

SF-36 Mental Component Summary (MCS) Score Does Not Predict Functional Outcome After Surgery for End-Stage Ankle Arthritis

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Background: Mental health status has been shown to influence functional outcome in a number of orthopaedic disorders. The purpose of this retrospective cohort study was to assess whether a diminished baseline Mental Component Summary (MCS) score on the Short Form-36 (SF-36) is predictive of less improvement in the Ankle Osteoarthritis Scale (AOS) score at the time of midterm follow-up after arthroplasty or arthrodesis for end-stage ankle arthritis.

Methods: Preoperative and postoperative patient scores on the SF-36 MCS and AOS questionnaires were obtained from the Canadian Orthopaedic Foot and Ankle Society (COFAS) End-Stage Ankle Arthritis Database. The relationship between the preoperative MCS score and the change in the total AOS score at the time of final follow-up was summarized with use of a Pearson correlation coefficient (r). Subgroup analyses according to the type of treatment (ankle arthrodesis versus ankle arthroplasty) and preoperative MCS score (<50 versus ≥ 50) were conducted.

Results: Of an initial 372 ankles enrolled, 337 (91%, ninety-five arthrodeses and 242 arthroplasties) were reviewed after a mean duration of follow-up of 5.2 ± 1.3 years. Analysis revealed no correlation between the preoperative MCS score and the change in the AOS score, from the preoperative baseline to either a mean 5.2 years postoperatively or two years postoperatively ($r < 0.1$ in both analyses). There was no difference in the change in the AOS score between patients with a preoperative MCS score of <50 and those with a preoperative MCS score of ≥ 50 .

Conclusions: In our study of patients with end-stage ankle arthritis treated with arthroplasty or arthrodesis, preoperative mental health status (as measured with the MCS score) did not predict functional outcome (as measured by the change in the AOS score) at the time of intermediate-term postoperative follow-up. AOS scores improved for all patients, regardless of the preoperative MCS score.

Level of Evidence: Prognostic Level IV. See Instructions for Authors for a complete description of levels of evidence.

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End-stage ankle arthritis has been shown to be as debilitating as end-stage hip or knee arthritis¹. As with those disorders, patient-rated functional outcome scores after treatment of end-stage ankle arthritis are quite variable, and radiographic and physical findings alone do not appear to account for these differences. A large proportion of postoperative disability involving the hip, knee, or elbow remains similarly

unexplained by objective functional measures or other medical variables^{2,3}.

A number of studies have shown that psychological factors such as depression, pain catastrophizing, anxiety, and post-traumatic stress disorder can contribute to poorer outcomes in association with multiple spine, upper-extremity, and lower-extremity conditions²⁻¹¹. In a systematic review of the literature,

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TABLE 1 Baseline Patient Characteristics and Mean SF-36 MCS and AOS Scores

	Total Cohort (N = 337)	Ankle Arthrodesis (N = 95)	Total Ankle Arthroplasty (N = 242)
Follow-up* (yr)	5.2 ± 1.3	5.1 ± 1.0	5.3 ± 1.2
Male sex (no. [%])	186 (55)	57 (60)	129 (53)
Age* (yr)	61 ± 12	54 ± 12	64 ± 11
BMI* (kg/m ²)	28 ± 5	29 ± 6	28 ± 5
Preop. SF-36 MCS score* (points)	49.8 ± 11.6	48.0 ± 12.9	50.5 ± 11.0
Total AOS score* (points)			
Preop.	51.8 ± 17.6	53.9 ± 18.8	50.9 ± 17.3
Final follow-up	28.2 ± 21.6	32.9 ± 23.4	26.3 ± 20.6
Improvement	23.6 ± 23.5	21.0 ± 23.6	24.6 ± 23.8

*The values are given as the mean and standard deviation.

Vissers et al.¹² found strong evidence that a lower preoperative mental health status results in poorer functional and pain scores following total knee or hip replacement. The World Health Organization has stated that depression may be the most important factor in global health status, more important than even diabetes, asthma, angina, and arthritis¹⁰.

Preoperative mental health questionnaires may therefore have predictive value regarding which patients will derive the greatest benefit from surgery. For example, Ayers et al.⁵ found that patients with a preoperative score of <50 on the Mental Component Summary (MCS) of the Short Form-36 (SF-36) questionnaire had a higher rate of clinical levels of trait anxiety, mild depression, lower social support, and poorer coping skills than those with higher emotional health scores, and that this predicted diminished benefit from hip or knee arthroplasty, with no significant improvement in SF-36 Physical Component Summary (PCS) score. Conversely, patients with a preoperative MCS score of ≥50 demonstrated a mean improvement of 10 (and as high as 30) points in the PCS score.

To our knowledge, mental health has not been previously assessed as a prognostic factor for patients treated for end-stage ankle arthritis. The objective of the present retrospective, multicenter, observational cohort study was therefore to evaluate and quantify the impact of preoperative mental health status on functional improvement, as measured with validated scoring instruments, following surgical treatment (total ankle arthroplasty or arthrodesis) of end-stage ankle arthritis in a large cohort of patients. We hypothesized that diminished preoperative SF-36 MCS scores would be predictive of reduced patient-reported functional improvement in the Ankle Osteoarthritis Score (AOS) at the time of midterm follow-up.

Materials and Methods

Patient Enrollment

The Canadian Orthopaedic Foot and Ankle Society (COFAS) multicenter Ankle Arthritis Outcome Study was established in 2002 and includes four study centers: Dalhousie University/Queen Elizabeth II Health Sciences Centre, University of Toronto/St. Michael's Hospital, University of British Columbia/St. Paul's Hospital, and Vancouver Island Health Authority.

The present investigation was designed as a retrospective, observational cohort study. Patients enrolled in this study constitute a subgroup of the COFAS End-Stage Ankle Arthritis Database. This database includes all patients with symptomatic end-stage ankle arthritis of various etiologies who had undergone an unsuccessful trial of nonoperative treatment, gave informed consent for database enrollment, and had been treated with total ankle arthroplasty or ankle arthrodesis by one of six subspecialty-trained orthopaedic surgeons at the four study centers.

Inclusion in the present study required skeletal maturity, an age of eighteen years or older, completed preoperative outcome questionnaires, and willingness to give informed consent. Patients treated with revision ankle arthrodesis or arthroplasty as well as those who had concomitant procedures such as arthrodesis of another joint or osteotomy were included, and the most recent follow-up score was used to document outcome. Exclusion criteria were substantial osteonecrosis of the talus, active infection, Charcot arthropathy, unwillingness to sign informed consent forms, inability to complete forms in English, and inability to complete follow-up interviews with study coordinators. Patients were enrolled by study coordinators at each center, and failures to return for follow-up because of study withdrawal, loss to follow-up, or death before two years were documented.

The clinical question and design for this study were developed without prior access to the data. Institutional review board approval was obtained at each center for administration of the questionnaires, and informed consent was obtained from each patient for study enrollment and for all surgical procedures prior to questionnaire administration. Two authors of the present study had previous experience with performing evaluations with use of psychological instruments.

Data Collection

Patient responses were obtained retrospectively from the COFAS Prospective Ankle Reconstruction Database. During compilation of this database, patient assessments were completed by study coordinators at each center preoperatively, at one year following surgery, and annually thereafter. Patient demographics, comorbidities, and diagnoses were recorded preoperatively. Data from the outcome measures were collected both preoperatively and at multiple time points postoperatively for each patient. For patients who had undergone revision surgery, the most recent follow-up scores after the revision were used to document outcome.

Procedure Selection

All procedures were performed by subspecialty-trained foot and ankle surgeons. The final decision regarding the surgical procedure (i.e., ankle arthroplasty or arthrodesis) was made by the patient after counseling and shared

decision-making with the surgeon. In general, arthrodesis was recommended for younger patients and patients with comorbidities that compromised soft-tissue healing (e.g., diabetes or current smoking). Ankle arthroplasty was generally recommended for patients who were sixty-five years of age or older.

Outcome Measures

The primary outcome measure for this study was the total AOS score¹³. The AOS is a patient-reported, ankle-specific functional outcome measure consisting of a self-administered questionnaire with eighteen items that are graded on a visual analogue scale (VAS). These items are divided into two subscales, comprising pain and disability. The AOS score increases with greater disability, to a maximum score of 100; therefore, a change in this score indicates a change in functional status.

Secondary outcome measures included the AOS pain and disability subscales, and the MCS subscale of the SF-36, a generic measure of general health status comprised of eight subscale components, with scores ranging from 0 to 100^{14,15}. The MCS score declines as mental health symptoms increase; it has thus been used as an indirect indicator of depressive symptoms¹⁴⁻¹⁹ and to predict depression and mood disorders in various populations^{9,18}. The AOS and SF-36 are responsive and show acceptable criterion validity when used for patients with end-stage ankle arthritis^{20,21}.

Statistical Analysis

All patients with postoperative follow-up scores were included in this analysis. The relationship between the preoperative MCS score and the change in the AOS score was examined visually with use of a scatterplot. The Pearson correlation coefficient (*r*) was calculated to evaluate the relationship between the MCS score before surgery and the change in the AOS score at the time of final follow-up. A secondary analysis was performed to evaluate this relationship at two years. Patients were also divided into two subgroups—those with a preoperative MCS score of <50 versus those with a score of ≥50—as was done in the study by Ayers et al.⁵. Mean changes in total AOS and AOS pain and disability scores from baseline to the postoperative follow-up evaluations were compared between the two subgroups. In addition, the relationship between the preoperative AOS and preoperative MCS scores was summarized with use of *r*.

Descriptive statistics for demographic variables, including patient age, sex, and body mass index (BMI), were expressed as means and standard deviations (SDs) for continuous variables and as counts and percentages for categorical variables. Changes in AOS scores were reported as means and standard deviations. The Student *t* test was used to compare the two procedures.

Source of Funding

Direct or indirect research funding for this study was received from Integra LifeSciences Corporation (Plainsboro, New Jersey) and DePuy (Warsaw, Indiana). An unrestricted research grant from DePuy supported data collection involving the Mobility prosthesis for each patient entered into the COFAS database. Some patients who received a Mobility ankle prosthesis at the Dalhousie site were also part of an independent radiostereometric analysis study supported by an unrestricted research grant from DePuy.

Results

Patients were enrolled in the source database from July 2002 to July 2007. Follow-up was conducted in July 2011. A total of 372 patients met all inclusion and exclusion criteria and were enrolled in the study. Fifty-five of them were undergoing a revision procedure. The mean follow-up duration (\pm SD) was 5.2 ± 1.3 years, with a minimum of 3.5 years. By the time of final follow-up, two patients had died, two had undergone transtibial amputation, one had withdrawn from the study, and sixteen were lost to follow-up. Fourteen patients who responded at the time of follow-up had incomplete scores. Of the initial 372 patients, 337 (91%) with a total of 337 involved

ankles (ninety-five arthrodeses and 242 arthroplasty procedures) were included in the analysis (Fig. 1).

The mean preoperative baseline and final postoperative scores are summarized in Table I, along with patient demographic characteristics. The mean preoperative MCS score was 49.8 ± 11.6 , with a median of 51.3 and range of 18 to 72 of a possible 100 (with a lower score reflecting more mental health symptoms). The mean total AOS score (with a lower score reflecting less pain and better function) was 51.8 ± 17.6 preoperatively and 28.2 ± 21.6 at the time of final follow-up.

The total AOS score improved from the preoperative baseline to the time of final follow-up for all patients, with a mean improvement of 23.6 ± 23.5 (Table I). There was no significant difference in the mean change in AOS scores between the two procedures (mean change, 24.6 ± 23.8 for ankle arthroplasty and 21.0 ± 23.6 for arthrodesis; $p > 0.05$).

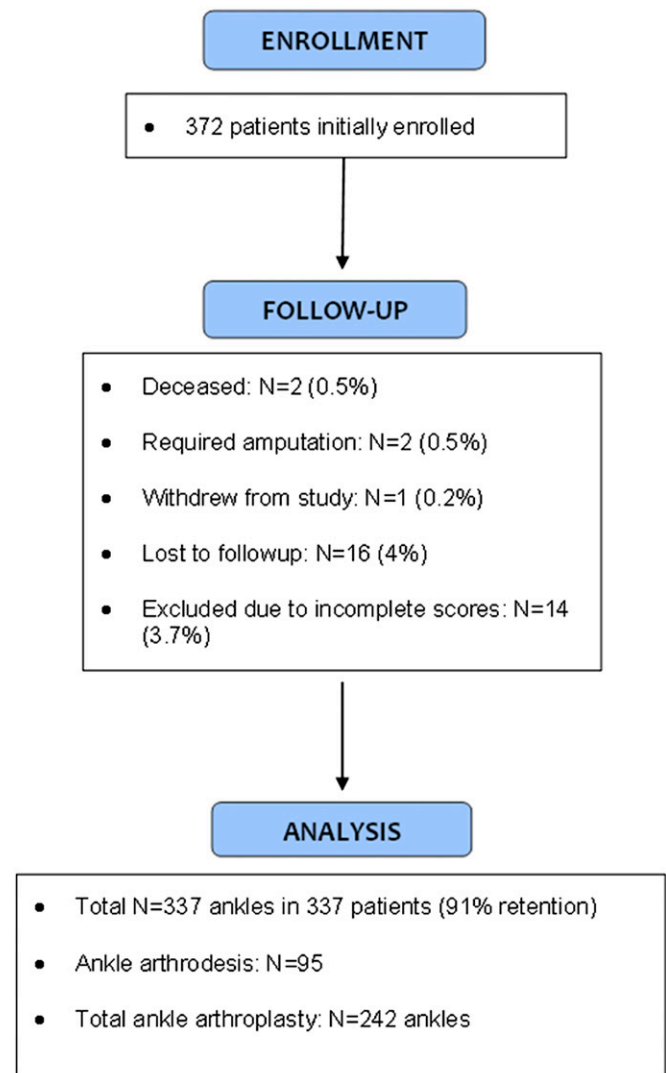


Fig. 1
Flow diagram of patient enrollment, follow-up, and analysis.

TABLE II Preoperative AOS Scores and Amount of Improvement in MCS Subgroups

	Preop. MCS <50	Preop. MCS ≥50	All Patients
No. (%) of patients	153 (45%)	184 (55%)	337 (100%)
AOS score* (points)			
Improvement in total score†	23.0 ± 24.4	24.2 ± 22.7	23.6 ± 23.5
Preop. total score	49.9 ± 17.2	53.9 ± 18.3	51.8 ± 17.8
Preop. pain score	44.9 ± 18.2	49.2 ± 19.4	46.9 ± 18.8
Preop. disability score	55.1 ± 18.8	58.6 ± 19.4	56.8 ± 19.1

*The values are given as the mean and standard deviation. †The change from the preoperative baseline to final postoperative follow-up evaluation at a mean of 5.2 years.

Scatterplot analysis revealed no correlation between the preoperative MCS score and the change in the AOS score from baseline to the time of final follow-up ($r < 0.1$) (Fig. 2). Similarly, there was no apparent difference between patients with an MCS score of ≥ 50 and those with a score of < 50 (Table II). The analysis

was repeated with the two-year follow-up data (the relationship between the change in the total AOS score at two years [from the preoperative AOS score] and the preoperative MCS), to determine whether there might be an association closer to the time of surgery, but no correlation was observed ($r < 0.1$, data not shown).

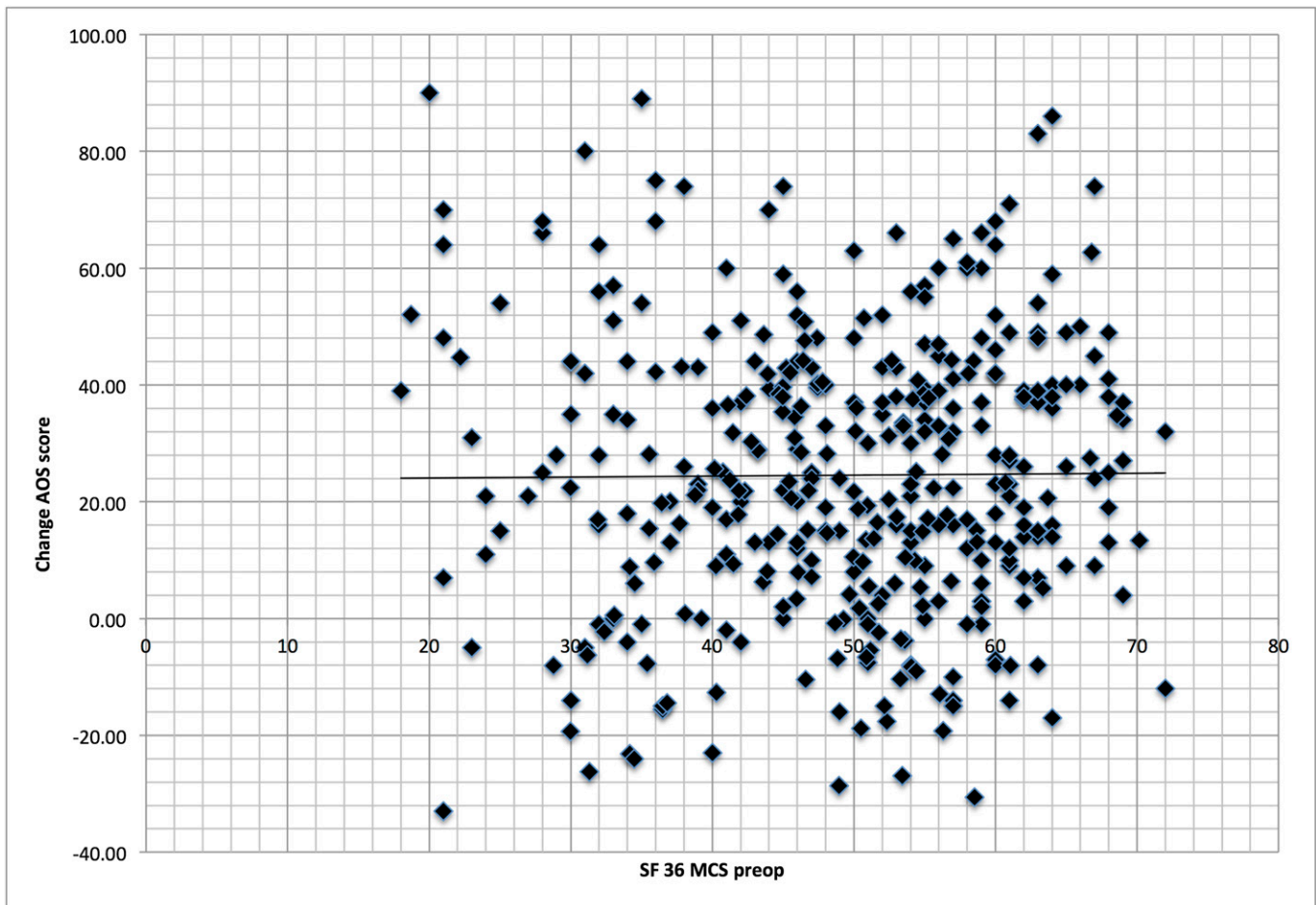


Fig. 2

Scatterplot of change in AOS score from baseline to the time of final follow-up (mean, 5.2 years) as a function of the preoperative MCS score. The linear regression line indicates little or no correlation between the two variables ($r < 0.1$).

The analysis of the preoperative MCS scores versus the preoperative AOS scores revealed an r value of 0.2. As shown in Table II, the preoperative AOS scores for the patients whose preoperative MCS score was <50 were somewhat lower than the preoperative AOS scores for those whose MCS score was ≥ 50 . This was true for the total AOS score (49.9 ± 17.2 versus 53.9 ± 18.3), AOS pain subscale (44.9 ± 18.2 versus 49.2 ± 19.4), and AOS disability subscale (55.1 ± 18.8 versus 58.6 ± 19.4).

Discussion

In this retrospective, multicenter, observational cohort study, we evaluated the correlation between preoperative mental health status and functional outcome at the time of intermediate-term follow-up after surgical treatment of end-stage ankle arthritis in 337 patients. A detailed analysis revealed no correlation between the preoperative SF-36 MCS score and the change in AOS score from the preoperative baseline to the postoperative follow-up evaluation after a minimum of 3.5 years (mean, 5.2 ± 1.3 years). There was, however, a very weak correlation between the preoperative MCS and preoperative AOS scores ($r = 0.2$).

The SF-36 MCS and subset questions have been used to predict depression and mood disorders in various populations^{5,17-19}, and the literature suggests that MCS scores may provide useful prognostic indicators for both hip and knee surgery^{4,5,12}. On the basis of these findings, the present study was done to test the hypothesis that the preoperative MCS score would be predictive of patient-reported functional improvement in AOS scores following ankle arthroplasty or arthrodesis (i.e., that poor preoperative MCS scores would predict reduced improvement after surgery).

Surprisingly, this did not prove to be the case. No correlation was observed between the preoperative MCS score and the response to surgery as indicated by the change in the AOS score, at either two or an average of five years postoperatively. There may be patient, injury, or treatment factors that differentiate end-stage ankle arthritis from arthritis involving the hip or knee. Alternatively, the AOS may not be sufficiently responsive to detect a difference in results based on the preoperative MCS score.

However, as noted, we did observe some correlation between the preoperative MCS and preoperative AOS scores of individual patients. This result is consistent with other studies indicating that mental health status may influence patient perceptions of health and physical function⁵.

In the present study, 45% of the study population had an MCS score of <50 (Table II), which is greater than the 32% reported in a study of knee or hip replacements by Ayers et al.⁵. This discrepancy may be due to the fact that the majority of cases of end-stage ankle arthritis are posttraumatic and the prevalence of depressive symptoms after traumatic injury is high⁷⁻⁹. It may also be due to a difference in the mental health impact of ankle arthritis compared with that of knee arthritis, the average severity of the arthritis in the study populations, a higher prevalence of depressive symptoms prior to traumatic injury, or chance alone. Additional studies on the prevalence of depression, pain catastrophizing, posttraumatic stress disorder,

and anxiety may be better able to determine the true prevalence in this population.

The present study has several strengths. The study population (337 patients) was large for a longitudinal surgical cohort study of ankle arthritis with multi-year follow-up. Another strength was the duration and completeness of follow-up, with a mean follow-up time of 5.2 years, a minimum of 3.5 years, and $<10\%$ attrition from the initial cohort. These factors provided an opportunity to accurately evaluate the relationship between baseline mental health status and patient-perceived surgical outcome.

Limitations include the retrospective design of the study, which limited the choice of psychometric tools and increased the risk of bias. Bias was mitigated by the fact that the study was designed and executed without prior access to the research database, but future studies would be strengthened by a prospective, longitudinal design. Time from surgery may also be a factor, and the MCS score may be more predictive of outcome shortly after surgery. (For example, in the study by Ayers et al.⁵, which identified such a correlation for hip and knee surgery, patients were evaluated at six months after surgery as compared with the two and five-year follow-up periods in the present study.) This seems unlikely, however, as similar studies demonstrating a positive correlation in patients treated with hip and knee surgery had follow-up times similar to those in our study¹².

In addition, the minimal clinically important difference for the AOS was recently determined to be 28.0 points²²; this may be sufficiently large to obscure any correlation between preoperative MCS score and change in AOS score. The AOS was derived from the Foot Function Index, which has been determined to be limited by ceiling effects for non-rheumatoid patients with higher levels of activity²³.

It would also be useful for future studies to include the Patient Health Questionnaire (PHQ-9)²⁴ or other depression-specific scales in addition to the SF-36 MCS, in order to directly assess depressive symptoms as well as overall mental health. Patients should also be followed in the early postoperative period as well as several years after surgery.

In conclusion, preoperative mental health status (as measured by the MCS score) did not predict perceived functional outcome (as measured by a change in the AOS score) at the time of intermediate-term follow-up of patients with end-stage ankle arthritis who underwent arthroplasty or arthrodesis. The AOS scores improved for all patients regardless of their preoperative MCS score. There was a very slight correlation between preoperative MCS and preoperative AOS scores, which is consistent with other studies indicating that current mental health status may influence patient perceptions of physical function⁵. ■

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