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Analysis of factors affecting baseline SF-36 Mental Component Summary in Adult Spinal Deformity and its impact on surgical outcomes

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ABSTRACT

Objectives: To identify the factors that affect SF-36 mental component summary (MCS) in patients with adult spinal deformity (ASD) at the time of presentation, and to analyse the effect of SF-36 MCS on clinical outcomes in surgically treated patients.

Methods: Prospectively collected data from a multicentric ASD database was analysed for baseline parameters. Then, the same database for surgically treated patients with a minimum of 1-year follow-up was analysed to see the effect of baseline SF-36 MCS on treatment results. A clinically useful SF-36 MCS was determined by ROC Curve analysis.

Results: A total of 229 patients with the baseline parameters were analysed. A strong correlation between SF-36 MCS and SRS-22, ODI, gender, and diagnosis were found ($p < 0.05$). For the second part of the study, a total of 186 surgically treated patients were analysed. Only for SF-36 PCS, the un-improved cohort based on minimum clinically important differences had significantly lower mean baseline SF-36 MCS ($p < 0.001$). SF-36 MCS was found to have an odds ratio of 0.914 in improving SF-36 PCS score (unit by unit) ($p < 0.001$). A cut-off point of 43.97 for SF-36 MCS was found to be predictive of SF-36 PCS ($AUC = 0.631$; $p < 0.001$).

Conclusions: The factors effective on the baseline SF-36 MCS in an ASD population are other HRQOL parameters such as SRS-22 and ODI as well as the baseline thoracic kyphosis and gender. This study has also demonstrated that baseline SF-36 MCS does not necessarily have any effect on the treatment results by surgery as assessed by SRS-22 or ODI.

Level of evidence: Level III, prognostic study.

Introduction

The prevalence of Adult Spinal Deformity (ASD) is high worldwide, and the need for surgical deformity correction and relief of symptoms has subsequently increased. Previous research indicates

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that in younger subgroup of patients with spine deformity, treatment is directed mainly by the severity of the deformity,[1] however in the elderly, the main decisive factors for treatment are pain, poor function and disability[2–5] factors that had been demonstrated to be strongly associated with several radiological parameters.[6] ASD surgery has been shown to yield better results compared to conservative treatment in the overall population of patients in terms of Heath Related Quality Of Life (HRQOL) outcomes.[7,8] However, still a significant proportion of operated patients do not improve following surgery regardless of the apparent technical success or failure of the operations.[5,9] What is not yet understood is how various clinical parameters of ASD affect the mental well being of patients before treatment and the potential snowball effect of the impact of baseline mental status of a patient on treatment outcomes after surgery. A recent study suggests that ASD may affect the mental and psychological functioning of patients.[10] It is well accepted in others areas of spine that pre-operative psychosocial factors are predictive of outcome and correlates with improvement in QOL after spine surgery.[11–15] Several studies also suggest that psychosocial questionnaires may serve as standardized tools for identifying patients who are more likely to have positive post-operative outcomes and those who are unlikely to derive the expected benefit from surgery.[16,17]

SF-36 is a widely used HRQOL tool in spine surgery, commonly broken into two main domains of the Physical Component Summary (PCS) and the Mental Component Summary (MCS). Several publications have demonstrated that SF-36 MCS highly correlates with standard tools used to screen for depressive symptoms.[18,19] Other studies have shown that SF-36 MCS is an effective screening tool for depression[20,21] and that; SF-36 MCS cut-off point of 35 is clinically relevant for identifying depressive symptoms in patients with spine pathology.[22] This cut-off point has been found to have a sensitivity of 80% and specificity of 90% for patients with back pain.[22]

The open questions in regard to the role of the SF-36 MCS in ASD are whether it is strongly affected by other factors (age, other demographic factors, disability) and to what extent it affects the outcome of patients undergoing surgery for ASD. Hence, the specific aims of this study were:

1. To identify the factors that affect SF-36MCS in patients with ASD at the time of presentation, regardless of the severity of deformity, disability and the final treatment decision, and,
2. To analyse, in turn, the effect of SF-36MCS on clinical outcomes in patients treated surgically.

As far as we know this is one of the first report in the literature to directly examine the impact of various HRQOL clinical parameters, on the psychological well being of ASD patients before commencing treatment and the subsequent effect of this, on outcomes after surgery.

Material and methods

Factors affecting SF-36 MCS at baseline

Two hundred and twenty nine patients who had been entered in an ASD database on adult spine deformity and had completed SF-36MCS were analysed. The inclusion criteria into the database and hence for this study was as following; age >18 years and scoliosis >20°, or sagittal vertical axis (SVA) >5 cm, or pelvic tilt >25°, or thoracic kyphosis >60°. All patients were enrolled into an institutional review board approved protocol by the respective sites. All patients with baseline parameters were included (before treatment). Baseline demographic data [age, gender, co-morbidities and body mass index (BMI)], HRQOL parameters [The Core Outcome Measures Index (COMI), The Oswestry Disability Index (ODI), Short-Form (SF)-36 Mental Component Summary (MCS), SF-36 Physical Component Summary (PCS) and Scoliosis Research Society-22 questionnaire (SRS-22)], the following radiological features were included in the analysis; Sagittal Vertical Axis (SVA), T2-T12 kyphosis, Coronal balance, Major curve Cobb angle, Lordosis Gap (L Gap),[6] Global Tilt (GT)[23] and T1 sagittal tilt. Patients were also stratified according to the aetiology of their deformity; idiopathic scoliosis, degenerative scoliosis and others.

Statistical analysis

A multivariate linear regression analysis model was built with SF-36MCS as the dependent variable. Demographic, radiological and HRQOL parameters were independent variables for this model. As a first step, a correlation analysis between the SF-36 MCS and all the independent variables was performed using Pearson's correlation coefficient, point bi-serial correlation and Eta coefficient. The purpose of this step was to define and select the candidate independent variables for multivariate linear regression. Sequential multiple linear regressions were used to explain the variation of SF-36 MCS scores. Each independent variable was regressed by sequentially adding the variables to the model starting first with the variable showing the highest correlation with SF-36 MCS. Decision to remove a variable from the model was based on the direction and magnitude of change in the estimate of the parameter with highest correlation as well as of the resulting adjusted-R^2 values (p-value <0.05). Using a stepwise automatic selection technique, a verification of this model was done. All statistical analysis was performed using the SPSS Statistics 21.0 software (IBM SPSS Statistics for Windows, Version 21.0. Armonk, NY: IBM Corp).

Impact of SF-36MCS on surgical results

From the same database, one hundred and eighty-six patients (157 women and 29 men) with ASD surgically treated, and with a minimum of one-year follow-up and full documentation were analysed. For this part of the study, the following data was extracted; baseline SF-36 MCS, demographics and HRQOL data (ODI, COMI, SRS-22 and SF-36 PCS) at one-year post surgery. Using the distribution based Minimally Clinically Important Difference (MCID) for each HRQOL parameter calculated from the aforementioned database; patients were dichotomized into two groups of, “un-improved” and “improved” cohorts.[24] That is, a patient who had deteriorated in terms of HRQOL or had not reached the MCID for that HRQOL parameter at the 1st year follow-up was categorized as un-improved.

Statistical analysis

The mean values (and SD) of baseline SF-36MCS for each parameter in the “improved” and “un-improved” categories were calculated. Student's t-test was used to compare pre-operative SF-36MCS between improved and un-improved cohorts for each HRQOL outcome measure ($p < 0.05$).

A univariate binary logistic regression method was then used to analyse the size effect of pre-operative SF-36 MCS on any HRQOL parameter that was statistically significant on Student's t-test. For this model, the pre-operative SF-36 MCS was the independent variable while HRQOL outcome measures were dependent variables ($p < 0.05$). For the scale (HRQOL) that statistically significant results were obtained, a clinically useful pre-operative SF-36 MCS cut-off point that could predict the likelihood of a patient attaining MCID post surgery was determined by Receiver Operating Characteristic Curve (ROC) analysis ($p < 0.05$). Statistical analysis was performed using the same the SPSS Statistics 21.0 software (IBM SPSS Statistics for Windows, Version 21.0. Armonk, NY: IBM Corp).