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Review Article

Clinical Application of the Timed Up and Go Test in Total Hip Arthroplasty for Osteoarthritis of the Hip

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ABSTRACT

The Timed Up and Go (TUG) test is a simple, widely used measure of mobility that has proven reliability in patients undergoing Total Hip Arthroplasty (THA) for osteoarthritis. This test is valuable for assessing physical function from the early postoperative period through long-term follow-up. Various studies show that TUG performance is influenced by factors such as age, body mass index, hip muscle volume and quality, phase angle, and cognitive function. On the other hand, factors like hemoglobin levels, surgical approach, and femoral stem design generally do not affect TUG results. Several interventions have been shown to improve TUG outcomes, including hip external rotator strengthening, telerehabilitation, imagery-based training, and enhanced recovery after surgery protocols. Conversely, interventions such as leg length correction, fascial manipulation, nutritional supplementation, and certain assistive devices have limited impact. Importantly, TUG has prognostic value as it can predict early hospital discharge, delayed functional recovery, long-term muscle deficits, and the ability to return to driving. These findings highlight the test's relevance beyond simple mobility assessment, extending to activities of daily living and social participation. In conclusion, the TUG test is a versatile and reliable tool that can guide postoperative rehabilitation and evaluate the effectiveness of interventions, with comprehensive assessment including muscle strength, muscle quality, and cognitive status optimizing patient recovery after THA.

Keywords: Total hip arthroplasty; Osteoarthritis; Timed up and go test; Clinical application

INTRODUCTION

Total Hip Arthroplasty (THA) is performed for hip osteoarthritis; however, in some cases, gait improvement during hospitalization is poor. According to the 2022 statistics in Japan, more than 80,000 patients undergo THA annually [1]. Functional recovery is a crucial priority for patients undergoing THA and an important expectation [2-4]. Unfortunately, long-term reports indicate that 14-22 % of patients experience limitations in gait ability and other physical activities or do not see clinically meaningful functional improvements [5-7].

Generally, the hospitalization period after THA is a few days in Western countries and approximately 1-2 weeks in Japan. In Japan, the trend toward shorter hospital stays is influenced by medical reimbursement considerations. Early recovery of gait ability is essential for safe discharge and return to daily life. Additionally, improvements in the minimally invasive nature of the surgery can contribute to safer and earlier discharge. Gait ability temporarily declines immediately after surgery but generally recovers to preoperative levels within 2 weeks post-surgery in patients who undergo THA [8]. However, in certain cases patients cannot walk independently within 1-2 weeks post-THA during hospitalization.

The Timed Up and Go (TUG) test is widely used as a method for assessing functional walking ability [9]. The TUG is a generalized evaluation parameter for fall assessment and gait independence; it is also utilized in the field of public health for fall assessment [10].

If the association between the TUG test, which can be performed easily, and clinical parameters becomes clear, it may help guide accurate rehabilitation approaches in a short period of time. Therefore, we conducted a literature review on the relationship between the TUG test and clinical parameters in THA for osteoarthritis.

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Association between timed up and go test and clinical parameters in total hip arthroplasty

A literature search was conducted using PubMed (MEDLINE). The search terms used were 'total hip arthroplasty' and 'Timed Up and Go Test'. This search yielded a total of 137 articles. These articles were then screened and reviewed to examine the relationship between the Timed Up and Go Test and clinical parameters in the context of total hip arthroplasty for osteoarthritis.

Search strategy

The Cochrane Library and Medline were searched to identify pertinent studies published in English from 2015 to 2025. The following search strategy was used to maximize search specificity and sensitivity: 'total hip arthroplasty' and 'Timed Up and Go Test' were used as keywords. Since some of these terms are not MeSH terms, text word searches were conducted. In addition, part of the literatures was manually retrieved. After removing duplicates, the author independently screened all titles, abstracts, and full text of potentially eligible studies.

Measurement and evaluation methods of the Timed Up and Go (TUG) test

TUG was measured in patients on postoperative day 2 following THA, and evaluated using the Intraclass Correlation Coefficient (ICC: 2.1) and the Minimal Detectable Change at 95% confidence (MDC95). A comparison of TUG measurements indoors and outdoors showed high reliability: ICC was 0.92 and MDC95 was 2.5 seconds indoors, and ICC was 0.93 and MDC95 was 2.4 seconds outdoors. No significant differences were observed between indoor and outdoor measurements [11].

In patients more than 3 months post-THA, TUG was assessed through both in-person observation and video analysis to evaluate its reliability and agreement. The TUG test results demonstrated a high level of reliability between in-person and video-based assessments, with ICCs ranging from 0.992 to 0.997. The Bland-Altman plots revealed that video measurements were slightly higher than in-person ones, with mean differences of -0.41 ± 0.11 seconds ($p<0.001$) and -0.31 ± 0.12 seconds ($p=0.015$) for comparisons between in-person and video Observer 1, and in-person and video Observer 2, respectively. Despite the observed difference, the variation between the two video observers was not statistically significant ($p=0.229$) [12].

Factors related to the TUG test

Age: In female patients within two weeks post-THA, participants were divided into two groups based on TUG times: less than 12 seconds and 12 seconds or more. The TUG <12 s group was significantly younger (64.3 ± 8.9 years) compared to the TUG ≥ 12 s group (68.0 ± 10.0 years) [13]. On the other hand, in male and female patients during the acute postoperative phase (3 weeks post-THA), multiple regression analysis revealed that age at the time of hospital admission was independently associated with TUG performance in patients who underwent total hip arthroplasty ($\beta=-0.264$, $p=0.009$) [14].

Body Mass Index (BMI): In female patients within two weeks post-THA, participants were divided into two groups based on TUG times: less than 12 seconds and 12 seconds or more. The TUG <12 s group had a significantly lower BMI compared to the TUG ≥ 12 s group (22.7 kg/m^2 [IQR 20.8, 26.0] *vs.* 24.8 kg/m^2 [IQR 22.2, 27.2]) [13].

Muscle strength (Gluteal muscles): In male and female patients three weeks after THA, the relationship between TUG performance and preoperative Computed Tomography (CT) imaging was examined. Six muscles were analyzed: the gluteus maximus, gluteus medius and minimus, iliopsoas, hip adductors, quadriceps, and hamstrings. TUG scores showed a significant association with the muscle volume of the gluteus maximus and the muscle quality of the gluteus medius and minimus on the operated side [15].

Phase angle: In patients with osteoarthritis of the hip scheduled for THA, the preoperative phase angle measured using bioelectrical impedance analysis and the TUG test were evaluated. Using partial correlation coefficients with age as a control variable, a significant association was found between the phase angle of the lower limb on the affected side and TUG performance ($r=-0.265$) [16].

Cognitive function: In male and female patients undergoing THA with Mini-Mental State Examination (MMSE) scores >23.9, evaluations were conducted preoperatively, at the start of rehabilitation, and at its completion. Higher preoperative cognitive function was associated with better postoperative recovery of TUG performance [17].

Hemoglobin levels: In male and female patients within two weeks after discharge following THA, preoperative and postoperative hemoglobin levels, as well as the amount of hemoglobin reduction, were evaluated in relation to TUG performance. Hemoglobin levels were not correlated with TUG scores [18].

Surgical approach: In male and female patients undergoing THA, TUG results were compared between anterior and posterior approaches at preoperative, 3-month, and 12-month postoperative time points. No statistically significant differences were found based on surgical approach [19]. In male and female THA patients at postoperative day 100, TUG scores were compared between the supercapsular percutaneously assisted total hip (superpath) approach and the posterior approach, with no significant differences observed [20]. In male and female patients who underwent THA *via* either the Direct Superior Approach (DSA) or Posterolateral Approach (PL), TUG was assessed preoperatively, and at 1 and 3 months postoperatively. In the DSA group, TUG scores significantly improved at 3 months compared to both 1 month and preoperative values (both $p=0.009$). In the PL group, no statistically significant changes in TUG scores were observed [21]. In male and female patients 1 year after THA, TUG scores were compared between the Direct Anterior (DA) and Direct Lateral (DL) approaches, and no significant differences were found [22]. In male and female patients on postoperative days 3 and 6, TUG was compared between the Direct Anterior Approach (DA) and the Postero-Lateral (PL) approach. On postoperative day 3, the DA group had significantly lower TUG scores; however, by day 6, there was no significant difference [23].

Femoral stem: In male and female patients undergoing THA at an average of 23 days postoperatively, Femoral Offset-both

Vertical (VFO) and Horizontal (HFO) was examined. A moderate negative correlation was found between the difference in VFO between the operated and non-operated sides and the TUG test (r=-0.570) [24]. In a study on femoral stem collars involving male and female THA patients, evaluations were conducted on the day of surgery and at 2, 4, 6, 12, 26, and 52 weeks postoperatively. Regarding changes in TUG test time, no significant differences were observed at any time point between the collar-on and collar-off stem groups [25]. TUG was also compared between short and conventional stem lengths in male and female patients at 3 months and 2 years post-THA. No differences in TUG were found at either time point [26].

Self-reported measures: In male and female patients who were at least 6 months postoperative following THA (median time since surgery: 4 years [range: 6 months-10 years]), the relationships between the Harris Hip Score (HHS), SF-36 subscales, and TUG were investigated. Both the HHS and SF-36 subscales were found to be associated with TUG [27].

Length of hospital stay: A total of 120 patients undergoing THA were prospectively recruited and analyzed according to surgical approach (anterior, posterior, and lateral). The TUG test was performed preoperatively to evaluate whether it could predict the length of hospital stay. The TUG test was a significant predictor of hospital stays exceeding 48 hours. For every 5-second increase in TUG time, the likelihood of hospitalization longer than 48 hours approximately doubled (Odds Ratio [OR]=2.02, 95% Confidence Interval [CI]=1.02–4.01, P=0.043) [28].

Intervention studies

Approach to leg length discrepancy: Baseline measurements were taken 1 week after surgery, and second measurements were taken 3 weeks after surgery at discharge. Patients who underwent THA (both male and female) were divided into three groups: A two-week exercise therapy group aimed at improving hip contracture and lumbar scoliosis, a group using insole-type heel lifts to correct functional leg length discrepancy, and a control group receiving standard postoperative care including conventional rehabilitation after THA. No significant differences in TUG were observed among the three groups [29].

Hip external rotator muscle training: In the acute postoperative phase following THA, patients were assigned to either an exercise group (hip external rotator training) or a control group, and TUG was evaluated. Both hip abductor strength (effect size=0.60) and the TUG test (effect size=-0.53) in the exercise group showed significant improvement after the intervention [30].

Fascial manipulation: For patients who underwent THA within 10 days postoperatively, TUG was evaluated four times up to postoperative day 10 in both the intervention group (fascial manipulation) and the control group. No significant differences in TUG were observed at any of the time points [31].

Telerehabilitation: The intervention group participated in a 12-week home rehabilitation program using a tablet with video-guided instructions and received remote coaching. Participants were instructed to perform strength and gait training at least five days per week. Data from the intervention group were compared with those of a control group that received standard care. TUG was evaluated at four time points: preoperatively, and at 4 weeks, 12 weeks, and 6 months postoperatively. The intervention group showed significant improvements in TUG at all three postoperative time points [32].

Dual task: Participants were randomly assigned to either the Control Group (CG) or the Intervention Group (IG). The CG received standard postoperative rehabilitation for 8 weeks, while the IG underwent the same program along with an additional 8-week dual-task training. TUG was evaluated at 6 weeks postoperatively and 2 months after the initial assessment. No significant differences were found between the groups [33].

Progressive rehabilitation: Participants were allocated to either a control group or an experimental group. The experimental intervention included a limited number of supervised sessions during the early postoperative period (0-12 weeks), followed by progressively advanced activity retraining under supervision during the late phase (12-16 weeks). At 16 weeks postoperatively, no significant difference in TUG was observed between the groups [34].

Antigravity treadmill and electrotherapy: The conventional group received training based on a standard rehabilitation protocol, while the hybrid group received the same training in addition to sessions using an antigravity treadmill and a low-frequency electrotherapy device. TUG was assessed at 2 weeks postoperatively in patients who underwent THA. No significant differences in TUG were observed between the two groups [35].

Digital assistance: The study evaluated early outcomes of using a smartphone-based exercise and educational care management system after THA, focusing on TUG performance during in-person physical therapy. The mean TUG time was 11.8 seconds (SD 5.1) in the control group and 11.9 seconds (SD 5.0) in the intervention group, showing no statistically significant difference [36].

Outpatient and unsupervised rehabilitation: The supervised group participated in a four-week outpatient rehabilitation program under the guidance of a physical therapist. The unsupervised group was provided with written instructions and illustrations to perform rehabilitation exercises independently at home. No significant differences in TUG were observed between the two groups [37].

Nutrition and Vitamin D: Based on an early recovery program, patients undergoing THA were assigned to either an intervention group (exercise therapy+nutritional supplementation) or a control group (exercise therapy only). The intervention group received daily protein and vitamin D supplements for a total of 12 weeks-starting four weeks before surgery and continuing for eight weeks postoperatively. No significant differences in TUG were found between the groups [38]. Regarding Vitamin D status, patients up to six weeks post-THA were categorized into three groups: deficient, insufficient, and sufficient. No significant differences in TUG were found among the three groups [39].

Motor imagery training: Patients scheduled for THA were randomly assigned to either an intervention group which underwent two 12-minute sessions of “action observation” and “motor imagery” on the day before surgery or a control group, which received standard preoperative education only. TUG was assessed on the day before surgery and on postoperative day 4.

On day 4, the intervention group showed significantly better TUG results [40].

In another study, patients undergoing THA were assigned to an intervention group that combined action observation and motor imagery of gait (30 minutes per day during hospitalization, followed by three sessions per week at home for two months), or a control group. TUG was evaluated two months postoperatively, and the intervention group showed significantly better outcomes [41].

Pharmacological interventions: Patients undergoing THA were randomized in a single-blind trial into an ERAS (Enhanced Recovery After Surgery) group and a conventional care group. The ERAS group received multidisciplinary education and preoperative crutch-walking training, along with postoperative pain relief and sedation management using medications. Compared to the conventional group, the ERAS group demonstrated significantly lower TUG times up to postoperative day 6 [42].

In another study, patients were assigned to an intervention group receiving tranexamic acid (a hemostatic agent) or a control group. TUG was evaluated at postoperative day 1, day 3, and at 2 weeks. No significant differences in TUG were observed between the groups at any of the time points [43].

Imagery training: Patients scheduled to undergo THA were assigned to either an intervention group, which received two 12-minute sessions of "action observation" and "motor imagery" on the day before surgery, or a control group, which received only standard preoperative education. The TUG test was assessed on the day before surgery and on postoperative day 4, and the intervention group showed significantly better performance on postoperative day 4 [40]. In another study, patients were assigned to either an intervention group, which combined action observation and motor imagery of gait (30 minutes per day during hospitalization, followed by three sessions per week at home for two months), or a control group. At two months postoperatively, TUG performance was significantly better in the intervention group [41].

Pharmacological interventions: Patients undergoing THA were randomly assigned in a single-blind manner to either an Enhanced Recovery After Surgery (ERAS) group or a conventional care group. The ERAS group received preoperative multidisciplinary lectures and crutch walking training, as well as postoperative analgesia and sedation. Compared with the conventional group, the ERAS group had significantly lower TUG scores up to postoperative day 6 [42]. In another study, patients undergoing THA were assigned to either a tranexamic acid intervention group or a control group, and TUG was evaluated on postoperative day 1, day 3 and at 2 weeks. No significant differences in TUG performance were observed between the groups at any time point [43].

Prognostic value

Prediction of early discharge: In a univariate regression analysis comparing patients discharged within 24 hours and those discharged after 24 hours, lower TUG scores (10.7 *vs.* 13.7 seconds, respectively) were associated with discharge within 24 hours [44]. To predict short-stay THA (defined as discharge within 36 hours), a logistic regression analysis was conducted to evaluate the predictive value of preoperative variables, including the TUG test as a measure of physical function. Patients with a preoperative TUG time of less than 9.7 seconds had an odds ratio of 4.01 (95% CI: 3.19-5.05) for discharge within 36 hours [45]. Similarly, another regression analysis targeting patients scheduled for THA defined delayed recovery as requiring more than 3 days to achieve independent ambulation. Among the strongest predictors of delayed recovery was a TUG time greater than 10.5 seconds [46].

Mid-term: A study investigated the relationship between the composition of the ipsilateral hip abductor muscles preoperatively and gait function at 6 months after THA. Faster gait speed and shorter TUG times were associated with smaller cross-sectional areas of low-density lean tissue or Intramuscular Adipose Tissue (IMAT) within the gluteus medius and gluteus minimus muscles, as well as lower ratios of low-density lean tissue area to total muscle area in these muscles. Furthermore, faster gait speed and shorter TUG times were correlated with larger cross-sectional areas of lean muscle mass in the gluteus maximus, higher ratios of lean muscle mass area to total muscle area, and lower ratios of IMAT or intramuscular adipose tissue area to total gluteus maximus area [47].

Long-term: In a study of male and female patients undergoing THA, participants were categorized into a "fast" group (TUG < 10 seconds) and a "slow" group (TUG ≥ 10 seconds) based on TUG performance at 1 year postoperatively. Comparisons were made regarding body mass index, muscle volume and CT attenuation values of the iliopsoas and gluteus medius muscles on CT images, as well as hip flexor and abductor muscle strength both pre and post-operatively. Nominal logistic regression analysis revealed that older age and lower preoperative abductor muscle strength on the non-operated side were significant predictors of a TUG time ≥ 10 seconds at 1 year post-THA [48]. In another study targeting female patients who underwent THA, hip abductor muscle strength on both the operated and non-operated sides was assessed 3 years postoperatively. The Timed Up and Go test showed a moderate correlation with the muscle strength deficit, and the association was statistically significant [49].

Driving: In a study of male and female patients 6 weeks after THA, the following factors were assessed: whether patients had resumed driving, TUG test performance, self-reported walking duration, use of walking aids, and pain levels. TUG times were significantly faster in the group that had resumed driving compared to the non-driving group (9.51 seconds *vs.* 11.98 seconds, P<001). Predictors of inability to resume driving included the use of two crutches and poorer TUG performance [50].

DISCUSSION

This review summarized previous studies on the TUG test in patients undergoing THA, focusing on its measurement, influencing factors, intervention effects, and prognostic value. The TUG test has shown high reliability from the early postoperative period to the long term, with excellent agreement between in-person and video assessments. Performance is affected by factors such as age, BMI, hip muscle volume and quality, phase angle, and cognitive function, while hemoglobin levels, surgical approach, and femoral stem design generally have little impact. Interventions like hip external rotator training,

telerehabilitation, imagery training, and ERAS protocols have demonstrated benefits, whereas leg length correction, fascial manipulation, nutritional support, and certain assistive devices have shown limited effects. TUG can predict early discharge, delayed recovery, and long-term declines in muscle strength and quality, and it is also associated with resumption of driving, reflecting its utility for assessing ADL and social participation. However, interpretation of intervention effects should consider sex differences in muscle strength and variations in rehabilitation engagement due to healthcare system differences.

CONCLUSION

The TUG test is a highly reliable outcome measure for postoperative physical function and is associated with a variety of factors. Beyond merely assessing mobility, it holds multifaceted clinical utility for predicting postoperative recovery, intervention effects, discharge readiness, and social participation. In particular, comprehensively evaluating complex factors such as hip muscle strength and quality, as well as cognitive function, may contribute to the development of more precise rehabilitation strategies.

CONFLICT OF INTEREST

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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