Functional Outcomes and Quality of Life After Ankle Fracture Surgically Treated: A Systematic Review

Viviane Ribeiro de Ávila, Teresa Bento, Wellington Gomes, José Leitão, and Nelson Fortuna de Sousa

Context: Ankle fractures (AFs) are the most common fractures of the lower limbs found in emergency services. Approximately 53% of these fractures are unstable and treated surgically. Objective: To conduct a systematic review evaluating functional outcomes and quality of life of patients with AFs surgically treated. Evidence Acquisition: A systematic review was conducted in accordance with the Preferred Reporting Items for Systematic reviews and Meta-Analyses statement. Five electronic databases were searched, without any limit on publication dates. Only patients with an unstable AF that was surgically treated were included; functional outcomes and the quality of life were controlled by the 36-Item Short-Form Health Survey instrument.

Evidence Synthesis: Five studies were included in the analysis, including 267 patients. The values of the Physiotherapy Evidence Database scale ranged between a minimum of 5 and a maximum of 7 points. Patients with surgically treated AF reported less functional disability and physical capacity compared with the nonfractured population. Some patients experienced vitality, emotional, and mental health limitations for a long period. Most surgically treated patients reported no pain and a good health and social status. Conclusion: Limitations in functionality and physical capacity represent the main threats to health-related quality of life in patients with surgically treated AFs.

Keywords: SF-36, functionality, lower limbs, physical capacity

Context

Ankle fractures (AFs) are the most common injuries among the fractures of the lower limbs found in emergency and emergency services. These fractures are a significant source of morbidity for both the young and elderly population. At a young age, the incidence is higher in men, but the rate per gender reverses after 50 years of age. The incidence of AF is estimated between 101 fractures per 100,000 inhabitants per year in Europe and 184 fractures per 100,000 inhabitants per year in the United States. In Finland, AFs are very frequent, with a prevalence of 154 fractures per 100,000 inhabitants per year. Of these, approximately 53% are unstable fractures requiring surgical treatment.

The treatment of AF may be conservative when there is no deviation, and may be sustainably managed nonsurgically, with splints or traction, or surgically, where the bone displacement and the instability in the recess of the ankle are treated with open reduction and internal fixation technique using plates, screws, and Kirschner wires. The objective of surgical treatment for AF is to allow the early motion after internal fixation, reduce the total time of treatment, and shorten the time required to return to day-to-day activities.

Although patients are routinely released from the formality of orthopedic medical follow-up to 4 to 6 months after the surgical stabilization, some authors claim that even after 3 years, half of the

patients still report symptoms of pain, stiffness, swelling, and instability of the ankle joint, which may prevent them from returning to the same level of physical activity they exhibited before the AF.

In addition to body signs and symptoms, an AF has significant negative effects on the quality of life (QOL) of patients, associated with functional disability for numerous activities, particularly in older populations. In fact, advanced age is considered a negative factor for returning to physical activity up to 1 year after AF. It has been reported that patients aged 45 years and older are 3 times less likely to return to their work than younger patients.

The literature points out that the focus of research related to AF should cover sociodemographic, clinical, and psychosocial predictors related to QOL, in particular when crafting prospective studies. It is clear that QOL must be a determinant variable to be evaluated when studying AF.

Among the instruments used to measure QOL, the 36-Item Short-Form Health Survey (SF-36) is critical for assessing patients with AF, and due to its ability to compare with other populations, it should be the instrument of choice when evaluating the functional recovery of this population.

Objective

To conduct a systematic review evaluating functional outcomes and the QOL of patients with surgically treated AF compared with the nonfractured population.

Evidence Acquisition

Study Search and Selection

A literature review was conducted to identify studies on surgically treated AF, from the perspective of the QOL of individuals.
The search period in the databases ranged between September 13, 2015 and August 2, 2016, conducted by 2 independent authors (V.R.d.A. and W.F.G.), without any limit of dates of publication. The following databases were surveyed: MEDLINE (PubMed), Embase, Scirus, Scopus (Elsevier), and the Cochrane Central Register of Controlled Trials.

The keywords and Boolean operators used included: ankle fracture OR ankle injuries AND operative fixation OR internal fixation OR open reduction AND 36-Item Short-Form Health Survey OR SF-36. All the work of revision was oriented according to the Preferred Reporting Items for Systematic reviews and Meta-Analyses protocol.24

There was no need to directly contact the authors of the studies selected during the search. The lists of references of the complete articles selected were reviewed, but no relevant studies were found matching the theme of this article.

Studies were eligible for inclusion if they: contained only subjects with unstable AF treated surgically; used the SF-36 to assess QOL and function; included the result of all 8 domains of SF-36 questionnaire: functional capacity, physical aspect, bodily pain, general health status, vitality and energy, social aspects, emotional aspect, and mental health; and have been published in the English language. The exclusion criteria were: fractures (stress, pediatric, pathological, calcaneus, tibial pilon, diaphyseal of the tibia and fibula); epidemiologic studies; case reports; review articles; or systematic review.

**Assessment of Methodological Quality**

The reviewer (V.R.d.A.), previously trained, assessed the methodological quality of each study selected (n = 5) using the Physiotherapy Evidence Database (PEDro) rating scale.25

**Data Extraction**

The data extracted from the studies were: mean age, population, sample size, gender, study design, follow-up in months, instruments used, fracture classification, cause of fracture, surgical technique, and results of the SF-36 questionnaire.

**Evidence Synthesis**

**Study Selection**

A total of 235 potentially relevant articles were identified through the search of the database, 5 of which matched the inclusion and exclusion criteria and were considered eligible articles (Figure 1).
Table 1 Characteristics of Included Studies

<table>
<thead>
<tr>
<th>Study (design)</th>
<th>Mean age (SD, range), y</th>
<th>Follow-up, mo</th>
<th>Instruments</th>
<th>Fracture classification</th>
<th>SF-36 results</th>
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<tbody>
<tr>
<td>Nilsson et al29(P)</td>
<td>71.5 (65–89)</td>
<td>6 and 12</td>
<td>SF-36, OMAS, VAS, radiography and interview by e-mail</td>
<td>Lauge-Hansen: SER IV (n = 39); SER III (n = 2); SER II (n = 2); SAD II (n = 1); SAD I (n = 1); PER IV (n = 2); PER III (n = 2); PAB II (n = 1)</td>
<td>Female patients (n = 34)</td>
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<td>$P$ values comparing patients with Swedish norm after 6-mo follow-up</td>
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<td>$P$ values comparing patients with Swedish norm after 12-mo follow-up</td>
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<td>.28 .22 .13 .49 .39 .45 .46</td>
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<tr>
<td>Obremskey et al27 (T)</td>
<td>48 (17.7, 17–85)</td>
<td>–</td>
<td>SF-36, SMFA, radiography and personal interview</td>
<td>AO/OTA: 44 A (n = 7); 44 B (n = 90); 44 C (n = 30)</td>
<td>Female (n = 72) and male (n = 54) patients</td>
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<td>No comparison with control population</td>
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<tr>
<td>Bhandari et al28 (P)</td>
<td>51.6 (15.2, 18–81)</td>
<td>3, 6, 12, and 24</td>
<td>SF-36, VAS, radiography and personal interview</td>
<td>AO/OTA: 44 B (n = 30)</td>
<td>Female (n = 13) and male (n = 17) patients</td>
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<td>$P$ values comparing patients with US population after 24-mo follow-up</td>
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<td>&lt;.01 &lt;.01 NS NS NS NS NS NS</td>
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<tr>
<td>Obremskey et al26 (P)</td>
<td>52.7 (5, 17–85)</td>
<td>4 and 20</td>
<td>SF-36 and phone interview</td>
<td>AO/OTA: 44 B (n = 15); 44 C (n = 5)</td>
<td>Female and male patients (n = 20, total)</td>
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<td>$P$ values comparing patients with US population after 4-mo follow-up</td>
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<td>&lt;.01 &lt;.01 NS &lt;.05 &lt;.05 NS NS NS</td>
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<tr>
<td>Ponzer et al21 (P)</td>
<td>41 (11.8, 19–63)</td>
<td>24</td>
<td>SF-36, OMAS, VAS, radiography, sociodemographic, clinical issues and personal interview</td>
<td>AO/OTA: 44 B (n = 41—B1 [n = 9]; B2 [n = 16]; B3 [n = 16])</td>
<td>Female (n = 22) and male (n = 19) patients</td>
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<td>$P$ values comparing patients with the Swedish average population after 24-mo follow-up</td>
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<td>&lt;.001 &lt;.001 NS &lt;.05 NS &lt;.001 &lt;.001</td>
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</table>

Abbreviations: AO/OTA, AO Foundation and Orthopaedic Trauma Association; AO/OTA 44, classification AO/OTA to malleolar fractures of the tibia and fibula calls 44; AO/OTA A, fibular fracture trans-syndesmotic infrastructure; AO/OTA B, fibular fracture trans-syndesmotic; AO/OTA B1, fibular fracture trans-syndesmotic isolated; AO/OTA B2, fibular fracture trans-syndesmotic with medial lesion; AO/OTA B3, fibular fracture trans-syndesmotic with medial lesion and fracture of Volkmann (fracture of the posterior-lateral edge); AO/OTA C, fibular fracture supra-syndesmotic; BP, bodily pain; EA, emotional aspects; FC, functional capacity; GHS, general health status; MH, mental health; NS, not significant; OMAS, Olerud and Molander Ankle Scale; P, prospective; PA, physical aspects; PAB, pronation abduction; PAB II, PAB with fracture of the tuber of Chaput, or of the tibiofibular ligament earlier; PER, pronation-external rotation; PER III, PER with medial lesion and a high fracture of the fibula; PER IV, similar to PER III with ligament lesion tibiofibular or posterior malleolus; SA, social aspects; SAD, supination adduction; SAD I, SAD with sprains talofibular or avulsion of the distal fibula; SAD II, SAD with vertical fracture of the distal fibula and possible impaction of the medial plateau; SER, supination-external rotation; SER II, SER with short oblique fracture of the distal fibula stable; SER III, similar to SER II with additional rupture of the posterior tibial-fibular ligament or fracture of the posterior margin; SER IV, SER with short oblique fracture of the distal fibula unstable with a fracture of the medial malleolus or deltoid ligament rupture; SF-36, 36-item Short-Form Health Survey; SMFA, Short Musculoskeletal Function Assessment; T, transversal; VAS, Visual Analog Scale; VE, vitality and energy.
et al28 and Ponzer et al21 noted that the majority of fractures in that 45 subjects (90%) had fractures resulting from falls. Bhandari evaluate the functional results of patients and 2 studies,28,29 the nonfractured North American population (United States; control), and 1 study27 compared the results of the questionnaire SF-36 with the Short Musculoskeletal Function Assessment questionnaire.

In the present systematic review, the majority of patients with surgically treated AF reported significant limitations on functional and physical capacity over time (Figure 2A and 2B).21,26–29 As shown in Table 1, however, one study29 reported significant differences in functional and physical capacity only in elderly (65 y and older) female patients (P < .01 and P = .02, respectively) after a 6-month follow-up, and no differences in elderly male patients. In this last study, both elderly genders reported self-perceived functional and physical capacity after a 12-month follow-up compared with control (Swedish population). Another study that reported differences in physical domain after a 4-month follow-up (P < .01) compared with control (US population) also reported no differences after a 20-month follow-up.26

Regarding bodily pain, there were no differences compared with the control population (Figure 2C). One study,26 however, showed significant differences in the first 4-month follow-up (P < .01) compared with the control population (US population), but no differences after the 20-month follow-up (see Table 1). Regarding general health status, the majority of studies reported no differences between the patients with surgically treated AF and control population over time (Figure 2D). However, 1 study29 reported significant differences (P = .04) in elderly men after a 1-year follow-up, but not in elderly female patients (Table 1).

As shown in Table 1, the results are not so consistent in the vitality and energy domain, as 2 studies reported no differences28,29 and 2 studies reported significant differences.21,26 However, all patients with surgically treated AF improved their vitality and energy over time (Figure 2E), and 1 study26 that reported significant differences after a 4-month follow-up (P < .05) compared with control also reported no differences after a 20-month follow-up.

The majority of studies found no differences in social aspects (Figure 2F). One study26 reported significant differences after a 4-month follow-up, but no differences after a 20-month follow-up with the same patients (Table 1).

Although the majority of studies showed increasingly higher scores over time for emotional aspects (Figure 2G), only 2

### Characteristics of Included Studies

Of the 5 studies included, 3 studies21,26,27 were intended to evaluate the functional results of patients and 2 studies,28,29 the QOL. There were 267 total number of participants involved in the 5 studies, but the study by Obremskey et al26 did not report the gender distribution of its sample. A total of 267 fractures were found, with 81% classified according to the AO Foundation and Orthopaedic Trauma Association21,27,28 and 19% according to Lauge-Hansen classification.29 Only the study by Bhandari et al28 reported the kind of fracture, all of which (n = 30) were closed fractures. No study referred to the occurrence of fracture side.

Regarding the cause of these fractures, Nilsson et al29 noted that 45 subjects (90%) had fractures resulting from falls. Bhandari et al28 and Ponzer et al21 noted that the majority of fractures in their samples, 67% and 88%, respectively, also resulted from falls. The other studies did not describe the causes of fractures.26,27 All the 5 studies21,26–29 were reported using the open reduction and internal fixation technique. The other characteristics of studies that constitute the sample of this review are organized in Table 1.

### Methodological Quality of the Selected Studies

There was total agreement for PEDro scores of all reviewed studies. Given that there is no known cutoff value for this scale, the following criteria were used to classify the methodological quality: a score from PEDro equal to or greater than 7 (n = 2) indicates a high methodological quality; scores between 5 and 7 (n = 3) indicate a moderate methodological quality; and scores below 5 (n = 0) indicate a low methodological quality. The highest PEDro rating was 7, with an average of 6.2 among the included studies (Table 2).

### Data Synthesis

Among the 5 studies included in this review, 2 studies21,29 compared the results of SF-36 with the nonfractured Swedish population (control), 2 studies26,28 compared the results with the nonfractured North American population (United States; control), and 1 study27 compared the results of the questionnaire SF-36 with the Short Musculoskeletal Function Assessment questionnaire.

<table>
<thead>
<tr>
<th>Study</th>
<th>Nilsson et al29</th>
<th>Obremskey et al27</th>
<th>Bhandari et al28</th>
<th>Obremskey et al26</th>
<th>Ponzer et al21</th>
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<tr>
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<td>1</td>
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<td>5</td>
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<td>Subjects blind</td>
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<td>Therapists blind</td>
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<td>Evaluators blind</td>
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<td>Comparison between groups</td>
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<td>5</td>
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<td>Measures of precision and variability</td>
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<td>7</td>
<td>6</td>
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</table>

Abbreviation: PEDro, Physiotherapy Evidence Database.

#### Table 2 Score of Articles According to the Scale of PEDro
Figure 2 — (A) Functional capacity results after surgically treated AFs over time. (B) Physical aspect results after surgically treated AFs over time. (C) Body pain results after surgically treated AFs over time. (D) General health status results after surgically treated AFs over time. (E) Vitality and energy results after surgically treated AFs over time. (F) Social aspects results after surgically treated AFs over time. (G) Emotional aspects results after surgically treated AFs over time. (H) Mental health results after surgically treated AFs over time. The symbols represent all participants scores (fractured and nonfractured) in the different studies for this domain. y-axis represents the SF-36 questionnaire points (from 0 to 100), and x-axis represents the time (in months) in which the questionnaire was applied.
studies\textsuperscript{21,29} found significant differences (Table 1). One of these studies\textsuperscript{29} showed significant difference only in elderly female patients ($P = .03$) after a 6-month follow-up, but no differences in the elderly male patients. In this study, all elderly patients (men and women) reported no differences in emotional aspects after a 12-month follow-up. Another study\textsuperscript{21} reported significant differences in this domain after a 2-year follow-up ($P < .001$).
Finally, in the mental health domain, the majority of studies showed only a small oscillation of the scores (Figure 2H). However, 1 study\textsuperscript{21} reported significant differences in this domain after a 2-year follow-up ($P < .001$; Table 1).

**Figure 2 — (Continued)**

[Figure showing data points over time for different conditions]

**Discussion**

This systematic review indicated that functionality and physical aspects are significantly different in patients with surgically treated
Figure 2 — (Continued)
AF over time, although the patients reported no pain. Most patients had a positive self-perception of their general health and social status. Less consistency is reported in the vitality and energy, emotional aspects, and mental health domains, which may represent prolonged limitations.

These findings are similar to other studies in which the patients in recovery after surgically treated AF had progressive functional and physical rehabilitation, which can be a long process. In the present review, 2 studies concluded that patients with surgically treated AF may have functional and physical limitations even 2 years after the injury. These prolonged limitations appear to be particularly related to adult patients rather than elderly patients. In fact, in the Nilsson et al study, the elderly patients with AF reported functionality and physical capacity similar to the control population (not fractured) only 1 year after injury. This finding contrasts with the results of other studies, where advanced age is associated with worse results in the functional and physical aspect domains of the SF-36. However, they are similar to other results previously reported. Therefore, the present review supports the idea that most common traumas in the adult population (ie, luxation, open, high-energy, with large soft tissues injury fractures) are more severe, unlike the typical traumas reported in the elderly population (general low-trauma energy resulting from falls). Thus, the fracture characteristic (high energy vs low energy) may represent a fundamental aspect in the QOL of patients with surgically treated AF.

Most patients after surgically treated AF reported no bodily pain over time. In fact, only Obremskey et al reported significant differences in self-perceived pain after a 4-month follow-up, but no differences were found in the same patients after a 20-month follow-up. It seems likely that bodily pain is not a negative factor in surgically treated AF.

In the general health status domain, only elderly male patients showed a significant difference between measurements after a 1-year follow-up. Elderly females and adult patients reported values similar or even superior to the control population. These results suggest that there are no differences in the perception of patients with AF in their general health status compared with the nonfractured population.

Some studies reported vitality and energy similar to controls in elderly and adults patients with surgically treated AF after 1–2 years of follow-up. Others reported significant differences even 2 years after the event that caused the AF. These results suggest that vitality and energy, inversely related to fatigue, represent domains that improve and even normalize over time, but some patients may report limitations for prolonged periods.

The mental component of the SF-36 related to QOL, which includes social and emotional aspects and mental health, exhibited some influence of these domains. Although the social aspects seem to have no influence on most patients’ QOL, emotional aspects and mental health may have a negative impact on the QOL of some patients. Indeed, one study reported significant differences in the emotional and mental aspect domains after a 2-year follow-up (P < .001 for both domains), suggesting that emotional and mental health may be lower than in the nonfractured population.

Limitations
A key limitation of this systematic review was that functional outcomes were controlled by the SF-36. Another limitation was the great heterogeneity of the participants included in the studies. However, using the open reduction and internal fixation technique as the surgical treatment and as the inclusion criteria ensured that the gold standard for orthopedic surgeons has been used.

Recommendations for Future Research
This systematic review combined the results of 268 participants, indicating a small sample size and number of articles included. Therefore, a new review should be conducted where possible, including a meta-analysis. Other instruments to measure functional outcomes should be implemented, perhaps including the 6-minute walk test, the 30-second chair test, and the 1-leg stand test to measure walk capacity, lower limbs strength, and balance, respectively.

Conclusion
Less functionality and lower physical capacity represent the major limitations in patients with surgically treated AF, compared with the nonfractured population. These limitations may prevail for long periods and may become the main threat to the QOL of these patients.

Practice Recommendations
Long-term functional rehabilitation programs are essential for the recovery and preservation of the QOL in patients surgically treated for AF.

References
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