

# Functional Outcome Study in Total Knee Arthroplasty

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## Abstract

**Objective:** The aim of this study was to validate the well-recognized outcome measure instruments (Medical Outcome Study Short Form-SF-36, Western Ontario and McMaster University Osteoarthritis Index-WOMAC, McMaster Toronto Arthritis Patient Preference Disability Questionnaire-MACTAR) for patients who had undergone total knee arthroplasty in Iran, with its cultural and ethnic differences and compare them with the reports from other parts of the world.

**Methods:** Sixty patients, 56 women and 4 men, who had undergone total knee arthroplasty by a single surgeon, were recruited for clinical evaluation and for filling out the questionnaires on 3 outcome instrument systems, namely SF-36, WOMAC and MACTAR. Two control groups consisting of 44 cases of similar age from general population with knee discomfort and susceptible to osteoarthritis as well as 26 patients scheduled for knee arthroplasty filled out the same questionnaires.

**Results:** The health status measurement (SF-36), disease-specific outcome measure and patient preference arthritis scores all showed significant improvement in operated cases, in both short and long term follow-up groups. Certain aspects of function like socialization with others, attending religious ceremonies and similar activities, often requiring full knee bending and/or sitting on the carpeted floor, were the main reasons for dissatisfaction with the procedure.

**Conclusion:** The knee arthroplasty increased quality of life, improved function and produced great satisfaction in the majority of cases in our society. This is, however, a viable option for people who could change their lifestyle and household and are able to make the adjustments mentally and financially.

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**Keywords •** Arthroplasty • Knee • Osteoarthritis • Treatment outcome • Outcome assessment

## Introduction

**T**he emphasis on evaluation of surgical outcome has shifted towards subjective assessment by the patients. Many health care delivery systems, institutions, insurance companies, as well as researchers dealing with clinical aspects of disease have been using outcome research as the basis for their work. "Outcome" in general would mean how a

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patient would experience or feel about the end-result of a particular treatment. "End-result" was first used by Codman, an orthopedic surgeon from Boston. He proposed that the end-result of management of a patient be used as the best and most fundamental issue for judging how well the treatment response has been in a medical or surgical patient.<sup>1,2</sup>

Health outcome should be defined and measured in a *consistent* and *valid* fashion and, to be reliable, it must measure the results in a uniform manner, and the test, and the questionnaire or instrument used for such measurement should be monitored and confirmed accordingly. The study of joint motion, radiographic findings, infections, union status, loosening, etc. are clinical outcomes which have been the focus of attention for researcher in orthopedics for years.<sup>2-4</sup>

The assessment of *quality of life* of patients in outcome measures has been a widely used concept.<sup>5</sup> Other studies used activities of living scales in elderly patients and psychological well-being scales.<sup>6,8</sup>

The quality of well-being and health status index was first validated and became a widely accepted scale.<sup>9</sup> Functional outcomes primarily involve patient's function at the most complete level, and not of a joint or a condition.<sup>10,11</sup> Measuring end results must include relevant clinical outcomes which are important to the process of care and to the patient. Such derived health-oriented outcomes, are generally obtained by questionnaires.<sup>9,11,12</sup> This has become possible by introducing several valid measuring systems comprising health equipments which are generic instruments such as Medical Outcome Study Short Form (SF-36) that uses broad mental and physical well-being of a patient.<sup>13</sup> There are also "Disease-Specific" instruments, namely Western Ontario and McMaster University Osteoarthritis index (WOMAC) which have the advantage of providing a more efficient evaluation, but less useful for common variable health conditions.<sup>14</sup> Among similar assessment scales developed since, are Sickness Impact Profile, the Functional Limitation Profile, the McMaster Health Index Questionnaire, the University of North Carolina Health Profile, the Nottingham Health Profile, the Functional Status Questionnaire, and the Medical Outcome Study Short Form-12 (SF-12) which measure all aspects of a person's activity including physical, psychological, social and functional role.<sup>15-19</sup> In addition, they assess the patient as a whole and not as an organ system, disease or limb. These measures are reproducible, can differentiate between clinical conditions of various

severities and are also sensitive to the changes in health status over time.<sup>13,18</sup>

Health-related quality of life, on the other hand, shows how patients feel about themselves by considering their overall health status. The level of satisfaction of the patients with the treatment they have received is another way of measuring an outcome. The subjective perception of a disability may be quite variable for different individuals. For example, inability to run may be a major physical handicap for one person, while for another individual it is not perceived as a disability.<sup>2,3</sup>

As for Total Knee Arthroplasty (TKA) in Iran, we have used a general health measure form, a disease-specific questionnaire, as well as patient preference scale in order to assess the outcome.<sup>15,16,18</sup> The assessment of total knee replacement and corresponding results have been extensively studied in western hemisphere, but the impact of this procedure on patient's general health and function has not been investigated in this part of the world. In this context, the results may be different due to the peculiarities of the ecologic, cultural and social aspects as well as likes and dislikes of the people.

## Patients and Methods

Data for this study were obtained from 60 patients aged from 45 to 80 years ( $67 \pm 0.3$  yrs) with osteoarthritis or rheumatoid arthritis, undergoing total knee arthroplasty by a single surgeon (GHS) during 15 years of 1986-2001 in Dena and Nemazee hospitals. This was considered as Group 3. The estimated number of patients who underwent such an operation during this period was 122 patients, of them only 60 patients were accessible. Sixty two other cases were not accessible because they were either from other provinces and could not attend the recall sessions, or had expired. Over-all, 56 women and 4 men underwent 75 total knee arthroplasties. The follow up period of the study group ranged from 6 to 168 months ( $58.81 \pm 47.21$  months). Our cases were evaluated in a *cross-sectional* study with questionnaires assessing self-reported pain, physical function, mental health, and personal satisfaction. The resources used for the foregoing consisted of General Health status Short form: SF-36<sup>13</sup> for which total score were 0-121 with 121 being the best case scenario, Disease-Specific Criteria of Western Ontario and McMaster University Osteoarthritis Index: WOMAC,<sup>14</sup> with score of 0-113 in which 113 was the worst case scenario, Arthritis Patient Preference Disability Questionnaire, MAC-

TAR,<sup>19</sup> having a total score of 0-50, with 50 being the worst case scenario, Knee Society Clinical Rating System,<sup>20</sup> having a total score of 200 with 200 being the best case scenario.

Among these 60 cases with 75 total knee arthroplasties, 52 had osteoarthritis and 8 had rheumatoid arthritis. Controls comprised 70 individuals of similar age and included two groups who filled out the same type of questionnaires: Group 1 consisted of 44 cases randomly selected from general population or from rehabilitation/rheumatology clinics. These were individuals in their 4<sup>th</sup> to 7<sup>th</sup> decade of life with pain or functional disabilities referable to their knees. Group 2 with 26 patients filled out the questionnaires as a part of their pre-operative knee arthroplasty evaluation. The questionnaires were scored for all the four parameters studied. Controls were used to obtain a total score base line which was compared with similar scoring of those who had undergone arthroplasties.

Specific elements of each parameter such as questions related to stair navigation, getting up from sitting down position, cosmetic appearance, social life change, praying habits were re-analyzed separately.

*Statistical Analysis*

Data are presented as Mean±SD. The methods utilized were Fisher exact test, Chi-square, NPar, Kruskal-Wallis and Mann-Whitney tests with P<0.05.

**Results**

The 60 operated patients with 75 knee arthroplasties (group 3) were compared with 70 control cases (Groups 1 and 2). The total scores of group 1 showed a mean value of 55.8±18.5 (range 19-92) for SF-36, and 55.07±18.47 (range 16-44) for WOMAC. The corresponding values for group 2 were 54.04±14.63 (range 32-83) for SF-36 and 67.15±15.43 (range 40-97) for WOMAC. These values for cases that had undergone arthroplasty were 67.2±17.97 (range 17-98) and 47.78±21.81 (range 2-101) (Table 1).

**Table 1: Mean±SD of data of general health status (GHS; SF-36), distribution of disease-specific arthritis (DDSA; WOMAC) and physical function scores (PFS; WOMAC) of the patients who participated in the three groups.**

|      | Group 1   | Group 2   | Group 3   |
|------|-----------|-----------|-----------|
| GHS  | 5.8±18.5  | 54.0±14.6 | 67.2±18.0 |
| DDSA | 55.1±18.4 | 67.1±15.4 | 47.8±21.8 |
| PFS  | 33.5±5.6  | 43.2±3.5  | 30.1±2.2  |

These two parameters show an improvement of 20% in general health status and

16.6% in disease-specific criteria of the patients. This was a significant improvement in operated cases (p<0.001).

The patients' perception of their health was reported as "bad" in 28% in the control group, which dropped to 9% in operated cases. In group 3 patients, 18% expressed their health as "excellent," while such feeling was not present in any of the control group. The deterioration in general health was felt in 66% of the control group during the year prior to our survey, whereas in the operated cases only 7% had such feeling, despite their advancing age. This 7% were those individuals with longer follow-up or with other systemic problems who had evidence of prosthetic failure. Severe pain was the major complaint in 54% of the non-operated cases, while 24% of the operated ones experienced only a mild and transient pain.

Social gathering and attitude towards friends or family members were adversely affected in 18% of control group but only in 11% of the operated cases. The indoor and outdoor functional capacity was impaired in 40% of control group and in 28% of the operated cases.

The pain scores in WOMAC was 10.27 in control subjects (group 1), 13.35 in immediate pre-operative cases (group 2) and decreased to 6.78 in those who underwent knee arthroplasty (the scores dropped as the severity of pain decreased). This was a significant improvement ( p<0.001).

The overall physical function scores in WOMAC were 33.5 in group 1, 43.19 in group 2 and 30.12 in operated cases p<0.001.

Specific elements of physical function which showed statistically significant improvements following surgery as compared with both group 1 and 2 included functions like: going up and down the stairs (p<0.01), sitting on the chair (p<0.001), standing (p<0.001), walking on flat surface (p<0.001), getting in and out of a car (p<0.019), lying in bed (p<0.027), sitting on the floor (p<0.011), getting on/off toilet seat, and heavy house work (p<0.008), and light house work duties (p<0.023).

The improvements in some of the functions which were not statistically significant involved bending, rising from a floor-sitting position, putting on or taking off socks and shopping.

The detailed findings of the patients' preference scores of MACTAR involved difficulties that patients experienced before the surgery and in a decreasing order of importance consisted of stair navigation, usage of Persian-style toilets, sitting on and getting up from the floor, distance walking ,and praying

(which requires full knee flexion while sitting on the floor). The patients, in decreasing order, expected to obtain improvement in walking, pain relief, stair navigation, floor sitting/getting up activities, and daily house work.

The *knee arthroplasty* helped in: pain relief, surface walking, housework, stair navigation and cosmetic appearance of the knee, in a descending order (Fig 1). The main achievements, as seen in about 80% of the cases, were alleviation of pain, and relief from walking disability; while 15% had remarkable improve-



**Fig 1:** 63-yr-old lady with bilateral knee osteoarthritis with significant deformity and subluxated knee surgery on right side has made major Improvement in all aspects of her health.

ment in all the above five parameters they were hoping for and is in the MACTAR questionnaire. The difficulty in praying which was a common complaint pre-operatively did not seem to be a significant complaint in post-operative cases. They seemed to have adjusted themselves to a different position for praying.

The mean post operative Knee Society Score was  $134 \pm 39$  (max. score 200). No such pre-operative data was, however, available for the direct comparison. The average arc of motion was  $100 \pm 40^\circ$  with 86% of cases having less than 5 mm antero-posterior instability and 72% exhibiting medio-lateral laxity of less than five degrees.

The SF-36, and WOMAC scores were analyzed in the operated cases comparing the ones with less than 12 months follow up ( $10.38 \pm 2.02$  months; range 6-12 months) with those with longer follow-up ( $70.4 \pm 45.4$  months, range 13 to 168 months). SF-36 score was 71.4 in the shorter follow-up and 68.36 in the longer follow-up group. These values were 44.8 and 46.1 for WOMAC, with no statistically significant differences between any of these

outcome studies. This suggests that change in these functional assessments appear early and stay even with longer follow-ups.

## Discussion

The information on health can be obtained either through some specific academic testing processes, or by validated questionnaires filled by the patients. Various scientific tools have been designed to measure the changes produced in the health status of a patient by a particular procedure.

The assessment of knee arthroplasty and its results have been studied extensively in western countries. In view of different lifestyles and frequently diverse expectations of people in Iran, it was necessary to explore the impact of this procedure on patients' general health, and its effect on knee function or its role in reaching patients' expectations. This had not been studied previously. People more often sit on the carpeted floor rather than chair and use a different type of toilet which does not have a seat and requires almost full knee bending in squatting position. They do not often own cars and have to use public transportation which has not been adjusted in terms of stairs, heights or seats for people with disabilities. The elderly people can not rely on postoperative assistances from social health agencies and have to be independent financially and in self-care. The use of walking aid is often embarrassing and is not accepted by most individuals particularly women. These cultural and diverse lifestyles indicate that the results of our study on knee arthroplasty do not necessarily concur with those of Europe or North America. Therefore we believe that the results of our study provide a valuable functional outcome for a socially different environment and can show the validity of the three commonly used assessment instruments.

As we did not access the assessment tools for pre-operative evaluation for SF-36, WOMAC and MACTAR, we had to build a control group. The control groups included individuals aged from 45 to 80 years in which knee pain or dysfunction was fairly common and none had any known underlying traumatic, metabolic or inflammatory joint diseases. The mean SF-36 scores were 55.8 and 54.0 for randomly chosen control group 1 and for the cases in group 2, scheduled for a knee replacement respectively (Table 1). The lack of significant difference between these values suggested that global health assessment in control (group 1) correlates well with a patient suffering from a major knee problem (group 2).

A marked increase in SF-36 score to 67.2 ( $p < 0.001$ ) was indicative of a positive effect on quality of life in patients following knee replacement. This point has been verified by studies performed by Ritter et al, who found a significant improvement in the general health of patients with osteoarthritis who underwent either total hip or knee replacement without any difference between such operations.<sup>22</sup> That study involved a maximum post-operative assessment of two yrs. Such improvement persisted for up to 14 years with an average of five yrs.<sup>21</sup> A similar study carried out by Benroth et al., examined the SF-36 regarding different demographic variables of age, gender, side of operation and unilaterality or bilaterality.<sup>23</sup> In taking these variables into account, they concluded that different health problems showed improvement after TKA. In terms of "quality of life" 18% described their health as excellent with knee replacement. However, 7% of the patients, mainly those with longer follow-up and evidence of loosening, felt deterioration in their general health. The positive effect of TKA has been even demonstrated in people over 85 years of age.<sup>23</sup> Like most other studies, most of our cases were women.<sup>24,25</sup>

The female/male ratio for prevalence of osteoarthritis is 6.1:1 in Iran, showing female preponderance that exceeds most other reports.<sup>24,26</sup> In our study of 60 patients, there were only four men with TKA. The control group had similar gender distribution. The cases in the waiting list for TKA suffered a more severe disability than individuals in group 1 control. This is due to the fact that the people in our community do not usually consent to an elective surgery until they are severely disabled. They were usually prepared not to use usual Iranian style toilets, avoid kneeling position or sitting on the floor. They would also modify their praying obligations by sitting at a desk for praying. These modifications were still not enough for a comfortable life and the patients eventually consented to surgery. Other reasons for conceding to surgery, despite the modifications they had already implemented in their life, were pain and difficulty in surface walking, getting on or off the toilet seat or a chair and problems with self care or simple household work. The advantage of a knee replacement in alleviating the above symptoms was even more evident in patients with longer follow-ups. The least improvement, which was observed in floor bending and putting on socks, or shoes, may be related to osteoarthritis in other joints or relative overweight commonly seen in people with knee osteoarthritis.<sup>24</sup> The improvement in cosmetic appear-

ance of the leg (having a straight lower limb as opposed to significant pre-operative bowing and varus) was a major source of satisfaction. This parameter was more outstanding as females constituted the majority of cases. The increased ability in self care and simple housework was also a great point for enjoyment. The patients were happy as they could dispense of their cane few weeks after surgery. One of the sources of dissatisfaction, however, involved such social activities as attending parties or going to mosque for prayer. Since the western-type toilets are not commonly available in houses or in public places, the leisure trips or participation in family or social gatherings were often abandoned by those with knee arthroplasty.

Some other patients were not happy with their post-operative inability to comfortably rise from their sitting position had they, at any time, chosen to sit on the floor. The resultant average knee flexion range of 100° was not enough for sitting cross-legged on the carpet. This position was discouraged in all patients, as none of these knees were mobile bearing total knees.<sup>27</sup> Whether designs with increasing flexion range would withstand long term exerted full flexion force and address this particular complaint of our patients remain to be seen.

The three outcome measures used seem to answer most of the queries concerning total knee arthroplasty in our population. The Knee Society Clinical Rating Scale did not add any further significant information, a point which has already been well shown by Lingard et al.<sup>28</sup>

However, some needed changes in life style and household, would make knee replacement a viable option for those Iranian people who could financially and mentally make the adjustments. A good functional outcome and high rate of satisfaction would be expected in such patients.

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