Predicting Short-Term Outcome of Primary Total Knee Arthroplasty: A Prospective Multivariate Regression Analysis of 11 Independent Factors

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Introduction: Total knee arthroplasty (TKA) is a commonly performed and successful procedure for the treatment of knee joint disorders. However, not all patients achieve enhanced mobility and return to comfortable, independent living after TKA. Therefore, it would be beneficial to both surgeons and patients to be able to predict short-term outcomes for TKA and thus identify patients who are at risk for a poor outcome. The purpose of this study was to investigate factors affecting the short-term outcome of primary TKA and then develop a multivariate regression equation that can predict the early outcome of primary TKA.

Materials and Methods: This was a prospective study of 129 patients (134 knees) who underwent primary TKA between August 2001 and August 2008. All patients were followed for a minimum of 1 year. 11 independent variables, including age, gender, diagnosis, the presence of preoperative co-morbidities, BMI, preoperative Physical Component (PC) score of the Western Ontario and McMaster University Osteoarthritis Index (WOMAC), Short Form Twelve (SF 12) physical score (SP), SF mental score (SM), type of anesthesia, the use of a postoperative drain, and length of stay were analyzed. The WOMAC PC score at a minimum of 1 year postoperatively served as the primary short-term outcome.

Statistical Analysis: The correlation of each independent variable to the outcome WOMAC PC score was tested for significance using a non-simple correlation analysis. For multivariate regression analysis, the Stepwise procedure was used to enroll variables into the model until all significant factors were included in the equation. All quantitative variables (age, BMI, preoperative WOMAC score, length of stay) were analyzed as their original values, while qualitative variables were coded. Correlation and multivariate linear regression analyses were performed using Excel and Statistical Analysis System (SAS 9.2) software. A p value of less than 0.05 was considered significant.

Results: Correlation analyses showed two variables significantly influence short term TKA outcome. These include preoperative WOMAC PC score (PC, r = 0.44767, p<0.0001) and SF 12 mental score (SM, r = 0.36367, p<0.0001) (Table 1 and Fig 1A, 1B). By multivariate regression analysis, the following regression equation was obtained:

\[ \text{Outcome} = PC \times 0.38 + SM \times 0.44 + 33 \]

Least squares analysis of this regression equation resulted in an R² value of 0.236.

Discussion: To our knowledge, this study is the first prospective multivariate regression analysis of factors affecting outcome of primary TKA and our equation is the first one, which can be used to quantitatively predict the TKA outcome. We identified two independent variables, preoperative WOMAC PC score and SF 12 mental score, which significantly affected outcome WOMAC PF score at a minimum of 1 year.

Our results indicate that preoperative WOMAC PC score is the most important predictor for TKA outcomes. Patients with better preoperative WOMAC PC scores have better outcomes. This suggests that TKA should be considered before a patient becomes significantly debilitated in the late stages of knee disease, while surgical candidates still have a moderate degree of physical function. SF 12 mental score is also a significant factor affecting the TKA outcomes. Patients with higher preoperative SF 12 mental scores have better outcomes. Therefore, a patient’s outlook toward surgery should be integrated into the decision to proceed with surgical intervention. Age, gender, BMI, and preoperative co-morbidities do not affect the short-term outcome significantly.

Conclusion: Preoperative WOMAC PC score and SF 12 mental score are two factors, which affect the short term outcome of primary TKA. Our multivariate regression equation can be used to predict the general short-term outcome of primary TKA.

Table 1: Summary of Non-simple Correlation Analysis Summary

<table>
<thead>
<tr>
<th>Variable</th>
<th>Age</th>
<th>gender</th>
<th>Length of stay</th>
<th>Diagnosis</th>
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<tbody>
<tr>
<td>P</td>
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<td>0.1196</td>
<td></td>
</tr>
</tbody>
</table>

Fig 1A: Correlation analysis of Preoperative WOMAC PC score and follow up WOMAC PC score showed that there was a significantly positive correlation (r=0.44767, p<0.0001).

Fig 1B: Correlation analysis of Preoperative SF 12 mental score and follow up WOMAC PC score showed that there was a significantly positive correlation (r=0.36367, p<0.0001).

Figure 2: Exhibits good correlation between actual follow up WOMAC PC score and predictive WOMAC PC score with the derived multivariate.