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School of Occupational Therapy

# Total Joint Arthroplasty Outcomes Using Short Musculoskeletal Function Assessment and University of California, Los Angeles Activity Score

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Under the direction of the research advisor:

Lucinda Dale EdD, OTR, CHT, FAOTA

# A Research Project Entitled

Title: Total Joint Arthroplasty Outcomes Using Short Musculoskeletal Function Assessment and University of California, Los Angeles Activity Score

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By

Shelby Allen, Melanie Browne, Curtis Clem, Taylor Millar, Shannon Nale, and Zachary Selby

Occupational Therapy Students

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Abstract

**Objectives:** The purpose of this study was to explore the impact of total hip arthroplasties (THA) and total knee arthroplasties (TKA) through measurement of functional outcome via the Short Musculoskeletal Function Assessment (SMFA) and activity level using the University of California, Los Angeles (UCLA) Activity Score for patients with elective, primary THA or TKA.

**Method:** Patients scheduled for THA or TKA completed the SMFA and UCLA Activity Score during routine assessment and intervention sessions preoperatively, and at 1-month, 3-month, 6-month, and 12-month follow-up visits. Hospital personnel de-identified and entered SMFA, UCLA Activity Score, and demographic data from a convenience sample into an Excel spreadsheet. Researchers entered data into Statistical Package for the Social Sciences (SPSS) for analysis.

**Results:** From a sample of 490 patients, complete data for patients with THA ($n$ = 27) and TKA ($n$ = 21) could be used for analysis. Insufficient data prevented analysis of 6-month and 12-month THA, and 12-month TKA time frames. An independent $t$-test and independent samples test confirmed similarities of SMFA and UCLA Activity Score for THA and TKA, allowing the two populations to be combined for analysis. Total SMFA and all subcategories showed more disability than normative values at pre-operation. Results from a paired $t$-test indicated significant improvements in total SMFA scores from pre-operation to 1 month, and from 1 to 3 months. Arm and hand, mobility, and emotional subcategories of the SMFA showed significant improvements from pre-operation to 1 month; the activities of daily living subcategory showed a significant improvement from 1 to 3 months. Total SMFA, activities of daily living, emotional status, and mobility subcategory mean scores were statistically similar to normative values by 6

months, whereas arm and hand mean score was better than normative value by 1 month. Results from a Wilcoxon Signed-Rank test indicated a significant improvement in UCLA Activity Score from 1 to 3 months.

**Conclusion:** THA and TKA impact multiple areas of occupational performance and nonoperative areas of the body. Researchers and clinicians can use the SMFA and UCLA Activity Score to measure multidimensional outcomes for THA or TKA.

*Keywords:* total hip arthroplasty; total knee arthroplasty; occupational therapy; physical therapy; Short Musculoskeletal Function Assessment; University of California, Los Angeles Activity Score; activities of daily living

# Total Joint Arthroplasty Outcomes Using Short Musculoskeletal Function Assessment and University of California, Los Angeles Activity Score

More than seven million Americans are living with total hip arthroplasties (THA) and total knee arthroplasties (TKA) (Maradit-Kremers, Crowson, Larson, Jiranek, & Berry, 2014). The annual number of TKA doubled from 300,000 surgeries in 1991 to 600,000 in 2010 (Martin, Thornhill, & Katz, 2015). Researchers estimate that demand for primary THA and TKA in the United States will increase by 174% and 673% respectively between 2005 and 2030 (Patel, Pavlou, Mújica-Mota, & Toms, 2015). Increases in the incidence of osteoarthritis (OA) and in the aging population are two contributing factors for the rise of THA and TKA in the United States (Allen & Golightly, 2015; Yan & Pogoda, 2013). OA is the most frequently diagnosed joint disease in adults and is the principal cause of pain and disability for older adults (Harding, Holland, Delany, & Hinman, 2014; Simmons & Smith, 2013). OA can be associated with poor physical function and is the most common reason for THA/TKA (Davison, Ioannidis, Maly, Adachi, & Beattie, 2014; Harding et al., 2014).

Occupational therapy (OT) and physical therapy (PT) services are often prescribed for patients who have undergone THA or TKA to improve occupational performance and physical function, with an emphasis on lower extremity function (American Occupational Therapy Association [AOTA], 2011; Reicherter, 2017; Sathe, 2013; Singh & Lewallen, 2013b; Umpierres et al., 2014). OT and PT practitioners evaluate patients and provide interventions, pre- and postoperatively that focus on education regarding precautions, pain management, engagement in occupations to increase quality of life (QOL), exercise programs, and appropriate adaptive and mobility devices (AOTA, 2011; Reicherter, 2017; Sathe, 2013). Patients typically spend 1 to 3

days in the hospital after THA/TKA, and full recovery is expected to occur 6 to 12 months after surgery (American Association of Hip and Knee Surgeons, n.d.).

Researchers have focused on lower extremity function, muscle strength, and joint mobility, and have rarely used the Short Musculoskeletal Function Assessment (SMFA) and University of California, Los Angeles (UCLA) Activity Score outcome tools for individuals with THA/TKA (Herbold et al., 2014; Simmons & Smith, 2013; Wimmer, Nechtow, Schwenke, & Moisio, 2015). In the reviewed literature there has been a greater focus on PT interventions than OT interventions after THA/TKA (Harding et al., 2014; Heiberg, Ekeland, & Mengshoel, 2013; Huber, Roos, Meichtry, de Bie, & Bischoff-Ferrari, 2015). However, according to AOTA (2014), OT practitioners provide services using a client-centered, multidimensional approach to improve QOL, function, safety, and independence in work, play, leisure, activities of daily living (ADL), and instrumental activities of daily living (IADL).

"Outcomes are the end result of the OT process; they describe what clients can achieve through OT intervention," (AOTA, 2014, p. S16). Outcome measures are chosen based on client goals and psychometric properties of the tool (AOTA, 2014). Due to their assessment of multiple factors contributing to occupational performance, the outcome tools used in this study were the SMFA and UCLA Activity Score. The SMFA is a patient-reported assessment tool that supports a holistic, multidimensional approach through its inclusion of ADL, arm and hand, mobility, and emotional areas of daily function, allowing practitioners to gather patient-reported information relevant to daily living (Swiontkowski, Engelberg, Martin, & Agel, 1999). The UCLA Activity Score is also a patient-reported assessment tool that is used to measure an individual's activity level, and has been shown to be the most useful tool to measure physical

activity in individuals diagnosed with OA in the hip and/or knee (Terwee, Bouwmeester, van Elsland, de Vet, & Dekker, 2011).

The purpose of this study was to measure functional outcome via the SMFA and activity level using the UCLA Activity Score for patients with elective, primary THA or TKA. The research question for this study was: For patients who undergo THA or TKA and participate in OT and PT, what are the outcomes as measured by the SMFA and UCLA Activity Score?

## Literature Review

Patient-rated outcome tools are used to measure patients' perceptions of their recovery of function after THA or TKA. Researchers have used the Western-Ontario McMaster Universities (WOMAC) Osteoarthritis Index, Oxford Hip Score, Oxford Knee Score, 36-Item Short Form Health Survey (SF-36), Hospital for Special Surgery (HSS) Knee Rating Form, Knee Injury and Osteoarthritis Outcome Score (KOOS), Hip Injury and Osteoarthritis Outcome Score (HOOS), Functional Independence Measure (FIM), Short Questionnaire to Assess Physical Activity (SQUASH), 12-Item Short Form Health Survey (SF-12), UCLA Activity Score, and internally developed questionnaires to report outcomes after THA or TKA (Andrawis et al., 2015; Harding et al., 2014; Herbold et al., 2014; Huber et al., 2015; Judd et al., 2014a; Judd, Thomas, Dayton, & Stevens-Lapsley, 2014b; Mandzuk, McMillan, & Bohm, 2015; Monticone et al., 2014; Peter et al., 2015; Terwee et al., 2011; Umpierres et al., 2014). These outcome measures included ways to assess effectiveness of pre- and postoperative PT and OT rehabilitation, patient function, pain levels, ADL, QOL, and community reintegration (Fujita, Xia, Liu, Mawatari, & Makimoto, 2014; Harding et al., 2014; Herbold et al., 2014; Peter et al., 2015; Poortinga, van den Akker-Scheek, Bulstra, Stewart, & Stevens, 2014; Singh & Lewallen, 2013a; Singh & Lewallen, 2013b; Stergiou-Kita & Grigorovich, 2014).

Most researchers in the reviewed literature focused on PT intervention after THA/TKA with an emphasis on strength, functional activity, range of motion (ROM) exercises, mobility training, and stretching; however, most researchers did not address nonoperative areas of the body that may also be impacted by THA/TKA (Judd et al., 2014a; Poortinga et al., 2014; Simmons & Smith, 2013; Umpierres et al., 2014). Fewer researchers addressed a combination of OT and PT intervention in regards to joint mobility and function in ADL (Herbold et al., 2014; Yan & Pagoda, 2013). General trends in the reviewed literature indicate preoperative education interventions alone were equally effective as a combination of preoperative education and PT interventions (Huber et al., 2015). Additionally, participation in OT and PT post-THA/TKA resulted in improved QOL, pain, physical function, ADL performance, and community reintegration (Harding et al., 2014; Mandzuk et al., 2015; Peter et al., 2015; Singh & Lewallen, 2013b; Stergiou-Kita & Grigorovich, 2014).

To assess physical function, researchers have used general health status measures, outcome tools for lower extremity function, and outcome tools designed for individuals with arthritis, which have yielded mixed results (Harding et al., 2014; Poortinga et al., 2014; Schotanus, Bemelmans, Grimm, Heyligers, & Kort, 2016; Simmons & Smith, 2013). In addition to these tools and measures, researchers have commonly used performance-focused outcome tools in combination with patient-reported outcome tools (Andrawis et al., 2015; Harding et al., 2014; Maxwell et al., 2013). Results from studies that include both types of outcome tools indicate that patient-reported outcome tools have more consistently detected improvements in function, physical activity, pain, and QOL, whereas performance-focused outcome tools yielded mixed results (Andrawis et al., 2015; Harding et al., 2014; Maxwell et al., 2013). Objective, performance-based measures may not represent patients' perceptions of functional status.

Researchers have found that patients who have undergone THA/TKA generally experience an increase in QOL (Dailiana et al., 2015; Harding et al., 2014; Keurentjes et al., 2013; Mandzuk et al., 2015). Harding et al. (2014) reported that pain was inversely related to function and QOL after THA/TKA. Furthermore, Singh & Lewallen (2013a; 2013b) showed that decreased pain was associated with improved ADL and functional mobility post-THA/TKA. Dailiana et al. (2015) found that approximately 50% of patients who planned to undergo THA or TKA experienced depressive symptoms. Researchers identified a significant improvement in patient-reported QOL and reduction of depressive symptoms after THA and TKA (Dailiana et al., 2015; Harding et al., 2014).

Although individuals planning to undergo THA have reported impaired sexual activity, only one study in the reviewed literature included this topic. Lavernia and Villa (2016) used an internally developed questionnaire and found that THA was effective in decreasing pain and increasing mobility for sexual activity. Using outcome tools that include sexual activity as part of ADL could help practitioners identify and address concerns about meaningful activities that otherwise may not be addressed (Lavernia & Villa, 2016).

Reports of research have shown that patients value their performance in meaningful activities and engagement in their communities (Stergiou-Kita & Grigorovich, 2014). Participants who experienced significant pain relief expressed satisfaction with community engagement because decreased pain allowed them to participate in meaningful activities. This concept is essential for practitioners to consider when measuring IADL (driving, community mobility, meal preparation, and care of others/pets) that are meaningful to individuals planning to undergo THA or TKA (AOTA, 2014; Stergiou-Kita & Grigorovich, 2014).

Although outcomes after THA and TKA have been extensively reported in the literature, there are gaps that need to be addressed. Outcome measurement has rarely included OT interventions for this population (Poortinga et al., 2014; Simmons & Smith, 2013, Singh & Lewallen, 2013b; Umpierres et al., 2014). Despite usefulness, validity, and reliability of the SMFA and UCLA Activity Score (Swiontkowski et al., 1999; Terwee et al., 2011), researchers have rarely used these outcome tools with THA or TKA. Other limitations in the reviewed literature consisted of: limited sample sizes, incomplete data, compromised external validity, and a limited focus on participants' function (Andrawis et al., 2015; Harding et al., 2014; Heiberg et al., 2013; Judd et al., 2014a; Judd et al., 2014b; Maxwell et al., 2013; Singh & Lewallen, 2013b). Researchers in the current study chose the SMFA and UCLA Activity Score to measure outcomes for patients after THA or TKA. Patients participated in OT and PT prior to and after surgery. The current study methodology serves to fill some of the gaps identified in the reviewed literature.

## Method

### Study Design

The researchers in this study used a quantitative, repeated measures design with retrospective data. A regional healthcare organization, which included one hospital-based and three satellite outpatient OT and PT locations, partnered with a university for the purpose of measuring outcomes for THA and TKA. In this study, the independent variables were THA and TKA and the dependent variables were outcome scores for the SMFA and UCLA Activity Score.

In this study, three surgeons performed elective, primary TKA and one of the three surgeons also performed elective, primary THA using an anterior approach. The primary investigator (PI) of this study is an OT practitioner, faculty of the university, and advisor of six

student researchers. The SMFA and UCLA Activity Score assessment tools were collaboratively selected by the PI, healthcare organization administrators, surgeons, and OT and PT practitioners at the organization's facilities.

Researchers completed this study to fulfill an academic requirement to earn a doctoral degree in OT.

**Instruments**

**SMFA.** The Musculoskeletal Function Assessment (MFA) is a health status instrument with 101 self-rated health items, designed for patients with a wide variety of musculoskeletal diseases (Engelberg, 1996). The MFA is used to assess patient function including upper and lower extremity function, daily activities, recreational functioning, emotional adjustment, and overall functioning as well as standard clinical measures such as ROM, grip strength, walking speed, fine motor skills, and knee and elbow strength (Engelberg, 1996).

The SMFA is a shortened version of the MFA that contains two parts: the dysfunction index and the bother index (Swiontkowski et al., 1999). A five-point Likert scale is used for each of the 46 items that comprise the dysfunction and bother indices. The dysfunction index is a 34-item questionnaire that assesses one's daily activities, emotional status, arm and hand function, and mobility. A score of 1 shows good function and a score of 5 shows poor function. The bother index is a 12-item questionnaire that addresses how "bothered" patients feel about problems related to their condition and how these problems affect performance (score of 1 shows not bothered at all to a score of 5 extremely bothered). For the SMFA, both indices are standardized and have normative data. To score the SMFA results in a specific category, the first step is to calculate the sum of the scores for that category; this sum is the raw score. Then, the lowest possible sum from the category is subtracted from the raw score. The difference obtained

is then divided by the maximum possible sum from the category. Finally, this value is multiplied by 100 to obtain the standardized score. The standardized scores give a measure of patient disability; lower scores indicate higher function, and higher scores indicate lower function. Standardized scores can also be calculated for a SMFA index, using the same rules. The lowest possible raw score total for the dysfunction index is 34, and the highest possible score is 170. The range of possible standardized scores for the dysfunction index is 0 to 100 (Swiontkowski et al., 1999).

Swiontkowski et al. (1999) found that both SMFA indices were shown to have internal consistency and stability, with most values more than 90 percent. In the same study, significant correlations were found between the SMFA indices and physicians' ratings of patient function (e.g. emotional function and ADL) ($r \geq .40$). Correlations of similar significance were found between both indices and standard clinical measures (e.g. grip strength and walking speed) ($r \geq .40$). These correlations demonstrated convergent validity for both SMFA indices. Convergent and discriminant construct validity of both SMFA indices was demonstrated ($p < 0.01$) when the indices were compared to clinical, demographic, SF-36 Health Survey, and life-change data. Content validity was demonstrated for both indices, with very little skew (less than 1.00), few ceiling effects (less than 5 percent), and no floor effects. Responsiveness of both SMFA indices was demonstrated with standardized response means that ranged from moderate (0.76) to large (-1.140) for patients whose health status changed (Swiontkowski et al., 1999).

The SMFA is a valuable outcome tool for patients who have undergone THA/TKA because it allows them to rate daily activities, arm and hand function, emotional status, and mobility. For this study, researchers used the the SMFA dysfunction index. Patients were

administered the SMFA five times: preoperatively, and at 1-month, 3-month, 6-month, and 12-month follow-up visits.

**UCLA Activity Score.** The UCLA Activity Score is a non-normative and non-standardized self-assessment questionnaire that can be used to measure the activity level of patients who have undergone joint arthroplasties (Terwee et al., 2011; Zahiri, Schmalzried, Szuszczewicz, & Amstutz, 1998). To complete the assessment, respondents rate their activity levels using the 10-point UCLA Activity Score rating scale. This score indicates their current participation in activities, regardless of intensity or frequency. The assessment tool includes activity level ratings ranging from 1 to 10. Level 1 is defined as wholly inactive, dependent on others, and cannot leave their residence, and level 10 is defined as regularly participates in impact sports (Zahiri et al., 1998). The UCLA Activity Score was found to be useful for measuring physical activity levels of populations including lower extremity joint replacement, osteoarthritis, and healthy individuals (Judd et al., 2014b; Terwee et al., 2011; Zahiri et al., 1998). Content validity and reliability of the UCLA Activity Score have been established (Terwee et al., 2011). Zahiri et al. (1998) found a significant correlation ($p < 0.05$) between pedometer data and the UCLA Activity Score, bringing validity to the rating scale. Patients were administered the UCLA Activity Score five times: preoperatively, and at 1-month, 3-month, 6-month, and 12-month follow-up visits.

## Procedures

**IRB.** The Institutional Review Board of the university approved this study as exempt.

**Training.** The PI trained OT and PT practitioners on scoring procedures and interpretation of scores for the SMFA and UCLA Activity Score. The practitioners were also educated on the normative data of the SMFA. Student researchers received the same training at

a university. Aides and office staff were trained to administer tools and to collect and scan tools for electronic retrieval.

Researchers completed the Collaborative Institutional Training Initiative to ensure ethical standards were fulfilled .

**Patient sample.** Patients who underwent elective, primary unilateral or bilateral THA or TKA were included in the study. Patients were excluded if they had either of the following: a fractured bone which required a THA or TKA or revision of a THA or TKA.

**Preoperative intervention.** As a part of routine assessments and interventions, all individuals who planned to undergo THA or TKA were scheduled to attend a pre-operation clinic. OT and PT practitioners administered and collected the SMFA and UCLA Activity Score during the pre-operation clinic. Additionally, the practitioners completed routine assessments including: ADL performance, ROM and manual muscle testing of upper and lower extremities, a grind test of the first carpometacarpal (CMC) joint, and functional mobility. Occupational and physical therapists prescribed upper and lower extremity exercises, educated patients on environmental modifications and adaptive devices, and described routine postoperative OT and PT interventions.

**Postoperative intervention.** Patients who underwent THA or TKA were referred to OT and PT immediately post-operation. OT practitioners focused on increasing patients' independence in toileting, bathing, and dressing. PT practitioners focused on ambulation, stair climbing, lower extremity ROM, and functional mobility. OT and PT practitioners collaborated with surgeons, nurses, and family to make recommendations for discharge to home, to a rehabilitation facility, or to a skilled nursing facility. All patients were referred to PT for

continued rehabilitation after discharge. During hospitalization, aides administered and collected the SMFA and UCLA Activity Score.

### Data Collection

Data were collected by OT and PT practitioners, aides, and office staff as part of routine assessments and interventions for patients with THA and TKA. Hospital personnel de-identified the patient information before it was made available to the researchers.

### Data Analysis

De-identified data from an Excel spreadsheet were copied and pasted into International Business Machines Corporation ® (IBM) Statistical Package for the Social Sciences (SPSS) version 23.0 software for data analysis. In order to reduce chance of human error, data were entered by pairs of researchers. One researcher entered data as another oversaw the data input process to check for errors. Independent *t*-test and independent samples test were conducted to determine if unilateral THA and TKA outcome scores for the SMFA and UCLA Activity Score were the same at pre-operation and could be combined for a single sample. A repeated measures ANOVA test and an equivalent nonparametric test were used to analyze the SMFA outcome score and UCLA Activity Score data for each of the five administered times to determine statistical change. Paired *t*-test and Wilcoxon Signed-Rank test were completed to determine statistical change between each sequential time frame. Descriptive statistics were utilized to analyze the demographic data. Researchers established $p < .05$ to identify statistical significance.

## Results

Of the 490 patients who underwent THA or TKA from 2010 to 2016, data from 442 patients were removed prior to analysis due to incomplete data. At pre-operation, the sample included 30 patients who underwent bilateral TKA. However, data from only 15 of these

patients were completed 1 month after surgery, which was too few for an accurate analysis and resulted in removal from the data set. Of the 48 patients that had complete data, 27 underwent THA and 21 underwent TKA; 20 percent had a positive grind test of the first CMC joint; and 97.9 percent were overweight or obese (Table 1).

Patients who underwent more than one primary THA or TKA were recorded as separate patients for the data set. Scores of the 6-month THA, 12-month THA, and 12-month TKA data were not included in the data set due to insufficient data. If patients were missing scores on fewer than half the items within any of the four SMFA subcategories, researchers replaced the missing data with the mean scores of available data from the remaining sample. The means for the SMFA subcategories did not change when missing data were replaced. Data entries were removed if missing more than two subcategories of the SMFA, or more than one time frame of the UCLA Activity Score. If patients were missing only one UCLA Activity Score time frame, it was replaced with the median score of the available data from the remaining sample. If patients chose more than one answer on the UCLA Activity Score, researchers recorded the higher score.

Data of the SMFA scores showed normal distribution ($p > .05$), which allowed researchers to use parametric tests. Because The UCLA Activity Score data did not meet assumptions for normal distribution, nonparametric tests were used for analysis. At pre-operation, results of independent *t*-tests and independent samples test for nonparametric tests were not significantly different ($p > .05$) when scores of the SMFA and UCLA Activity Score were compared, which allowed researchers to analyze THA and TKA data as a single sample. THA and TKA means and median scores remained the same on the SMFA and UCLA Activity Score respectively, at 1- and 3-month post-operation time frames.

Repeated measures ANOVA for the SMFA showed significant differences ($p < .05$) across means over the separate points in time. Paired t-tests indicated significant improvements for the total SMFA score from pre-operation to 1 month after, and 1 to 3 months post-THA/TKA (Table 2). Table 2 shows the mean differences and significance level for each subcategory on the SMFA at the various time frames.

Figure 1 shows a comparison of the total SMFA and subcategory means and normative data for each time frame. The SMFA total and all subcategory scores at pre-operation showed more disability than the normative value. Improvements in total SMFA, and subcategories of ADL and emotional status achieved statistical similarity with normative values by 3 months; similarity with normative value was reached at 6 months for the mobility subcategory (Table 3). The preoperative score for the arm/hand subcategory was worse than, but not significantly different than, the normative value. The mean score for arm/hand became significantly better than normative data at 1 and 3 months, which indicated reduced disability. Arm/hand mean score indicated a slight increase in disability at 6 months but, though not statistically significant, remained better than the normative value.

Results of a Friedman ANOVA for repeated measures showed significant difference ($p < .05$) in UCLA Activity Score across separate points in time. Follow-up Wilcoxon Signed-Rank test showed significant improvements in scores only for the 1-to-3 month time frame (Table 2). Patients maintained activity levels from pre-operation to 1 month, and made additional improvements 3 to 6 months (Figure 2), though these improvements were not statistically significant ($p > .05$) (Table 2).

## Discussion

Research results in this study reflected patients' progress after PT and OT interventions post-THA/TKA. This interdisciplinary approach, which could influence the outcome scores, is in contrast and contributes to the literature in which researchers have primarily reported outcomes for patients receiving PT (Harding et al., 2014; Heiberg et al., 2013; Huber et al., 2015). The SMFA allowed researchers to address function of operative and nonoperative extremities that contributed to the patients' overall levels of function in daily living (walking, shopping, community mobility, driving, leisure activities, sexual activity, home management, yardwork, work, toileting, dressing, bathing, self-care, and sleeping) impacted by THA or TKA. Use of the SMFA in measuring outcomes for the current study enabled researchers to address a gap in the literature in which most researchers have focused on impairments of the operative extremity or tasks that primarily rely on the operative extremity (George, Hu, & Sloan, 2014; Huber et al., 2015; Stergiou-Kita & Grigorovich, 2014; Umpierres et al., 2014). Use of the UCLA Activity Score allowed researchers to determine change in activity levels between measured time frames (pre-THA/TKA to 1 month post-operation, 1 month to 3 months post-operation, and 3 months to 6 months post-operation), and to determine whether activity levels increased preoperatively to 6 months post-operation.

### SMFA

**Total SMFA.** At pre-operation, the total SMFA score showed a higher level of disability when compared to normative data. This score indicates, but cannot confirm that osteoarthritic conditions resulting in elective, primary THA or TKA could affect operative and non-operative parts of the body, and multiple areas of occupational performance that are reflected by all items of the SMFA.

The total SMFA score at the 1-month time frame showed less disability than pre-operation, but remained significantly worse than normative data. One possible explanation for results of the total SMFA score at 1 month could be patients' restrictions suggested by surgeons. Patients may have just begun, or had not yet started IADL performance and mobility tasks at this time frame, depending on surgeons' orders for duration of restrictions. Limited performance in occupations could have affected the emotional status subcategory mean, in turn contributing to the total SMFA score.

**Mobility.** The average score at pre-operation was significantly worse than the normative value. One explanation for this finding is that patients may have been self-limiting mobility tasks at pre-operation due to pain. The mobility score improved nearly 50 percent from pre-operation to the 3-month time frame, but still remained significantly worse than the normative value. This result could be partly attributed to the time frame for discontinuation of postoperative restrictions for community mobility that were required by surgeons. Only indirect comparisons can be made of the mobility score to others' findings as the items in the SMFA subcategory focus more on quality of mobility than ambulatory speed or distance. Researchers who have reported change in mobility for THA and TKA have used measurements of speed or distance during ambulation, and found mixed results at 1-month, 3-month, 6-month, 12-month, and 2-year time frames (George et al., 2014; Judd et al., 2014a).

**Arm/hand function.** Arm/hand score was worse than normative value preoperatively, but improved to be better than the normative value at 1 month, and remained better through the 6-month time frame. Although Peter et al. (2015), did not specifically use a grind test to confirm that pain in the hand was attributed to OA, they were the only researchers in the reviewed literature that addressed the relationship between upper extremity (elbow and distal joints)

function and THA/TKA. Arm/hand disability could be attributed to overuse of and increased pressure on the hands preoperatively with the use of assistive devices for functional mobility. By 1 month post-operation, improvement in lower extremity joint mobility and pain may have been attributed to less reliance on ambulatory devices and upper extremities for functional mobility due to decreased lower extremity function. This possible explanation could also be applied to 3-month score for the arm/hand function subcategory. Despite a significant improvement in arm/hand function at the 3-month time frame, the average score at the 6-month time frame showed an increase in disability for this subcategory. This trend could be attributed to individuals resuming activities that had ceased because of lower extremity joint pain, and that also required more aggressive use of the arms and hands, such as leisure, sports, or IADL. Researchers in a previous study found similar results (Dale et al., n.d.).

Merritt, Roddey, Costello, and Olson (2010) suggested that outcomes of the grind test of the first CMC joint are influenced by performance of activity prior to test administration. In the current study, OT practitioners administered a grind test during the preoperative evaluation, and these results were used to guide intervention during the postoperative time frame. The grind test was not repeated post-operation. It could be that patients with negative grind tests pre-operation became symptomatic after surgery due to the increased physical demands on the arms and hands with use of mobility devices and functional mobility prior to discharge from the hospital. With no inpatient data, the results may imply that patients' arm and hand function improved continuously from pre-operation to 1-month post-operation. However, data from Dale et al. (n.d.) suggest that arm and hand performance initially decreases after THA and TKA, and then improves by 1 month post-THA/TKA. Results from this study indicate hand function is important in initial and ongoing assessments because it can impact intervention plans. In this

study, 20 percent of patients had a positive grind test at the first CMC joint, which affected postoperative intervention plans. Those with a positive grind test received padding on walker handles post-operation to reduce stress on joints in the hands, as well as education on methods to pursue conservative management of CMC OA through OT services.

**ADL.** Similar to the mobility score, the average ADL subcategory score improved nearly 50 percent from pre-operation to 3 months post-operation. Patients' reasons for lack of ADL performance preoperatively, such as comorbidities and reliance on caregiver, were not provided in the data set. The average ADL score improved between all time frames, with the least amount of change from pre-operation to 1 month. This could be explained by the demands of the activities included in this subcategory (shopping, driving, physical recreation, leisure activities, sexual activity, yard work, and work). Patients received restrictions for physical activities that risked injury or improper healing; restrictions differed among surgeons. These restrictions may have resulted in patients avoiding activities within the 1-month time frame.

The ADL score showed the largest functional improvement at the 3-month time frame when compared to average ADL scores of other measured time frames, and was no longer significantly different than the normative value. It is possible that patients experienced improved ADL function from 1 month to 3 months because restrictions were either reduced or discontinued, and pain levels may have decreased. George et al. (2014) also found that patients who underwent TKA had fewer ADL limitations, better health, and experienced less pain and fewer deficits in physical function than patients who did not undergo TKA. In this study, although functional improvement at the 6-month time frame was not significantly better, similar explanations for decreased disability may apply. The decrease in disability in ADL at 3 months post-operation coincided with improved activity level indicated by the UCLA Activity Score at 3

months post-operation (5.03), which is defined as, “sometimes participate in moderate activities,” (Zahiri et al., 1998, p. 891). Similarly, the decrease in disability at the 6-month time frame in the SMFA (13.53) matched the 6-month activity level in the UCLA Activity Score (6.00), which is defined as, “regularly participate in moderate activities, such as swimming and unlimited housework or shopping,” (Zahiri et al., 1998, p. 891). Naal, Impellizzeri, & Leunig (2009) found that the UCLA Activity Score may be the “most appropriate subjective physical activity assessment” [for patients who have undergone THA or TKA] (p. 958).

**Emotional Status.** Although others have not used the SMFA, researchers have recognized the impact of emotional status and pain for patients who have undergone THA/TKA and found improvement after surgery (George et al., 2014; Harding et al., 2014; Keurentjes et al., 2013; Stergiou-Kita & Grigorovich, 2014). In the current study, the SMFA emotional status score included patient-rated pain, sleep and fatigue levels, concentration, self-limitation, and emotions such as anger and frustration. Comparison of average mobility status scores at 1-, 3-, and 6-month time frames indicated the significant improvement for this subcategory occurred from pre-operation to 1 month. This may indicate that elective, primary THA/TKA can make the largest impact within 1 month after surgery on areas of occupational performance that may be indirectly related to the operative hip or knee. Because the data were given to the researchers in aggregate, it is not possible to know which of the items in this subcategory showed the most improvement. However, with pain as one of the items, it may be that lower levels of pain typically reported after THA/TKA could explain the change in this subcategory. Less pain may have resulted in better quality of sleep, less frustration, and increased participation in meaningful occupations and, therefore, an improvement in overall emotional status. The SMFA emotional status score possibly improved as a result of increased mobility, ADL, and arm and hand

function. Patients' improvement in emotional status could have resulted from an increase in activity level as measured by the UCLA Activity Score, as well as participation in daily occupations measured by the SMFA.

**UCLA Activity Score**

Naal et al. (2009) found that, unlike other assessment tools, the UCLA Activity Score [showed discrimination between] "insufficiently and sufficiently active patients" [who underwent THA or TKA] (p. 958). In this study, researchers found that UCLA Activity Score results showed continuous improvement through the 6-month time frame. Patients may have shown additional increases in activity level after 6 months, however, insufficient data prevented analysis.

The UCLA Activity Score median result did not significantly change from pre-operation to 1 month. This finding was different from Judd et al. (2014a), who found that the UCLA Activity Score significantly decreased from pre-operation to 1 month. Dale et al. (n.d.) found significant improvements in the UCLA Activity Score at this time frame. The results in this study could be partially explained by effective preoperative education and postoperative intervention that prevented a decrease in reported activity levels. These results could also be explained by patients' lower activity levels at pre-operation due to pain or other self-limitations, and continued low levels of activity at 1 month post-operation due to prescribed postoperative restrictions.

The UCLA Activity Score indicates overall activity level of the patient, which may or may not reflect hip or knee OA symptoms. Therefore, postoperative scores could also be explained by patients having a sedentary lifestyle, rather than functional limitations. Of the total sample, 97.9 percent were overweight or obese, with a mean body mass index (BMI) of 32.35

$kg/m^2$. This is a similar finding to Harding et al. (2014), whose patients had an average BMI of 31.10 $kg/m^2$. Both of these BMI means are classified as obese, which could impact one's OA symptoms as well as participation.

Preoperative and 1-month scores showed a median of 4.00, which is defined as "Regularly participate in mild activities, such as walking, limited housework, and limited shopping" (Zahiri, 1998, p. 891). The median score at the 3-month (5.03) to 6-month (6.00) time frame on the UCLA Activity Score showed a continued increase in activity compared to the preoperative score. However, the 6-month time frame only included patients who underwent TKA. This is important for future patients and practitioners to consider because evidence supports that activity levels can improve after THA and TKA. For example, Harding et al. (2014) found that the UCLA Activity Score significantly improved from baseline to 6 months postoperatively for THA and TKA. Andrawis et al. (2015) also found improvements in the UCLA Activity Score from pre-operation to post-operation at 6- and 12-month time frames for THA and TKA.

**Limitations**

The researchers analyzed the data that healthcare providers in the organization were able to collect. The study had a small sample size due to incomplete data in the majority of patient charts. Researchers were informed that reasons for missing data included: outcome tool incompletion, patients not returning for appointments, patients leaving item 22 (sexual activity) of the SMFA unanswered, and inconsistencies in distribution or collection of outcome tool by the hospital staff.

The SMFA scores were calculated and entered into the computer manually; this could have led to human error in reporting scores. Although data were entered by pairs of researchers to reduce chance of human error, the possibility of error remains.

Another limitation is that due to de-identified data, researchers were unaware of how many of the patients had more than one joint replacement. With varying time frames between the replacements, scores may have been influenced by patients still recuperating after one joint replacement at the same time they were undergoing a second replacement.

**Recommendations**

A larger sample of patients who undergo elective, primary THA or TKA is recommended to improve generalizability. Implementation of an electronic method that reduces data input and handling errors, and permits easier access for patients to complete the UCLA Activity Score and SMFA may yield complete data for more patients. An electronic method of data input and calculation would lessen the administrative burden for outcome tool completion and interpretation. Additionally, the sample size of patients who underwent THA only includes the anterior approach. It is recommended for future research to analyze outcomes of patients with anterior and posterior approaches for THA in facilities where both procedures are performed routinely.

It is also recommended for researchers to utilize a longer follow-up time frame in the study design. The UCLA Activity Score and SMFA scores, except for the arm/hand subcategory, showed continued improvement at the 6-month time frame for TKA; gathering data past the 6-month time frame for THA and TKA could show more accurate levels of function and activity post-operation. The retrospective design does not allow researchers to explain why patients improved in the UCLA Activity Score and SMFA scores. Future research could include

established benchmarks found in this study to evaluate interventions and determine reasons for improvements in the UCLA Activity Score and SMFA scores for THA and TKA in this facility.

A grind test of the first CMC joint is recommended for any future study in which post-THA/TKA patient function is measured. Use of mobility devices with, and increased reliance on, arms and hands prior to and after lower extremity joint replacement, may exacerbate CMC OA. Therefore, this test should be performed at more than one time frame to accurately determine if patient activity levels are affected due to increased use of arms and hands, rather than limitations in physical activity being attributed to the operative extremity. Patients who may benefit from conservative management of OA in the hand could be identified and educated in OT services for this condition. A grind test at the first CMC joint has been shown to have high specificity and moderate sensitivity for identifying OA (Merritt et al., 2010).

**Conclusion**

THA and TKA influence multiple areas of occupational performance, as well as non-operative areas of the body. Using outcome measures that reflect many areas of patient function, including occupational performance, emotional status, and QOL, is important for researchers and OT practitioners to consider when assessing the impact THA and TKA have on patients. OT practitioners should be aware of a potential impact on nonoperative areas such as hand function for patients before and after THA and TKA, as OA generally affects multiple areas of the body. Researchers can use the SMFA and UCLA Activity Score to measure outcomes for THA or TKA that address occupational performance beyond lower extremity function.

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Table 1

*Demographic Characteristics*

| Characteristic | M (*n* = 48) | *SD* |
|---|---|---|
| Age | 63.81 | 10.11 |
| BMI | 32.35 | 6.15 |
| **Characteristic** | **Frequency (*n* = 48)** | **%** |
| Sex | | |
| Male | 21 | 43.8 |
| Female | 27 | 56.3 |
| Diagnosis | | |
| THA | 27 | 56.3 |
| TKA | 21 | 43.8 |
| 1st CMC Grind Test | | |
| Both positive | 4 | 8.3 |
| Left positive | 2 | 4.2 |
| Right positive | 4 | 8.3 |
| Both negative | 27 | 56.3 |
| Missing | 11 | 22.9 |
| BMI | | |
| Normal (18.5-29.4 kg) | 1 | 2.1 |
| Overweight (25-29.9 kg) | 18 | 37.5 |
| Obese (30 kg and over) | 29 | 60.4 |

*Note.* BMI = body mass index.

Table 2

*Results*

| Time Frame | Pre-op to 1-month | | 1-month to 3-month | | 3-month to 6-month | |
|---|---|---|---|---|---|---|
| | *M* difference (*SD*) | *p* | *M* difference (*SD*) | *p* | *M* difference (*SD*) | *p* |
| SMFA total | 9.02 (13.35) | .00* | 6.09 (9.61) | .00* | 1.65 (7.75) | .34 |
| Mobility | 18.81(17.78) | .00* | 2.78 (11.27) | .09 | 3.84 (8.81) | .06 |
| Arm/hand | 3.32 (8.11) | .01* | .70 (4.28) | .26 | -3.03 (8.03) | .10 |
| ADL | 1.67 (19.46) | .56 | 14.85 (19.08) | .00* | 2.48 (15.81) | .48 |
| Emotional | 12.69 (15.89) | .00* | 2.49 | .19 | 3.23 | .23 |
| UCLA | .33 | .19 | 1.04 | .00* | .57 | .08 |

* $p < .05$

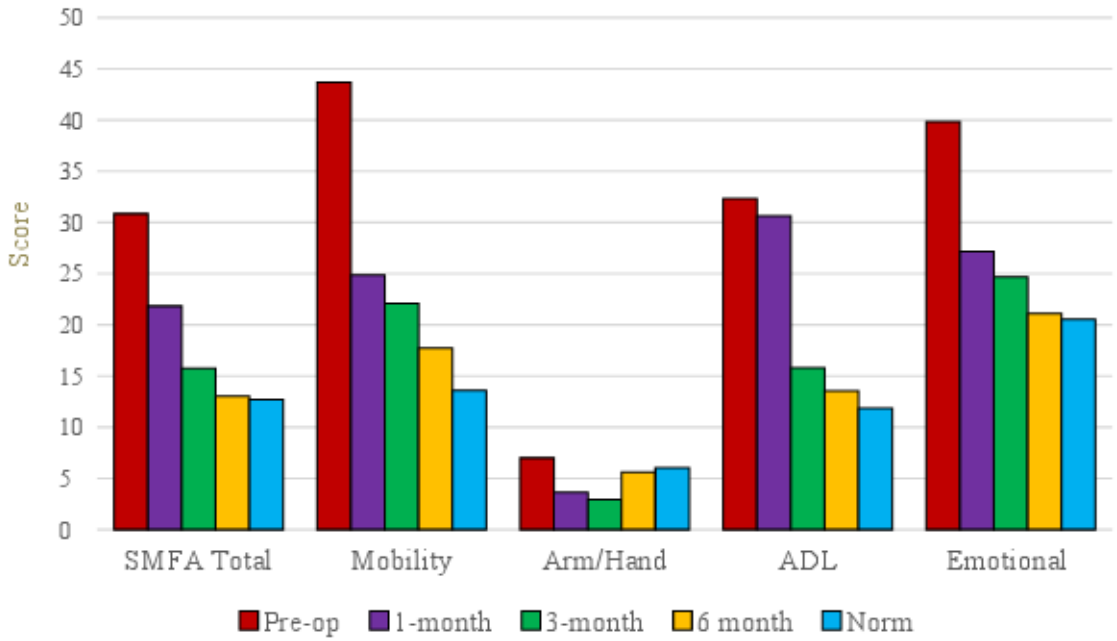


*Figure 1.* SMFA scores compared to established normative values; higher scores reflect greater disability.

Table 3

*SMFA Results Compared to the Normative Values*

| | M ($n$ = 48) | SMFA Normative Values | Significance ($p < .05$) |
|---|---|---|---|
| Total SMFA | | | |
| Pre-op | 30.85 | 12.70 | .00* |
| 1-month | 21.83 | 12.70 | .00* |
| 3-month | 15.74 | 12.70 | .11 |
| 6-month | 13.02 | 12.70 | .91 |
| Mobility | | | |
| Pre-op | 43.69 | 13.61 | .00* |
| 1-month | 24.89 | 13.61 | .00* |
| 3-month | 22.11 | 13.61 | .00* |
| 6-month | 17.73 | 13.61 | .20 |
| Arm/Hand | | | |
| Pre-op | 7.00 | 6.02 | .42 |
| 1-month | 3.65 | 6.02 | .02* |
| 3-month | 2.95 | 6.02 | .00* |
| 6-month | 5.60 | 6.02 | .87 |
| ADL | | | |
| Pre-op | 32.32 | 11.85 | .00* |
| 1-month | 30.65 | 11.85 | .00* |
| 3-month | 15.8 | 11.85 | .17 |
| 6-month | 13.53 | 11.85 | .70 |
| Emotional | | | |
| Pre-op | 39.85 | 20.54 | .00* |
| 1-month | 27.16 | 20.54 | .00* |
| 3-month | 24.67 | 20.54 | .09 |
| 6-month | 21.09 | 20.54 | .88 |

* $p < .05$

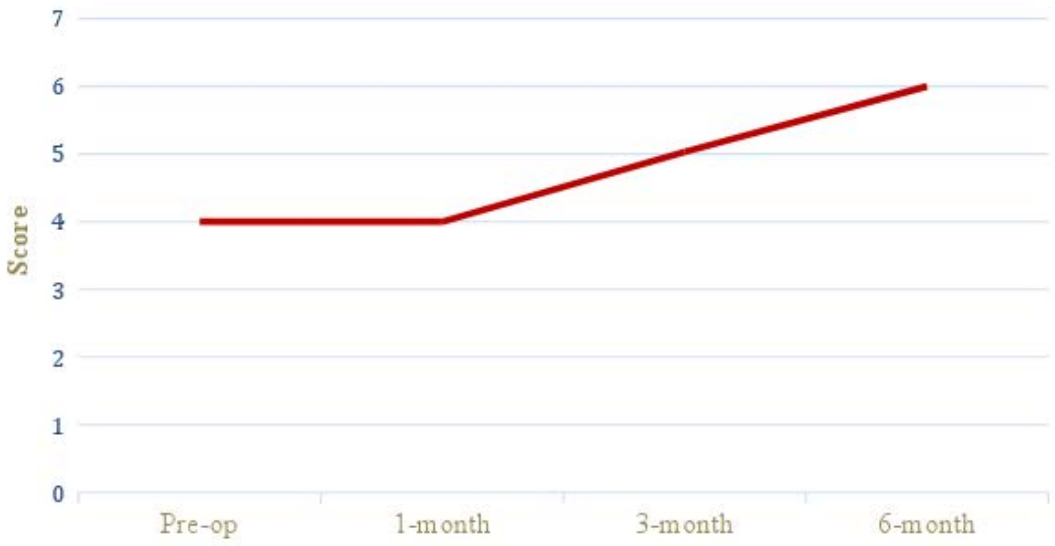


*Figure 2.* Median UCLA scores.