Journal of Research and Practice on the Musculoskeletal System
JRPMS

Review Article

Timed Up and Go Test in Musculoskeletal Conditions

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Abstract

This paper discusses the wide use of the Timed Up and Go test and its variations by physicians and rehabilitation specialists around the world, in order to assess motor skills, balance, strength and gait speed of patients with orthopedic conditions, which vary from osteoporosis to amputation. Its very few limitations, linked mainly with the cognitive level of the patients, its simple performance and its being a positive predictor for falls, render it the tool of choice for medical practitioners in rehabilitation. Predicting risk of falls is its greatest asset, as a person's difficulty in mobilization can lead to serious injuries, mainly owing to falls, and subsequent reduced quality of life.

Keywords: Balance, Injury, Gait, Risk of falls, TUG

Introduction

The Timed Up and Go test (TUG) is an easy and quick test, requiring basic household equipment, and is widely used to assess the physical ability of elderly individuals with regard to mobility, motor skills- including dynamic balance- when combined with other assessment tools, and fall risk. Its prognostic value is of particular importance given that falls are by far the primary cause of injury in elderly people[1]. Its easy and quick performance made it the assessment tool of choice in various studies of orthopedic conditions[2-7], Parkinson's disease[8], post – stroke patients and amputees[9,10]. Due to its simple administration, sensitivity to therapeutic interventions, as well as fall risk prediction, the TUG is highly recommended by both the American and British Geriatrics Societies[11].

Types of TUG

The TUG and its variations are simple tests used mainly to identify individuals who are at a risk for serious injuries, as a consequence of poor balance and subsequent falls. The general scope of the test is to determine whether a person can stand up from a chair, following a verbal instruction, walk to a line drawn on the floor three meters away from the chair, then turn around and return safely to the chair to conclude the test by sitting down again. It was described as such by Podsialdlo and Richardson in 1991, who added the time variable to the already established Get Up and Go Test[12].

The expected time of concluding the test varies depending on the age of the individuals that participate. A meta-analysis, in 2006, allowed for a classification of data on a normative reference level, in three rather homogeneous age groups. The first group, aged 60-69 had a mean time of 8.1 seconds (7.1-9.0), the second group of 70-79 years had a mean of 9.2 seconds (8.2- 10.2) and the third group of 80-99 years had a mean time of 11.3 seconds (10.0-12.7)[13].

Its performance does not require formal training and patients are allowed to use their usual assistive devices for walking, given that it has to be performed without the active assistance of another individual. It has a limitation though, because the ability to follow simple instructions is a prerequisite. In the TUG- Cognitive individuals are asked to complete the test whilst counting backwards by threes, starting from any given number between 20 and 100, or alternatively reciting the letters of the alphabet omitting one (a-c-e-g etc.)[14].

The authors have no conflict of interest.

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Edited by: *Konstantinos Stathopoulos*

Accepted *4 November 2025*

In the TUG- Manual, the individual is instructed to either walk holding a cup of water or a tumbler of water which they grasp from a table by the chair after they stand up[15,16].

The prognostic validity of the TUG

The addition of the time variable rendered the test a very useful assessment tool, especially in combination with other tests administered to orthopedic patients, such as gait speed/ time[17,18] and the Berg Balance Scale (BBS)[16]. It has been noted for its ability to point out patients at high risk of falls and mortality[19]. According to a study, falls are responsible for 40% of all deaths caused by injury and they can lead to 20-30% of injuries that can vary from mild cases of soft tissue lacerations to severe cases of fractures[20].

In a research conducted by Hofheinz et al, the TUG has been proven to have an excellent test-retest reliability in community-dwelling elderly, scoring *r* T1-T2=0.98 and *r* T1-T3=0.98, as well as an excellent correlation with the equally simple Berg Balance Scale (*r*=-0.66). The study cohort consisted of 120 community- dwelling elders[16]. Another study by Shumway- Cook on two equally numbered groups of fallers and non-fallers, proved the TUG to have high specificity (93.3%) for predicting non- fallers, as well as a high sensitivity (80%) in predicting falls[15]. Maranhao et al, also concluded that the TUG- Cognitive has a positive predictive value for falls in elderly Parkinson's patients, measuring a staggering 71%, while the simpler version of TUG motor test scored 42%[14]. Another study, however, after measuring the times achieved by 265 participants for a follow-up period of 12 months, found that multiple fallers took longer to complete the TUG (10.3 ± 1.9s) compared to non- fallers (9.5 ± 1.7s). What is of particular interest in this study is the fact that both the BBS and the Dynamic Gait Index (DGI), also tested at the same period of time, resulted in scores not significantly related to falls ($p > 0.05$)[11].

A meta- analysis conducted in 2014, which used QUADAS-2 tool to assess the quality and diagnostic accuracy of assessment tools, included 25 separate studies. It defined 13.5 seconds as a time threshold to classify individuals who took longer than that as a higher risk of falling population and being at a higher risk of injury or even death because of the inflicted injury. The same meta-analysis argued that the TUG is a more useful tool to "rule in" a certain population by classifying patients who took longer than 13.5 seconds to complete the test as being of high risk of falling, than for "ruling out" falls altogether for those who completed the test in 13.5s or less[21]. In addition, there has been reports suggesting that when performed by elders with high level of functionality, the TUG will not provide safe results when it comes to risk of falls[22].

However, TUG's qualitative characteristics, as described above, can provide additional information on the patient, as cognitive function is combined with motor skills when an individual is undergoing his ADL routine, where gait speed is not the most significant factor. Viccaro et al, suggested that the TUG can indeed provide a clinical insight, as injuries usually occur in an everyday routine context, or in a well-known environment[23].

However, regarding Parkinson's Disease patients and the TUG- Cognitive, it has been shown that changes in gait occur in dual task conditions. Those changes tend to be proportional to the complexity of the secondary instruction given to them to perform while walking[8].

The TUG as an assessment, predictive and intervention tool in orthopedic patients

Knee Osteoarthritis

From the point of view of rehabilitation specialists, the steps involved in the TUG- standing up, walking safely to a given point in the room and then returning to the seat- are all part of the therapeutic goals a therapist wants to achieve with targeted intervention, when tacjling physical inhibition.It is well established that poor balance can lead to an increased risk of falling because of the restrains in normal movement. Movement is inhibited even more in the presence of a bone, joint or muscle disease that leads to physical impairment, as in the case of osteoarthritis (OA). This condition causes articular cartilage destruction, which leads to pain and discomfort, and it subsequently changes the gait motif of the weight- bearing joints. Eftekharsadat et al, studied the efficacy of a therapeutic program given to patients with knee osteoarthritis, based on action potential simulation and interferential therapy approaches. TUG was used to measure improvements achieved in a simple yet sufficient way[2].

Arthroplasty

Furthermore, the TUG can be used to assess the therapeutic regimes, and the progress achieved through them, regarding the functional recovery of patients immediately after arthroplasty. A study in 2016, showcased that the TUG, along with Iowa Level of Assistance Scale (ILAS), proved to have the best clinimetric properties for assessing functional rehabilitation after lower limb arthroplasty[3]. Tatsuya et al. designed a rather elegant approach on three groups, one given specific exercise approach (SEA), another practicing modifiable heel lift (MHL) and a third control group, all measured by the TUG, shortly after surgery and after three weeks. Results concluded that both SEA and MHL regimes improved functional leg length discrepancy (LLD)- a decisive factor of dynamic balance, as well as less pain and lower time scores to complete the TUG[4].

Lower limb fractures

Another case of gait impairment that needs to be addressed by rehabilitation specialists is the occurrence of fractures. As it was mentioned above, falls are a leading cause of serious injury in the geriatric population. Any physical impairment in the elderly, if not addressed properly and in a timely manner, may lead to permanent disability. Assessment of postoperative function of the lower limb is

critical, as showcased by Nygard et al[5]. The only reference tool they used was the TUG in order to specify whether it can be useful to predict the walking ability of patients who underwent surgery due to hip fracture. They concluded that the TUG can not be used to assign patients to different levels of rehabilitation but it can predict the level of physical function a person can achieve in relation to the scores they measured shortly after the operation (high physical function a year after the surgery was associated with a score of 60 seconds or less)[5].

Osteoporosis

The predictive ability of the TUG in the case of osteoporosis was used in a study that aimed to prove the link between bone mineral density (BMD), the risk of falls and subsequent fractures in the peripheral skeleton and the physical performance of a cohort of 484 healthy women. The team concluded that low BMD is associated with low physical performance in postmenopausal women, thus raising the risk of falls and fractures. In this case of healthy subjects, a combination of improvement of BMD and "weight bearing" exercises, proved to improve the time of TUG significantly and lower the risk of falls and injuries[6].

Sarcopenia

Severe injuries can lead to long hospitalization. One of the issues that occur in those cases is sarcopenia. Although not a life-threatening disorder, sarcopenia is a cause of strength and balance loss. A study used the TUG to predict sarcopenia in elderly hospitalized patients, measuring the time scored on the first and on the fifth day of hospitalization. Results showed that the test is accurate in predicting sarcopenia in patients at risk[7].

Lower limb amputations

As it was shown, the TUG can be used in a rather large variety of orthopedic conditions, keeping its predictive properties regardless the pathophysiology. One last category of orthopedic patients, discussed in the present paper, is that of amputees. Amputation of the lower limb leads, almost without escape, to serious alteration in the proprioceptive feedback, a change in biomechanics of the whole body due to the loss of significant amount of weight, often on one side alone, and as such it requires a lot of time in rehabilitation, not only to adjust to the prosthesis, but also to avoid atrophy and reduced ADL. Gait asymmetry must be prevented at all costs, since with an altered proprioceptive feedback, the reaction time to loss of balance increases and falls that were previously avoided, after amputation become almost inevitable[10]. For that reason, a study evaluated the efficacy of hip abductor strength training 2 times/week with the sole purpose of improvingthe TUG score after 8 weeks of rehabilitation, in 17 patients with unilateral transfemoral amputation[9]. The study proved that along with the biomechanical gait properties, confidence balance and self- perception also improved, as the TUG itself was set as a rehabilitation goal for patients, which was easy to understand.

Conclusions

The TUG is an easy, inexpensive and efficient tool both for assessment and prediction of the risk of falls and subsequent severe injuries and reduced quality of living due to mobility restrictions. Its excellent test-retest reliability and excellent correlation to Berg Balance Scale, paired with its positive predictive value regarding falls, render it a very useful tool for medical practitioners. The goal to complete the test safely under a specific time can also act as a positive motivation in people who have undergone orthopedic surgery, as it could easily be part of their ADLs.

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