The Journal of Arthroplasty 29 (2014) 2140–2145

Contents lists available at ScienceDirect

The Journal of Arthroplasty

journal homepage: www.arthroplastyjournal.org

A Novel Methodological Approach for Measuring Symptomatic Change Following Total Joint Arthroplasty

Amit Kiran, BSc, MSc, PhD [a], David J. Hunter, MEng, PhD [a], Andrew Judge, BSc, MSc, PhD [a,b], Richard E. Field, PhD, FRCS, FRCS [c,d], M.Kassim Javaid, MBBS, BMedSci, MRCP, PhD [a,b], Cyrus Cooper, MA, DM, FRCP, FFPH, FMedSci [a,b], Nigel K. Arden, FRCP, MSc, MD [a,b] Oxford NDORMS Musculoskeletal Epidemiology Unit Writing Committee

[a] NIHR Biomedical Research Unit, Nuffield Department of Orthopaedics, Rheumatology and Musculoskeletal Sciences, University of Oxford, Oxford, UK
[b] MRC Life course Epidemiology Unit, University of Southampton, Southampton General Hospital, Southampton, UK
[c] Research & Education South West London Elective Orthopaedic Centre, Epsom, Surrey, UK
[d] St. Helier Hospital, Carshalton, Surrey, UK

ARTICLE INFO

Article history:
Received 12 March 2014
Accepted 12 June 2014

Keywords:
PoPC
patient reported outcome measures
epidemiology
Oxford Hip Score
Oxford Knee Score
satisfaction

ABSTRACT

The OHS/OKS are PROMs for assessing symptomatic pain and function following TJA. However, actual change in pre-operative/post-operative scores cannot distinguish patients of varying baseline symptom severity. The percentage of potential change (PoPC) is a simple method that accounts for this, expressing the actual change attained, as a percentage of the potential change possible. Measures are described using OHS/OKS at baseline and 6-months (1784 – TKA, 1523 – THA) from the Elective Orthopaedic Centre. Each method identified different proportions of patients as satisfied and importantly, the measures identified different patients. PoPC overcomes floor and ceiling effects and standardises measures to an easy to interpret −100 to +100 scale. In addition to actual change, we recommend using PoPC to assess the overall outcome of patients.

Total joint arthroplasty (TJA) is a widely used surgical procedure. The measure of success is currently determined through the use of patient reported outcome measures (PROMs) [1–3] which assesses symptomatic improvement from the patients' perspective. In the UK, the Oxford Hip Score (OHS) [4] and Oxford Knee Score (OKS) [5,6] are the adopted PROMs of choice by the NHS.

The OHS and OKS are scoring systems developed in 1996 and 1998 respectively to report on the pre-operative condition and post-operative outcome of hip and knee replacement surgery [6]. Scores are collected to assess how patients' symptoms of pain and function change following surgery. These self-reported questionnaires, initially used for clinical trials, have been extensively used in cohort studies, audits, and national joint arthroplasty registries, including those in England, New Zealand and Sweden. Their application also extends to surgical management other than arthroplasty. Individually, the pre-operative and post-operative scores offer an assessment of a patient's condition at given time points. However when reviewed together, the effect of surgery, with respect to pain and function, provides an additional dimension for assessing surgical outcome.

Measures of change comparing post-operative scores against a patient's pre-operative position are almost always quoted [7,8], with 'actual change' (post-operative score minus pre-operative score) frequently used to describe patient improvement [9–11]. This direct measure, whilst important, does not account for the baseline position of patients and cannot differentiate between patients who had the most severe pre-operative symptoms from those who had the least severe pre-operative symptoms. This paper proposes a new measure, 'Percentage of Potential Change' (PoPC, pronounced *"pop-see"*), that takes account of the baseline position and distinguishes the improvement made by patients with severe and less severe pre-operative symptoms. PoPC is a simple measure that provides relativity to symptomatic change following TJA, by expressing the actual change attained, in the context of what could have potentially been achieved. PoPC was developed from earlier work by the authors which used potential scores to assess improvement [11].

The appropriateness and limitations of both methods are reviewed in this paper using OHS and OKS data and satisfaction with surgery responses from the Elective Orthopaedic Centre (EOC). The similarities and differences between the methods are highlighted using individual patient examples and differing reports of discriminated patient satisfaction are also examined. Subjects classed as satisfied by one measure of change are compared with those classed as satisfied by other

The Conflict of Interest statement associated with this article can be found at http://dx.doi.org/10.1016/j.arth.2014.06.008.

Reprint requests: A. Kiran, BSc, MSc, PhD, The Botnar Research Centre Institute of Musculoskeletal Sciences, University of Oxford, Nuffield Orthopaedic Centre, Windmill Road, Oxford, UK, OX3 7LD.

http://dx.doi.org/10.1016/j.arth.2014.06.008
0883-5403/

measure, in order to identify the discordance of satisfied subjects; that is, not all subjects classed as satisfied by one measure of change, are classed as satisfied by the other measure.

Although we apply the methods to a sample of patients in the UK using Oxford PROMS, PoPC can easily be applied to other scoring systems such as the Western Ontario and McMaster Universities Arthritis Index (WOMAC) and the Short Form Health Survey (SF-36).

Patients and Methods

Data

The EOC is a purpose-built NHS treatment centre covering a population of 1.5 million. The centre performs hip and knee replacement surgery for four acute NHS Trusts, Kingston, St George's, Mayday, and Epsom and St Helier. Between 2004 and 2009, n = 3082 patients underwent a primary total hip arthroplasty (THA) and n = 3608 underwent a primary total knee arthroplasty (TKA) as previously described [12]. Patients were invited to complete a pre-operative (baseline) and 6-month post-operative (follow-up) OHS or OKS questionnaire. The OHS and OKS are scoring systems consisting of 12 questions each on pain and function of the respective joint. Each response is on a Likert scale from 0 to 4, which leads to a total score of 0 (worst possible score and most severe symptoms) to 48 (best possible score and least symptoms). For this analysis, patients with completed pre-operative and post-operative questionnaires were used (n = 1523 for OHS and n = 1784 for OKS).

In addition to the OHS and OKS questionnaires, all patients were also asked about their overall satisfaction with the outcome of surgery, measured on a visual analogue scale (VAS) from 0 (not satisfied) to 100 (very satisfied). An anchoring binary variable was generated from this, using the cut-off ≥50 in accordance with the threshold previously used [12].

Method

Following TJA, a patients post-operative score could be higher, the same or lower than their pre-operative score. Patients could therefore show an improvement, no change or worsening in their symptomatic pain and function following surgery. This direct change in score is measured by actual change (Eq. 1).

PoPC expresses the actual change a patient has attained, as a percentage of the potential change (improvement or worsening) the patient could have achieved (Fig. 1). Potential improvement is the amount a patient could have potentially improved by given their baseline score (i.e. best possible score − pre-operative score). Potential worsening is the amount a patient could have potentially worsened by given their baseline score (i.e. pre-operative score − worst possible score). Patients that have had no change in pre-operative and post-operative scores have an actual change of zero and subsequently have a PoPC of zero.

$$\text{actual change} = \text{post-operative score} - \text{pre-operative score} \tag{1}$$

$$\text{PoPC} = \begin{cases} \dfrac{\text{actual change}}{\text{potential improvement}} \times 100 & \text{if actual change} > 0 \text{ (i.e. improvement)} \\ \dfrac{\text{actual change}}{\text{potential worsening}} \times 100 & \text{if actual change} < 0 \text{ (i.e. worsening)} \\ 0 & \text{if actual change} = 0 \text{ (i.e. no change)} \end{cases} \tag{2}$$

Statistical Analysis

Descriptive statistics of the cohorts used in this analysis are presented. The characteristics of patients used in this analysis who completed both pre-operative and post-operative questionnaires, are compared with patients not used in this analysis who completed pre-operative questionnaires only. Characteristics were compared using the two

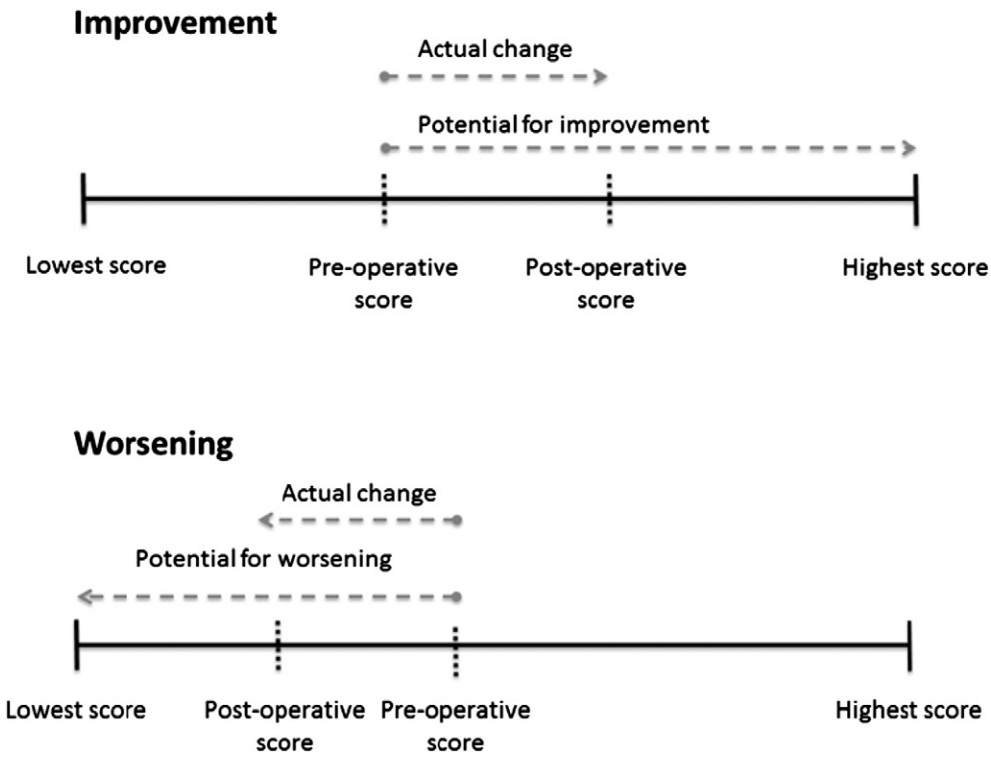

Fig. 1. Pre-operative and post-operative changes.