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CLINICAL REPORT

The timed get-up-and-go test revisited: Measurement of the component tasks

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Abstract—The "Timed Get-up-and-Go" (TGUG) test measures the overall time to complete a series of functionally important tasks. In the "Expanded Timed Get-up-and-Go" (ETGUG) test, times for the component tasks are measured using a multimemory stopwatch. Results from the ETGUG test were compared to those from the TGUG test on three groups of subjects: nonimpaired young, nonimpaired elderly, and elderly subjects at risk of falling. Significant differences were found between the two control groups and the at-risk group for all components of the test. Walking speed was the only measurement found to be significantly different between the young and elderly controls. The ETGUG test is a sensitive and objective assessment of function that requires minimal equipment, training, or expense. It better isolates functional deficits, thereby aiding the clinician in devising prevention strategies and guiding both treatment and further testing.

Key words: *assessment, gait, kinematics, measurement, timing.*

INTRODUCTION

A number of screening tools have been developed to identify persons with balance deficits. Many were designed primarily to identify elderly patients at risk of falling. One such instrument is the "Get-up-and-Go" (GUG) test that has the subject rise from a chair, walk 3 m, turn around, return to the chair, and sit down (1). Performance is graded on a 5-point scale in which 1 is normal and 5 severely abnormal. To overcome the subjectivity involved in administering such a scale, the test was later modified to include the time taken to complete the test: the "Timed Get-up-and-Go" (TGUG) test (2). It has been found that a sample of adults without balance problems could complete this test in under 10 s, whereas a sample of those dependent in most activities of daily living and mobility skills, according to the Barthel Index, took more than 30 s (3). However, a recent study has shown that the time taken to complete the task varies with the use of an assistive device and concludes that clinicians should not compare test times if the device is changed (4). Nonetheless, the TGUG does appear to be capable of distinguishing elderly persons who have balance problems from those who do not, based on the objective measure of time taken to complete the task.

A major feature of the test is that it incorporates a series of tasks: standing up from a seated position, walking, turning, stopping, and sitting down, all of which are critical for independent mobility. However, by only measuring the time to complete the entire series of tasks, the problems a subject may be having with any particular one of them may be masked. If one could measure the times for each of the tasks separately, then the test would provide useful clinical information: it would better isolate the areas of functional deficit, thereby aiding the clinician in devising prevention strategies and in guiding both treatment and further testing. For example, a finding that a patient was taking excessive time to rise from a sitting position but walked well would help the clinician focus initial treatment.

It has been shown that a multimemory stopwatch can be used to measure the temporal gait parameters (5). The key feature of this instrument, designed primarily for sports

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use, is that it can measure not only the total time to complete a task, but also the time intervals for components within that task. Thus, if an athlete were running 1,500 meters, the watch could be used to time each lap run, as well as the overall time to complete the distance. It is this piece of technology that is the basis of the "Expanded Timed Get-up-and-Go" (ETGUG) test here being proposed as a more sensitive and clinically useful test of mobility in the elderly. This pilot study compares the results from the ETGUG test to those obtained from the TGUG test on three groups: nonimpaired young, nonimpaired elderly, and elderly subjects identified as being at risk of falling.

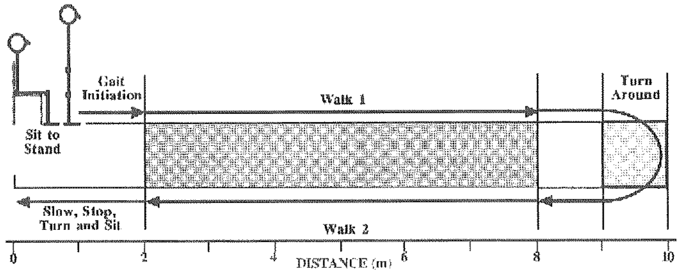

Figure 1.
Schematic diagram showing the arrangement for the Expanded Timed Get-up-and-Go test, together with the components measured.

METHODS

The area for the TGUG test was set up by measuring 3 m from the front legs of a straight-backed armchair with a seat height of ~46 cm. The subject was instructed to: "Sit with your back against the chair and your arms on the arm rests. On the word 'go,' stand upright, then walk at your normal pace to the line on the floor, turn around, return to the chair, and sit down." The stopwatch was started on the word 'go' and stopped when the subject returned to the starting position.

For the ETGUG test, a 10-m walkway was used to allow for better delineation of the component phases of the test. Another deviation from the original GUG test was the use of an armless chair with a seat height of ~46 cm, as opposed to an armchair of the same seat height. It was felt that the armless chair would provide a greater challenge to better assess the ability to rise from sitting to standing. The chair was positioned with the back legs placed at the start of the walkway, as shown in **Figure 1**. From this point, colored electrical tape was placed on the floor at 2, 8, 9, and 10 m, as indicated in the figure. The final meter of the walkway, taped off as a box, indicated the area in which the subjects were asked to turn around. The instructions for the ETGUG test were: "Sit with your back against the chair and your arms in your lap. On the word 'go,' stand upright, then walk at your normal pace and turn around in the box at the end, return to the chair, and sit down." The stopwatch was started on the word 'go' and the lap button that records the interval times was pressed at the following events:

a. When the subject was standing upright;
b. As the subject passed the 2-m mark;
c. As the subject passed the 8-m mark;
d. As the subject passed the 8-m mark when returning; and
e. As the subject passed the 2-m mark when returning.

The watch was stopped when the subject was seated. The time interval between starting and stopping the watch provided the overall time for the test. The stopwatch also recorded the intervals between each click of either the start/stop button or the lap button. The laps and the phases of the test with which they correspond are as follows:

Lap	Task
Lap 1.	Sit to Stand;
Lap 2.	Gait Initiation;
Lap 3.	Walk 1;
Lap 4.	Turn around;
Lap 5.	Walk 2;
Lap 6.	Slow down, stop, turn around, and sit down.

These intervals are shown with reference to the walkway in **Figure 1**. Notice that since the distances for Walk 1 and Walk 2 are known, the walking speeds can be calculated from the times taken for these components of the ETGUG test. This is an important objective measure of functional ability in the elderly. It has been shown that subjects who have either fallen or who have a fear of falling walk significantly slower than the young or the elderly without these balance problems (6,7). In a study of nonimpaired females, it was shown that the elderly walked significantly slower than the young at each self-selected walking speed from slow to medium to fast (8).

This new instrument was used to assess three groups, with 10 subjects, both male and female, in each group. The young controls, recruited from the students in the Physical Therapy program, ranged in age from 19 to 29 years with a mean age of 25.5±5.60 (standard deviation). The elderly controls, recruited from a group of community dwellers who attended a local senior citizens center, were 65 years and older with a mean age of 72.7±3.97. These subjects had no history of falls within the past 2 years nor any known

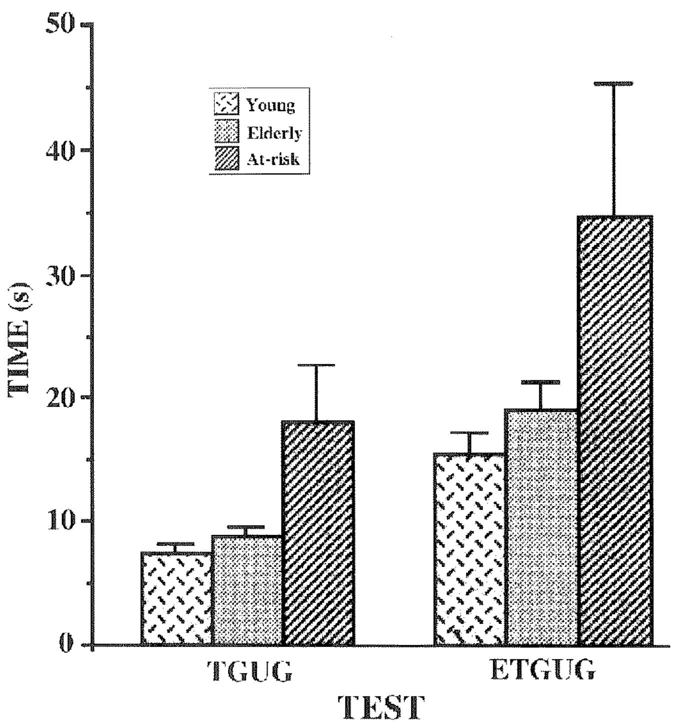

Figure 2.
Graph showing the mean and standard deviations for the times taken to complete the Timed Get-up-and-Go (TGUG) test and the Expanded Timed Get-up-and-Go (ETGUG) test for the three groups of subjects tested.

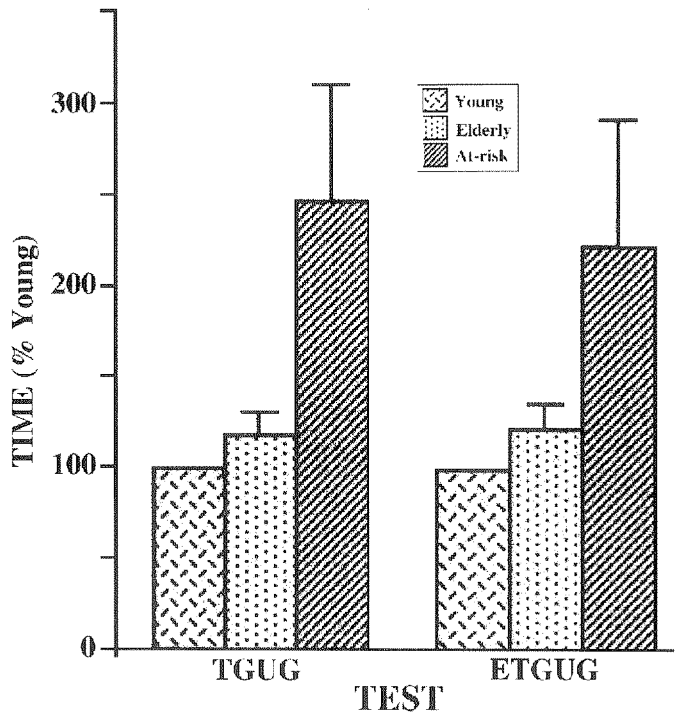

Figure 3.
Graph showing the mean and standard deviations for the times taken to complete the TGUG test and the ETGUG test for the three groups of subjects tested expressed as percentages of time that the young group completed the tests.

gait pathologies or balance disorders. The at-risk elderly group was 65 years and older with a mean age of 75.8±9.28. These subjects were receiving physical therapy at a local long-term care facility, and either had a history of falls within the past 2 years or had been treated for gait pathologies or balance disorders. All subjects volunteered for this study, and each completed a screening survey and signed informed consent prior to being tested.

Each subject completed a trial walk and a timed walk for both the original TGUG test and the ETGUG test. After receiving standard instructions, the subject completed a trial walk of the TGUG test to become familiar with the sequence of events. The subject was reinstructed prior to the second walk of the TGUG test, which was timed with a stopwatch. Data from the stopwatch were recorded directly onto a data collection form. The same sequence was then used to obtain data on the ETGUG test. For neither test was a demonstration performed, since this could be suggestive of a walking speed other than the subject's normal pace.

To test for inter-rater reliability, two investigators undertook the timing, each blinded to the results of the other. This test of reliability was only done with the young and at-risk groups for the ETGUG test. These data were then subjected to t-tests to determine whether there were significant differences between the data collected by the two investigators.

RESULTS

For the TGUG test the young controls had a mean time of 7.36±0.945 s, the elderly 8.74±0.851 s, and the at-risk group 18.14±4.604 s. These data are plotted in **Figure 2**. A one-way analysis of variance (ANOVA), followed by the Scheffe F-test, indicated that there were no significant differences between the young and elderly controls at the 95 percent confidence level and that both of these groups took significantly less time to complete the test than did the at-risk group. Similar findings resulted from an analysis of the overall time for the ETGUG test. The overall time for this test was, for the young group, 15.36±1.638 s, for the elderly 19.095±2.112 s, and for the at-risk group 34.52±10.628 s. These data are also plotted in **Figure 2**.

In an attempt to make a more meaningful comparison between the two tests, the data for the elderly and at-risk were calculated as percentages of the time taken by the young group to complete the test. For both tests therefore,

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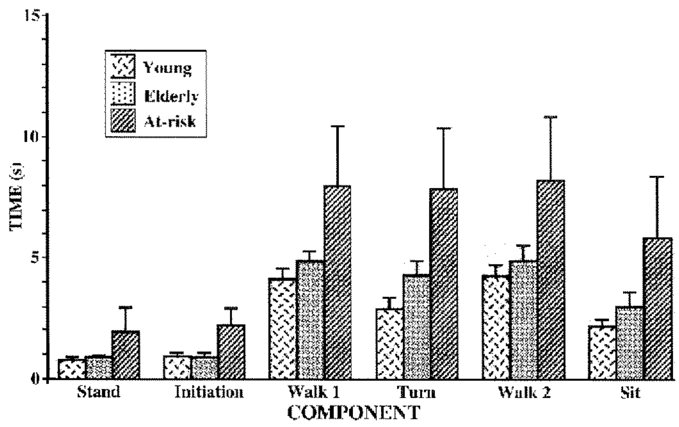

Figure 4.
Graph showing the mean and standard deviations for the times taken to complete each component of the ETGUG test for the three groups of subjects tested.

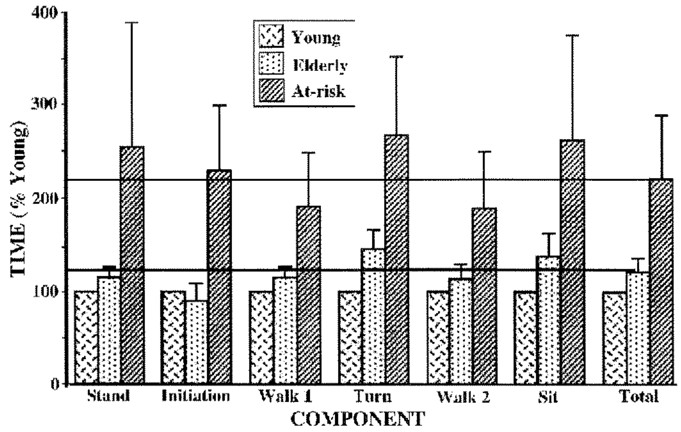

Figure 5.
Graph showing the mean and standard deviations for the times taken to complete each component of the ETGUG test for the three groups of subjects tested expressed as percentages of time that the young group completed that component. The horizontal lines are drawn through the mean values for the overall time taken to complete the test by the elderly and at-risk groups.

the mean value for the young group was 100 percent. The elderly controls took 119 percent of this time for the TGUG test and 123 percent for the ETGUG test. The at-risk group had times of 246 percent and 222 percent for these tests, respectively. These results are shown in **Figure 3**.

The times for the various components of the ETGUG test are plotted in **Figure 4** for the three groups. A one-way ANOVA, followed by a Scheffe post-hoc test, revealed a significant difference, with a 95 percent level of confidence, between the young and at-risk groups, as well as between the elderly controls and the at-risk groups for each component of this test. Again, to enhance comparisons, the data for each component of the ETGUG test for the elderly and at-risk groups were calculated as percentages of the values obtained for the young group. The results of this analysis are plotted in **Figure 5**. Note that this graph also includes values for the total times to complete the tests.

The means and standard deviations for the walking speed data are shown in **Table 1**. There were no significant differences in speed between Walk 1 and Walk 2 for any of the three groups, as revealed by t-tests. ANOVA and the Scheffe F-test revealed that the three groups walked at significantly different speeds for Walk 1. The same tests showed that there was no differences in speed between the young and elderly controls, but that both of these were significantly faster than the at-risk group.

For the young and the at-risk groups, two different investigators recorded the times for each subject simultaneously. Data were then subjected to a paired t-test that indicated no significant differences between the raters for any of the components of the ETGUG test.

DISCUSSION

It was observed that some subjects found the instructions for the TGUG test confusing with respect to where they were supposed to turn around when they reached the line at the end of the 3-m grid. Some turned at the line while others went past it before turning. This problem was successfully addressed in the ETGUG test by providing a square at the end of the walkway (see **Figure 1**), within which the subject should turn around.

All of the young and elderly controls performed the TGUG in less than 10 s, which is consistent with the findings of Podsiadlo and Richardson (1), who stated that people who performed the test within this time frame were freely independent in physical mobility. The TUG test times for the subjects in the at-risk group were all well over 10 s, which correlates with the inclusion criteria for these subjects: a history of falls within the past 2 years or treatment for gait pathologies or balance disorders. As can be seen from **Figure 3**, when expressed as a percentage of the mean time for the young group, the elderly and at-risk groups had very similar increases for both the TGUG and ETGUG tests. Thus the new expanded test reflects the results obtained using the original test.

The results of this study indicate significant differences between the young group and the at-risk group, and also between the elderly group and the at-risk group. Without exception, all of the individual component times, as well as the total elapsed times, were significantly higher in the at-risk group than in the other two groups (see **Figures 4** and **5**). **Figure 5** illustrates the data for these component parts of the ETGUG test, expressed as a percentage of the times that the young took to complete the same components. This graph also includes lines indicating the total times for the test by the elderly and at-risk groups. If these groups had equal difficulty with each component, compared to the young, then it might be expected that the percentages for each component would be the same, as would be that for the total time taken to complete the test. It can be seen from **Figure 5** that this is not the case. The elderly controls had the most difficulty with the turning and sitting components. The same can be seen for the at-risk group, who also had difficulty with the standing component. This might suggest that one could measure just these component tasks rather than the full test if one were using it to predict patients at risk of falling. However, to get these measurements, one has to collect the times for the other tasks, and so there would be little time gained in only recording the intervals for these sensitive tasks.

As can be seen from **Table 1**, the mean walking speed for the at-risk group was significantly slower than for either of the other two groups, which corroborates the findings of earlier studies (6,7). The walking speeds found in this study are higher than those reported by VanSwearingen et al. (7), who recorded speeds of 0.72 and 0.47 m/s for their no-recurrent-falls and recurrent-falls groups, respectively. However, the walking speeds for the young and elderly groups do compare well with data obtained by Öberg et al (9). They found that normal walking speed for females aged 19–29 was 1.23±0.111 m/s and for males 1.24±0.175 m/s. Their data for 70–79 year olds were 1.18±0.154 m/s and 1.11±0.125 m/s for males and females, respectively. It is interesting to note that the speed for Walk 1 was the only part of the test that revealed a significant difference between the young and the elderly controls. This corroborates the findings of O'Brien et al. (8) and suggests that this may be the most sensitive part of the test.

Table 1.
The means and standard deviations for walking speeds on Walks 1 and 2 for each of the groups.

Walking Speed (m/s)

Group	Walk 1	Walk 2
Young	1.44±0.144	1.39±-0.150
Elderly	1.23±0.108	1.23±0.167
At-risk	0.81±0.232	0.78±0.211

CONCLUSION

The ETGUG test is a practical, objective, assessment tool that can be used in almost any clinical setting with minimal equipment, professional expertise, or training. Additionally, it has the capacity to give the clinician more information than the TGUG test, since it measures each of the component parts of the test. Additional research is needed to determine correlations between increased component times and specific functional deficits. Once these relationships have been established, the scope of application of the test might be enlarged to include implications for prevention strategies in the high-risk geriatric population and in guiding treatment more specifically.

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