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The Functional Assessment Test: A Method of Evaluating Improvement in Function After Knee Arthroplasty

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ABSTRACT

Questionnaires are marginally useful for objectively measuring function after knee arthroplasty. The Functional Assessment (FA) test is an easily administered, timed test of a person's ability to stand, walk and ascend/descend stairs that would be useful for quantifying a patient's function after knee arthroplasty. Four hundred forty-five individuals were included in the study: 313 without lower extremity arthritis or neurologic disease and 132 with advanced degenerative arthritis prior to knee arthroplasty. As expected, the test times were longer for individuals afflicted with knee arthritis. Arthroplasty patients were tested pre- and postoperatively to determine if their FA test time improved. The FA test takes less than a minute and is practical for use in the clinical setting as a simple means of quantifying function before and after knee arthroplasty.

Most patients undergoing a total knee replacement are seeking pain relief. Pain impairs a patient's ability to walk as well as their ability to rise from a chair and to maneuver stairs. Patient questionnaires are useful in quantifying pain after arthroplasty but are marginally successful at measuring improvement in a patient's ability to stand, climb, and ambulate. Functional measures currently available, such as the Six-Minute Walk Test [1], lack specificity and are altered by a patient's general conditioning, co-morbidities, and other joint involvement. Age and body mass are other factors that alter a patient's ambulatory abilities. The diverse patient population undergoing joint arthroplasty makes it difficult to interpret and compare clinical outcomes with measurement tools currently available.

The benefits of joint replacement surgery for patients with gonarthrosis currently are assessed primarily by questionnaires that measure a patient's perception of pain relief and recovery of function. The most common approach is through the use of self-evaluation questionnaires such as the Oxford survey [2] and Western Ontario and McMaster Universities OA index (WOMAC) [3] and physician derived outcome measures such as the Knee Society Score (KSS) [4]. Such instruments do not take into account the impact of co-morbidities and the impact of de-conditioning that comes with age, degenerative arthritis, and obesity. Additionally, the expectations, demands, and performance of a joint replacement in a younger, athletic patient are considerably different than those of an elderly, inactive patient; however, the same instruments are being used to evaluate both groups. In 2004, McCarthy and Oldham validated the aggregated locomotor function (ALF) score for use in patients with osteoarthritis of the knee [5]. This score is composed of three functional components – an eight meter walk time, stair ascent and descent time, and transfer time. Each component is performed multiple times – eight meter walk (3 times), stair ascent and descent (4 times) and transfer time (3 times). The ALF score for the patient was calculated by adding the mean test times of each task (walk, stairs, transfer). We hypothesized that a simple physical test, similar to the ALF score, that measures an individual's ability to stand, walk, and climb could be a test practical for use in the clinical setting. The test could be administered before and after arthroplasty and the test times could be compared, thus the patient would be their own control. The patient's Functional Assessment (FA) test time after surgery could be compared, in terms of age, gender and body mass, with the test time of an individual without lower extremity arthritis or neuromotor dysfunction. A patient's functional ability could be expressed as a percentage improvement in their ability to sit, stand, ambulate and negotiate stairs.

Phase I of the study was to establish FA test times for comparison based on gender, age and body mass index for healthy volunteers (VOL group). Phase II of the study was to measure the impact of degenerative arthritis on the FA test times for individuals with advanced knee arthritis scheduled for elective Knee Arthroplasty (KAP group). Phase III of the study was to determine if the FA test times of the KAP group improve after knee arthroplasty and if changes in the FA test times corresponded with an improvement in the Oxford score obtained at the same time interval. We also set out to determine

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if the annual FA test times of the KAP group improved to the level of the healthy individuals (VOL group).

Materials and Methods

The Functional Assessment test is a timed test that measures the ability of an individual to stand from a seated position in a standard chair (17-in. seat height), walk a measured distance of thirty feet, ascend four stairs (6-in. height), turn, descend four stairs, walk thirty feet to their initial starting position and return to a seated position in the chair. The individual was asked to perform the test at their normal pace.

This study group was a prospective cohort from 627 individuals who gave Informed Consent to participate in the study and performed the Functional Assessment (FA) test. In order to obtain adequate numbers to stratify groups according to age, gender and body mass index we included healthy individuals without activity limitations due to health reasons from persons accompanying patients to office visits to serve as our healthy comparison (VOL group). The VOL group was comprised of 313 individuals who reported no activity limitations due to any health reasons prior to giving informed consent for participation in the study and performing the FA test one time. Three hundred fourteen individuals were eligible for the Knee Arthroplasty Group (KAP group). These potential patients had no lower extremity musculoskeletal problems other than osteoarthritis in their knee, no neurologic dysfunction and no history of previous lower extremity joint replacement in the knee. These individuals were candidates for knee arthroplasty because of the degenerative arthritis in the knee. These individuals gave informed consent, performed the FA test and completed the Oxford survey at the time of their clinical evaluation prior to knee arthroplasty surgery. Fifty-seven individuals subsequently did not schedule arthroplasty surgery. Patients who did not receive a unilateral unicompartmental knee arthroplasty (UKA) or a unilateral total knee arthroplasty (TKA) were not included in the KAP group (84 patients). Additionally, patients were not included if they had staged arthroplasties (a contralateral knee arthroplasty performed within a year of arthroplasty knee in this study) (36 patients) or if they underwent a revision of their arthroplasty within a year (5 patients). Thus, the KAP group was comprised of 132 patients who performed the FA test and completed an Oxford survey preoperatively, underwent fixed-bearing *unilateral* unicompartmental (54 knees) or fixed-bearing total knee (78 knees) arthroplasty and performed the FA test and completed Oxford Survey at their postoperative 4-week and annual clinical evaluations.

Table 1
Categorization of Study Groups.

	Healthy Comparison (VOL Group)	Knee Arthroplasty (KAP Group)
# Subjects	313	132
Age		
50 or younger	57	5
50–59	84	38
60–69	89	52
70–79	62	30
80 or older	21	7
BMI		
<25	108	22
25–29	139	48
>30	66	62
Gender		
Men	145	60
Women	168	72

The subjects in the Healthy Comparison (VOL) (Phase I) and the Knee Arthroplasty (KAP) (Phase II) were stratified for comparison according to age group and BMI group (Table 1). In Phase III of the study, we compared the FA test time of the same 132 individuals (KAP group, Phase II) to their postoperative FA test times at the 4-week and annual evaluations, thus the patient served at their own control. The Oxford survey was completed in conjunction with each FA test and was compared to determine if there was a relationship between the FA test time and the Oxford survey questionnaire.

For the knee arthroplasty group, we also examined radiographs of their contralateral knee. Based upon the presence or absence of radiographic evidence of arthritis in their contralateral knee, they were assigned an Ahlbäck Classification score [6]. This score was then categorized into two groups – *None/Minimal Arthritis* (Ahlback score: 0 or 1) or *Arthritic* (Ahlback score: 2, 3, 4, or 5).

Source of Funding

The study was funded in part by a grant from the Knee Society. The Knee Society did not play a role in the development or investigation of the Functional Assessment test.

Statistical Methods

Since all patient activities are directly observed with the Functional Assessment test and there were no questions concerning patient-perceived limitation of activity, internal consistency testing was not required for Phase I and Phase II of the study. In Phase I of the study, analysis of variance (ANOVA) tests were used to evaluate any differences in the FA test time among the age groups and the BMI groups. A *t* test was used to examine a difference between the FA test time and gender.

ANOVA tests were also used in Phase II of the study to examine the KAP group for differences in the FA test times among the age groups and BMI groups. As the data for patients with arthritic knees was not of a normal distribution, non-parametric Mann–Whitney tests were used to evaluate differences in FA test times among groups.

In Phase III of this study, the Oxford Score was used as the criterion measure for construct validity. A Spearman test was used to assess the correlation of the FA test with a validated measure of function (the Oxford score). Concurrent Oxford scores were assessed at pre-op, 4-weeks, and 12 months. We used general linear model and repeated measures testing to determine within-subject and between-subjects effects for the 132 patients in the KAP group. The same testing was used to evaluate subjects based on arthroplasty type (TKA or UKA).

For all analyses in this study, a P value less than 0.05 were considered to be the threshold for statistical significance.

Results

In Phase I of the study, we examined the functional assessment (FA) test times of the Healthy Comparison Group (VOL). Individuals under age 50 and subjects 80 or older performed the test significantly different than the other age groups ($P < 0.01$ at each age group comparison level) (Fig. 1A). We found no differences in the mean FA test times among the three BMI groups (Fig. 1B). When evaluating the FA test time and gender for the VOL group, there was no difference in the mean test time of men (25.1 seconds) and women (25.2 seconds) ($P = 0.71$). There were no differences found among the BMI groups for men ($P = 0.51$) or for women ($P = 0.55$).

In Phase II of the study, we compared the FA test times of the Healthy Comparison Group (VOL) to the FA test times of the patients with arthritic knees (preop KAP). Overall, the mean FA test time was