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Use of Patient Reported Outcomes Measurement Information System (PROMIS) and Timed Up and Go (TUG) Test for Patients Pre- and Post- Total Knee Arthroplasty (TKA)

Introduction

Osteoarthritis (OA) is a condition associated with damage to a joint's articular cartilage and leads to changes in underlying bone and joint margins.[1] OA may develop idiopathically, but most likely predisposing factors lead to development of the disease.[1] Metabolic disorders, anatomic derangements, major trauma, and inflammatory disease are well recognized causes of OA.[1] Osteoarthritis is prevalent in the general United States population with evidence suggesting that by 65 years of age almost all people have some OA in the hands and/or feet.[2] In addition, the Framingham Osteoarthritis Study reports that approximately 33% of survey participants between 63 to 93 years old had knee OA.[2] By the year 2020, it is estimated that almost 60 million Americans will be affected by arthritis.[2]

For adults over 50 years old, osteoarthritis (OA) is the leading cause of knee pain, which can limit function, decrease mobility, and reduce quality of life.[3] Approximately 700,000 adults seek surgical management of knee OA by undergoing a total knee arthroplasty (TKA).[4] Though a TKA is costly, surgery is capable of providing an improvement in patients' quality of life, especially if previously physically active with adequate family and social support.[5] Some do experience poor outcomes following a TKA, particularly those that have additional comorbidities or are of an advanced age, but overall there is little information about outcomes to expect in the post-operative period.[4,5] Therefore, it would be beneficial for clinicians to identify a tool that better predicts outcomes following a TKA.

Physical therapists commonly utilize outcome measures to appraise symptoms, track improvements, and assess goal progression. There are multiple patient reported outcome

measures, such as the Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC) and the Knee Society Score (KKS), which can be used to assess patients' subjective knee pain and function.[6] However, many subjective measures have a ceiling effect with pain dominance typically negatively influencing thoughts about functional status.[6] Performance-based outcome measures can capture dimensions of physical function that subjective measures may not. Simple functional outcome measures commonly used by clinicians include the 6 Minute Walk Test (6 MWT), Timed Up and Go (TUG) Test, and the Stair Climbing Test (SCT).[6] However, administering functional outcome measures may be time consuming, limited by patient motivation, and unable to fully capture functional limitations.[6] Determining an appropriate outcome measure that can be used to predict patient function after a TKA would be beneficial for clinicians to establish prognosis, aid with discharge planning, and recognize those at risk for poor outcomes.

Patient-Reported Outcomes Measurement Information System (PROMIS)

PROMIS is a relatively new tool initiated by the US National Institutes of Health.[7] PROMIS uses psychometric techniques to collect precise information with relative brevity from participants' subjective responses.[8] PROMIS utilizes the item response theory to recognize the underlying constructs being measured by each question.[9] A large number of questions are created over an entire range to create an item bank that comprises an underlying construct. Use of the item response theory allows for subsequent questions from the bank to be used to measure a participant on a particular construct's continuum.[9] In addition, by using computerized adaptive testing (CAT), a computer is able to interpret an answer to a question and administer the following question at a higher or lower level to more accurately measure a construct.[9] Through these methods, the PROMIS CAT is able to estimate health-related domains in approximately 4

to 6 questions.[9] Currently, the PROMIS Assessment Center has item banks for more than 44 health related domains.[9] PROMIS addresses several limitations that typical subjective measures present; specifically, the tool is able to capture the entire range of a construct at a greater precision compared to generic measures.[9] Therefore, use of PROMIS in clinical practice and research may be highly applicable with the potential of collecting participant information quickly and accurately.

Broderick et al validated the PROMIS domains of pain intensity, pain interference, fatigue, and physical functioning in people with OA compared to the general population.[8] The study's objective was to examine the known-group validity, ecological validity, and reliability. Known-group validity was operationally defined as a significant difference between groups that are expected to show a difference. Ecological validity was operationally defined as the degree to which patient reported outcome based recall over a period of time corresponded with momentary or daily ratings. Authors confirmed known-group validity with mean pain intensity, pain interference, and fatigue significantly greater ($p<0.001$) in participants with OA compared to the general population.[8] In addition, ecological validity was determined by comparing daily PROMIS short forms to weekly PROMIS CATs over a 4 week period; strong, positive correlations were reported between the PROMIS short forms and CATs.[8] Moreover, authors reported high test-retest reliability with ICC ranging between 0.80-0.95 for the domains examined.[8]

Additionally, Driban et al examined the construct validity and floor/ceiling effects of the PROMIS domains of anxiety, depression, physical function and pain interference in a study population with knee OA.[10] Results demonstrated that the domain of pain interference had a minimal floor effect and demonstrated a strong correlation with the Short Form-36 (SF-36)

bodily pain scale and SF-36 physical component summary; weaker correlations were reported compared to the WOMAC and gait speed.[10] The PROMIS physical function score correlated with the SF-36 physical function component but only had weak correlations to gait speed, 6 MWT, and WOMAC function scores.[10] PROMIS anxiety and depression domains both demonstrated floor effects but did have strong correlations with the SF-36 mental component score.[10] PROMIS is gaining recognition as a plausible tool for use clinically and in research as data about psychometric properties continue to be established. Unfortunately, there is limited evidence currently available to support the use of the PROMIS tool in a patient population with knee OA who are pre- or post-TKA; furthermore, there is no evidence describing the tool's ability to predict functional outcomes following surgery.

Timed Up and Go (TUG) Test

The TUG test is a simple functional outcome measure commonly used in clinical practice to assess mobility, balance, walking ability, and falls risk in older adults.[11] To complete the test, the patient begins in a seated position. On command from the clinician administering the test, the patient stands, walks 10 feet at a comfortable pace, returns to the chair, and sits.[12] The clinician records the time from when the patient rises to when the patient returns to sitting. The TUG test has been validated for use in a patient population of community dwelling older adults and has demonstrated reliability in patients awaiting a TKA.[4,13-15] Moreover, the TUG test is responsive for detection of deterioration and improvement in the early post-operative period.[15]

Normative data has been established for the TUG test and additional literature reports cut-off scores predictive of falls risk in community dwelling older adults. Steffen et al reported that 60-69 year old patients completed the TUG test in a mean time of 8 seconds, 70-79 year old patients completed the test in a mean time of 9 seconds, and 80-89 year old males completed the

test in a mean time of 10 seconds, while females took 11 seconds.[14] Additional literature reported by Shumway-Cook et al determined a cut-off time >13.5 seconds was predictive of increased falls risk in community dwelling older adults. [11]

Similar attempts to determine cut-off times to predict functional outcomes following a TKA have been made. Bade et al (2012) utilized Regression Tree analysis to determine TUG test times that may be used to predict function in patients following a TKA.[16] A TUG test time >10.1 seconds in patients that were >72 years old had the poorest results on the TUG test 6 months after surgery.[6] In addition, Bade et al (2014) further explored the use of the TUG test's ability to predict longer ambulatory distances as measured by the 6 MWT.[4] Bade et al (2014) determined that pre-operative TUG test time was significantly related to distance walked during the 6 MWT at 6 months post-operatively.[2]

Ko et al examined the relationship between the TUG test and 6 MWT compared to longer ambulatory distances in participants 1 year after a TKA.[17] The mobility of 32 TKA recipients were assessed using the TUG test, 6 MWT, and the 30 minute walk test.[17] Authors reported that the 30 minute walk distance correlated strongly with the shorter distance tests with correlation coefficients reported at 0.97 for the 6MWT and -0.82 for the TUG test.[17] However, the 6 MWT was reported to be a better predictor of distance walked during the 30 minute walk test by explaining 96% of the variability in the data.[17]

Zeni et al described the use of functional outcome measures, including the TUG test, for predicting function 1 and 2 years post-TKA.[18] Authors reported that the TUG test explained variability in data following a TKA better than the Knee Outcomes Survey (KOS)-ADLS.[18] This suggests a discrepancy between the ability of self-report measures and functional measures in

assessing function. Additionally, greater quadriceps strength and younger age significantly improved the ability to predict TUG test times 2 years after TKA.[18]

Furthermore, Kennedy et al described predictors of post-operative TKA outcomes using the TUG test.[19] Authors reported that baseline TUG function and gender were predictive of post-surgical function, with women having worse TUG times compared to men.[19] Surprisingly, Kennedy et al reported that the number of participant comorbidities, as well as age were not predictive variables for performance on the TUG test following surgery.[19] Potentially, these results may be explained by the relatively young age of the sample, with 25% of the study population reported as 58 years old or younger. Moreover, Robbins et al reported contradictory results compared to Kennedy et al, finding that older age and increased number of comorbidities were associated with worse TUG test times during the acute period following a TKA.[20]

Implications for Clinical Practice

Physical therapists may utilize this information in clinical practice. The PROMIS tool can be used to quickly and accurately collect patient reported outcomes. In addition, several domains have been validated for use in adults with OA. However, no research describes the use of PROMIS in patients pre- or post- TKA or the ability of the tool to predict post-surgical functional outcomes.

The available research suggests the TUG test has greater use to predict functional mobility following a TKA. By administering the TUG test pre-operatively, therapist may identify those patients at risk for poor outcomes following a TKA. Bade et al (2012) determined those participants completing a TUG test >10.1 seconds and >72 years old have greater risk for poor functional outcomes following surgery.[16] In addition, the TUG test is significantly related to walking distance as measured by the 6 MWT.[4] Though, it is reported the 6 MWT may be a better

test at predicting longer walking distances compared to the TUG test following a TKA.[17] Additionally, females, those with comorbidities, and patients of advanced age have been reported to have poorer outcomes following a TKA.[18-20]

This information may allow therapists to identify those patients that will require more intensive and supervised rehabilitation after a TKA to minimize poor functional outcomes. In addition, it may assist therapists and doctors in an acute care setting with discharge planning following a TKA by identifying patients that might need increased support if returning home or referral to a more supervised rehabilitation setting after discharge from the hospital.

Future Research

Ultimately, the evidence describing the ability of the TUG test and PROMIS tool to predict functional mobility following a TKA is sparse, with no evidence directly comparing the outcome measures. In addition, there is no evidence to describe the ability of the PROMIS tool to predict functional mobility following a TKA. As more PROMIS domains are developed, validity and reliability will need to be established. Therefore, research of high methodological quality, utilizing a large sample size should be conducted to determine the validity of the PROMIS tool in a patient population pre- or post-TKA, as well as the ability of the tool to predict post-surgical outcomes. Furthermore, future research comparing the TUG test and PROMIS would be beneficial to determine an accurate outcome measure which can predict functional mobility following a TKA.

Conclusion

The total number of TKAs performed in the United States annually is steadily increasing as knee OA is becoming more prevalent in an aging population.[3,4] Though surgical interventions are performed regularly, little is known about prognosis, discharge planning, and/or recognizing

people at risk for poor outcomes.[4] Therefore, identifying an outcome measure which has the ability to predict function in patients with OA that opted for a TKA would be useful for therapists, physicians, and surgeons to promote positive patient outcomes.

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