systematic review of studies published between 2010 and 2025 that reported validated QoL or mental health outcomes in adults with long bone COM with a minimum follow-up of 12 months. Due to the established differences between fracture-related infections and osteomyelitis, only studies on osteomyelitis without prior surgical fracture treatment were included. Methodological quality was assessed using the MINORS and ROBINS-I tools.

Results: Four studies met inclusion criteria. Evidence suggests that COM patients may experience variable improvements in QoL post-treatment, with psychological distress, including depression and anxiety, particularly pronounced in those with comorbidities such as type 2 diabetes. Evidence on the subentity of chronic hematogenous osteomyelitis (CHOM) was limited to a single small cohort, demonstrating functional and psychological gains, though interpretation was constrained by study design. Only half of the studies reported treatment-success and revision rates, thereby precluding any meaningful comparison. Overall, methodological quality was moderate, and heterogeneity precluded meta-analysis.

Conclusion: Overall, the current evidence base is insufficient to draw definitive conclusions regarding treatment success and long-term QoL impact of non-traumatic osteomyelitis. Well-designed, prospective investigations are urgently required to elucidate the enduring physical, psychological, and social sequelae of COM and CHOM and to inform patient-centered management strategies.

Keywords: Chronic Osteomyelitis; Chronic Hematogenous Osteomyelitis; Patient-Reported Outcome Measures, Quality of Life

Abbreviations

COM: Chronic Osteomyelitis; CHOM: Chronic Hematogenous Osteomyelitis; FRI: Fracture Related Infection; CNO: Chronic Non-bacterial Osteomyelitis; PJI: Periprosthetic Joint Infection; PROMs: Patient-Reported Outcome Measures; QoL: Quality of Life.

Introduction

Osteomyelitis is an indolent infectious process marked by progressive destruction of affected osseous tissue [1]. The disease may develop through contiguous spread, penetrating trauma, or hematogenous dissemination [2]. When inadequately treated in the acute phase or the infection recurs, the disease frequently evolves into a chronic state [3]. Although most cases of chronic osteomyelitis (COM) are exogenous, typically following trauma or surgery, COM may also occur in the absence of preceding injury or operative intervention. The condition predominantly affects young adult males and exacts a substantial toll in terms of morbidity and diminished quality of life (QoL) [4].

For affected patients, COM represents a disabling and complex disorder which can persist for months and years and whose management remains challenging. Patients frequently present with multiple comorbidities, compromised soft-tissues, and infections due to multidrug-resistant organisms [5]. A chronic inflammation is often accompanied by abscess formation, sequestration of necrotic bone, and sinus tract development [3,6]. Effective management typically requires a coordinated, multidisciplinary approach involving microbiologists, infectious disease specialists, and both orthopedic and plastic surgeons [7]. Advances in surgical debridement and the local delivery of high-dose antimicrobials have meaningfully enhanced outcomes, with reported cure rates between 79% and 97% [4,5]. Nonetheless, despite extended systemic antibiotic regimens following aggressive debridement, recurrence has been documented in up to 30% of patients within the first 12 months after surgery [1,8]. In some cases, infection persists despite comprehensive intervention and must be regarded as treatment-resistant [9].

A less frequent variant, chronic hematogenous osteomyelitis (CHOM), occurs when blood-borne pyogenic organisms rapidly localize to the metaphyseal region of bone. CHOM commonly originates from hematogenous bacterial emboli arising from distant infectious foci, with *Staphylococcus aureus* being the pathogen most often isolated [10,11]. The associated bone and soft-tissue destruction may lead to chronic pain, persistent drainage, and recurrent fistula or abscess formation, frequently resulting in loss of occupational function [10]. Hematogenous forms account for approximately 16% to 19% of all osteomyelitis cases [10,12].

Whereas prior research has primarily focused on clinical outcomes, while studies employing patient-reported outcome measures (PROMs) remain comparatively limited. The available literature assessing QoL in osteomyelitis has largely concentrated on post-traumatic osteomyelitis — commonly referred to as fracture-related infection (FRI). Consequently, the long-term physical and mental health consequences of patients suffering from osteomyelitis without preceding trauma remains insufficiently understood. Moreover, heterogeneity in QoL assessment tools complicates data aggregation and interpretation. A systematic, quantitative appraisal of QoL in non-traumatic COM is therefore warranted to guide clinical decision-making and provide patients with realistic expectations regarding prognosis and recovery trajectories.

This systematic review synthesizes longitudinal QoL outcomes (≥ 12 months) following treatment for COM or CHOM, with particular attention to psychological symptom burden and the incidence of depression. Specifically, the following research questions should be answered: 1) Which surgical approach was employed for managing COM and CHOM, and what revision and treatment-success rates were achieved? 2) Do patients treated for COM or CHOM exhibit persistently reduced QoL scores for ≥ 12 months after therapy? 3) Are patients with these two indications at increased risk of developing a mental health disorder within one year?

Methods

To achieve a comprehensive identification of the relevant scientific literature, a systematic computerized search was undertaken across PubMed, Web of Science, and Google Scholar, encompassing publications issued between January 2010 and August 2025. The review process adhered to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) statement [13]. The search strategy integrated a combination of targeted keywords and medical subject headings, including „Osteomyelitis quality of life“, „Osteomyelitis mental health“, „Osteomyelitis depression“, „Osteomyelitis pain“, „Osteomyelitis mobility“, „Osteomyelitis anxiety“, „Osteomyelitis PROMs“, „Hemosteomyelitis quality of life“, „Hematogenous osteomyelitis mental health“, „Hematogenous osteomyelitis depression“, „Hematogenous osteomyelitis pain“, „Hematogenous osteomyelitis mobility“, „Hematogenous osteomyelitis anxiety“ and „Hematogenous osteomyelitis PROMs“.

All citations retrieved through the electronic databases were screened independently by two reviewers (JAB and NW). To ensure maximal comprehensiveness, the reference lists of selected included articles were manually reviewed to identify additional studies not captured through the initial search.

Titles and abstracts were appraised against the predefined inclusion criteria. Eligible studies were required to meet the following conditions: enrollment of adult participants (≥ 18 years) diagnosed with osteomyelitis unrelated to traumatic etiology and involving non-spinal bones; inclusion of more than five participants; publication in English; and use of a cohort or case-control design. Studies were required to report QoL outcomes assessed with validated, standardized instruments at a minimum follow-up of 12 months after successful treatment, or to evaluate the risk of incident mental disorder within one year following treatment for COM or CHOM. Due to the established differences between fracture-related infections and osteomyelitis, only studies on osteomyelitis without prior surgical fracture treatment were included.

Investigations focusing on chronic non-bacterial osteomyelitis (CNO) were excluded from data extraction, as CNO constitutes a rare autoinflammatory condition of uncertain etiology that is conceptually distinct from bacterial osteomyelitis [14]. The use of the term osteomyelitis may therefore be considered misleading in this context. Moreover, CNO predominantly affects pediatric populations [15,16].

The level of evidence (LoE) for each study was assigned according to the Oxford Centre for Evidence-Based Medicine (OCEBM) framework as adapted for bone and joint research [17–19]. Ambidirectional cohort studies were conservatively classified as retrospective cohort studies. Methodological quality was appraised independently by two reviewers (JAB and NW) using the Methodological Index for Non-Randomized Studies (MINORS). Comprising eight items for non-comparative studies and twelve for comparative designs, the MINORS framework applies a three-point ordinal scoring system (0 = not reported, 1 = reported but not adequate and 2 = reported and adequate). In result, the scoring yields maximum totals of 16 and 24, respectively [20].

Risk of bias for all included studies was evaluated using the *Risk Of Bias In Non-randomized Studies—of Interventions* (ROBINS-I) framework, implemented via the ROBINS-I web-based assessment tool [21,22]. These assessments were conducted independently by two reviewers. Risk was judged across seven domains and categorized as low, moderate, or high. “Low” denotes minimal likelihood of bias, “moderate” indicates a discernible but acceptable risk, and “high” reflects substantial potential for bias.

Given both the limited number of eligible studies and the marked heterogeneity of outcome instruments (Table III), quantitative synthesis through meta-analysis was deemed methodologically inappropriate.

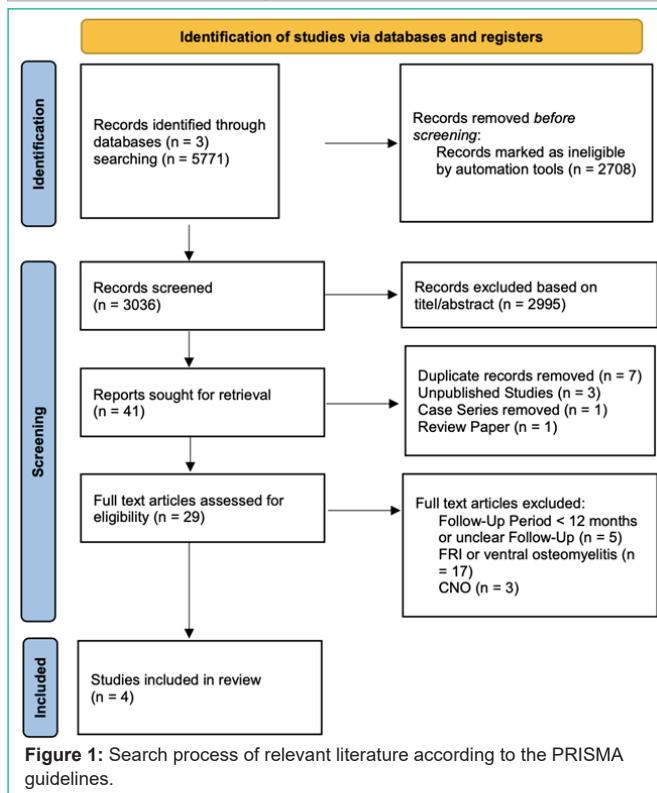
Results

Data Extraction

The systematic search identified 5,771 records across three databases, of which 2,708 were excluded by automated filters prior to screening. Following title and abstract review, 2,995 additional articles were removed. Further exclusions included duplicate records, one inadvertently included case series [23], a review [24] and three abstracts [25–27]. 29 full-text articles were selected for comprehensive assessment after detailed abstract review and reference list examination (Figure 1).

Table 1: Included Studies, Study Type and Level of Evidence.

Author (Year)	Study type	Control Group	Level of Evidence	Indication	Affected Bone
Hotchen et al. (2020)	Prospective Cohort Study	no	II	COM	Long bone
Klim et al. (2023)	Retrospective Single-Arm Cohort Study	no	IV	COM	Long bone
Wang et al. (2017)	Retrospective Cohort Study	without COM	III	COM	Heterogeneous
Wang et al. (2025)	Retrospective Single-Arm Cohort Study	no	IV	CHOM	Femur & tibia

**Figure 1:** Search process of relevant literature according to the PRISMA guidelines.**Table 2:** MINORS Score and drop-out rate for each included Study.

Author (Year)	Drop-Out Rate (%)	MINORS Score												Σ
		1	2	3	4	5	6	7	8	9	10	11	12	
Hotchen et al. (2020)	43.7	2	2	2	2	2	2	1	0	-	-	-	-	13
Klim et al. (2023)	NA	2	1	1	2	0	2	0	0	-	-	-	-	8
Wang et al. (2017)	NA	2	2	0	2	0	2	0	0	2	2	1	2	15
Wang et al. (2025)	0	2	0	1	1	0	2	2	0	-	-	-	-	8

Subsequently, five studies were subsequently excluded due to follow-up periods under 12 months [28–32] and seventeen were removed because cohorts included either partially or entirely patients with FRI or vertebral osteomyelitis [33–35,3,36,1,37,38,6,39–46]. Three additional studies were excluded for focusing on CNO [15,47,48]. Ultimately, four studies met the inclusion criteria [7,9,10,49], among which only a single study specifically evaluating the impact of HCOM on QoL [10].

Methodological Quality

Table 1 provides an overview of study designs and corresponding levels of evidence for all included studies. Half of the investigations assessing the impact of osteomyelitis on quality of life were rated as Level IV evidence [9,10], as they relied on patient-reported outcomes

analyzed using inferential statistics but lacked contemporaneous control groups. One study achieved Level II [7] and one Level III [49], among which only the latter employing a between-subjects design comparing COM patients with controls.

On average, studies examining quality of life in osteomyelitis patients achieved approximately 61% of the maximum MINORS score (range: 50.00%–81.25%), reflecting moderate to weak methodological rigor. Study heterogeneity was considerable regarding design, sample size, follow-up protocols, and instruments. Loss to follow-up ranged from 0% to 43.7%, with two studies not reporting attrition or data completeness (Table 2).

Risk-of-bias assessment indicated predominantly moderate risk, with one study classified as high risk [9]. Confounding was the primary source of bias, while participant selection carried the lowest risk. Across all studies, deviations from intended interventions contributed to a moderate risk of bias.

Quality of Life Measures

QoL was assessed using a heterogeneous array of instruments differing in structure and focus. The Short Form-36 (SF-36) was the most commonly employed instrument (Table 3).

Developed by the RAND Corporation, the SF-36 is a well-validated measure of physical and mental health. It comprises 36 items and generates two summary indices: the Physical Component Score (PCS) and the Mental Component Score (MCS). The PCS integrates four domains: physical functioning (PF), role limitations due to physical health (RP), bodily pain (BP), and general health perceptions (GH). Whereas the MCS is derived from vitality (VT), social functioning (SF), role limitations due to emotional problems (RE), and mental health (MH) [50].

The EQ-5D-3L [51–53], Self-Rating Anxiety Scale (SAS) [54,55], and Health Assessment Questionnaire (HAQ) [56] were also employed, each serving as a standard instrument for measuring QoL.

The Hospital for Special Surgery (HSS) Score is an assessment tool, administered by clinicians, to evaluate knee function. It measures the function in six subdomains pain, function, range of motion, muscle strength, deformity, and stability, providing a score between 0 and 100 that reflects the overall recovery [57]. Though the score is mainly used after knee surgery, it was interestingly administered in one paper to assess the recovery after treatment for COM in femur and tibia [10].

Moreover, one paper used a visual analog scale (VAS) without further information about the concrete scales and questionnaires used [10]. Also, one study employed an unspecified Activity of Daily Living Score (ADL) [49].

Impact of COM on QoL

Three studies [7,9,49] provided detailed assessments of COM's effect on quality of life. Hotchen et al. followed long-bone COM patients from preoperative evaluation to one year after single-stage

Table 3: Overview of frequently used validated quality of life questionnaires.

Name	Papers	Questions (n)	Focus of Testing	Sub-scales
Short Form 36 (SF-36)	Klim et al. (2023), Wang et al. (2017)	36	General health	Physical Component Scale (PCS): Physical functioning Bodily Pain Physical role functioning General health perception Mental Component Scale (MCS): Vitality Social role functioning Mental health Emotional Role functioning
EuroQoL-5D (EQ-5D-3L)	Hotchen et al. (2020)	5	General health	Mobility, Self-Care, Activities, Pain/ Discomfort, Anxiety/Depression
EuroQoL visual analog scale (VAS)	Hotchen et al. (2020)	5	General health	
Self-rating anxiety score (SAS)	Wang et al. (2017) Wang et al. (2025)	20	Mental health	
Health Assessment Questionnaire (HAQ)	Wang et al. (2017)	20	Physical health	Dressing, Arising, Eating, Walking, Hygiene, Reach, Grip, Common activity
Hospital for Special Surgery (HSS) Score	Wang et al. (2025)		Limb specific	Pain, Function, Range of Motion, Muscle Strength, Flexion Deformity, Instability

Table 4: Mean QoL measures (SD) and treatment success rates after at least 12 months after surgery.

Author (Year)	Treatment	Nr. treated	Nr. success	Success %	Nr. revision	Revision %	Questionnaire	Subscale	Mean QoL (SD)
Hotchen et al. (2020)	Single-stage surgery	40	NA	NA	2	2.80	EQ-5D-3L	index	0.740
								VAS	78.9
Klim et al. (2023)	Sinus tract treatment	22	NA	NA	NA	NA	SF-36	PCS	36.9
								MCS	45.4
Wang et al. (2017)	heterogeneous	107	NA	NA	NA	NA	SF-36	MCS	NA
							HAQ	walking	NA
Wang et al. (2025)	Masquelet technique	16	16	100.00	3	18.75	SAS	index	42.00 (7.63)
							HSS	Index	88.38 (6.39)

surgery. Revision surgery for reinfection occurred in 2.8% of cases, and PROMs improved significantly at one year, as measured by EQ-5D-3L and VAS, with overall QoL comparable to age-matched UK norms [7].

Klim et al. assessed quality of life with the SF-36 in patients undergoing iatrogenic sinus tract treatment following COM or periprosthetic joint infection (PJI). At a mean follow-up of 43.1 months, patients with chronic osteomyelitis demonstrated a significantly lower MCS than those with PJI, whereas the COM cohort exhibited a nonsignificant trend toward higher PCS. Compared with population norms, the combined sinus-tract cohort showed no significant difference in MCS but significantly lower PCS scores [9].

Wang et al. examined psychological burden in COM patients with and without type-2 diabetes after at least one year of follow-up. Rates of depression and severe anxiety, assessed via SF-36 and SAS, were significantly higher in COM patients with diabetes. Additionally, COM patients without diabetes reported fewer walking difficulties on the HAQ walking subscale [49].

Treatment success rates, revision rates, and patient-reported quality-of-life outcomes are summarized in Table 4.

Impact of CHOM on QoL

Only one study addressed the effect of chronic hematogenous osteomyelitis of the femur and tibia on QoL. Wang et al. assessed PROMs at multiple postoperative time points in 16 patients treated with the Masquelet technique for CHOM. Three patients required revision surgery for reinfection but all were infection-free at final

follow-up (Table IV). Functional outcomes (HSS) and psychological burden (SAS) improved significantly by three months postoperatively, with gains maintained and statistically significant at a minimum of two years compared with baseline [10].

Discussion

This systematic review sought to delineate the long-term consequences of COM and CHOM with respect to quality of life and psychological burden.

Our synthesis revealed a striking paucity of evidence regarding the impact of osteomyelitis on QoL in cases not classified as FRI. Over the past decade, only three studies have investigated COM and a single study examined CHOM. The overall evidentiary strength is low: half of the included studies were single-arm retrospective cohorts (LoE IV), and the mean methodological quality reached only roughly 61% of the maximum MINORS score. Marked heterogeneity was evident across studies in terms of design, sample size, research objectives, assessment tools, and the inclusion of control groups. One study demonstrated a high risk of bias, whereas the remaining three were rated as moderate, with confounding variables constituting the predominant threat to validity.

Hotchen et al. reported significant postoperative gains in PROMs, with higher EQ-5D and VAS scores one year after single-stage surgery [7]. After one year no statistically significant difference in QoL was observed when compared with the general population. Conversely, Klim et al. observed significantly lower PCS in a mixed cohort of COM and PJI compared with normative data [7,9]. Yet, since the

COM subgroup was not analyzed separately, it remains uncertain whether the observed differences were primarily driven by the PJI cohort. Notably, no significant difference in PCS between COM and PJI patients was detected [9].

Wang et al. highlighted that depression, severe anxiety and walking difficulties were more pronounced in COM patients with additional diagnosis of type-2 diabetes [49]. However, revision rates were addressed in only one study, precluding any firm conclusions.

Only one investigation evaluated PROMs for CHOM patients specifically. Wang et al. reported significant postoperative improvements in psychological and functional outcomes following Masquelet reconstruction for tibial and femoral CHOM, evident from three months onward [10]. Nonetheless, the absence of a control group and normative comparison precludes definitive conclusions about the long-term impact of CHOM on QoL.

The principal limitation of this review lies in the scarcity of primary research. With only three studies on COM and one on CHOM the current evidence base remains insufficient to permit robust or generalizable conclusions.

Half of the included studies lacked control groups, further undermining interpretability. Also, authors failed to report either treatment-success or revision rates in half of the studies. The small number of investigations likewise precluded the conduct of any meaningful meta-analysis. Substantial heterogeneity in study design, patient populations, and assessment instruments further constrains comparability.

Conclusion

Thus, the long-term impact of COM on quality of life remains inadequately characterized and inconsistent, while the effects of CHOM must, at present, be regarded as essentially unknown. As existing literature across diverse forms of osteomyelitis depicts the disease as a profound debilitating condition imposing physical limitations, psychological distress, and socioeconomic burden [6,58,59], there remains an urgent need for well-designed, prospective studies to clarify the long-term consequences of COM and CHOM and to guide evidence-based clinical practice. Clinicians should make the evaluation of their patients' mental health an integral part of routine follow-up. Moreover, to align patients' expectations with likely outcomes, there is an urgent need for rigorously designed, propensity-score-matched studies comparing revision and success rates across the surgical approaches employed.

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