Gait in stroke patients is influenced by upper limb functioning: a quantitative analysis correlating QuickDASH with instrumented TUG and 10MWT

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Introduction

Loss of mobility after stroke is one of the main target of intervention in PRM and physiotherapy as motor impairment affects gait efficacy and upper limb function[1,2]: it is possible to observe a consensual improvement of these latter aspect throughout rehabilitation. Neural connections between upper and lower limb in gait are known[3,4] as well as the fact that modifications of upper limb movement during gait can affect gait parameters[5]. A recent review supports the inclusion of arm activity in addition to leg activity as a component of gait retraining after neurotrauma[6]. To the best of our knowledge, the association between upper limb disability and ability to move and walk in stroke patients has not been quantitatively studied: analysis of correlation between Instrumented Timed Up&Go Test (TUG) / 10Meter Walking Test (10MWT) and QuickDASH questionnaire score can be a preliminary, easy to perform, and clinically suitable way to assess it.

Research question

Do TUG/10MWT temporal and kinematic parameters and QuickDASH score correlate in stroke subjects?

Methods

A cross sectional study was performed in a tertiary referral sub-acute rehabilitation centre. 20 stroke inpatients aged 66,53 (±7,60) were enrolled. Inclusion criteria were stable clinical conditions and no other neurological or musculoskeletal pathologies. Subjects evaluation consisted of motor and gait skills assessment by performing functional tests as 10 Meter Walking Test and Timed Up & Go, and upper limb disability evaluation by administering QuickDASH questionnaire. A wearable BTS G-Sensor IMU (Inertial Measurement Unit) was utilized to obtain a kinematic and temporal analysis of tests[7]. Spearman Correlation was carried out to evaluate the association between tests parameters and QuickDASH score ($p<0.05$).

Fig 1. IMU BTS G-Sensor.

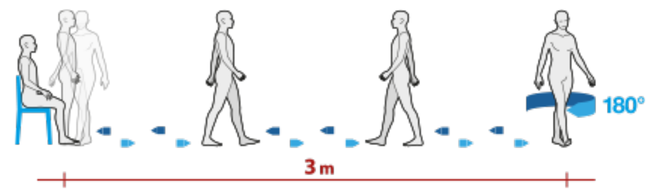

Fig 2. Timed Up And Go Test.

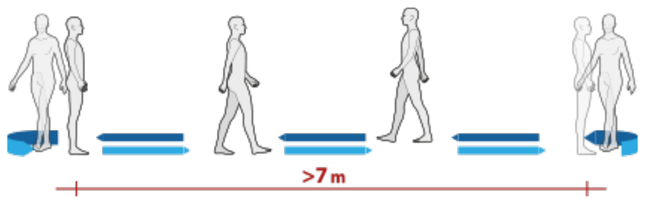

Fig 3. 10 Meter Walking Test.

Tab 1. QuickDash Score.

QuickDash	Level of Difficulty	Functional Outcome
Up to 11	No difficulty	Excellent
12-22	Mild difficulty	Good
23-33	Moderate difficulty	Fair
34-44	Severe difficulty	Poor
45-55	Unable	Disable

Results

Correlation between QuickDash and TUG time to completion was find (r = 0.64) as for the correlation between QuickDash and some TUG sub-phases time to completion: forward gait (r = 0.60), mid turning (r = 0.65) and return gait (r = 0.66). With regard to QuickDash and 10MWT, correlation was also find, among the others, for: time to completion (r = 0.71), gait pace (r = -0.55) and gait speed (r = -0.78).

Tab 2. QuickDash – TUG correlation.

TUG parameters	r_s	p-value
Time to completion	r = 0.64	p = 0.003
Forward gait	r = 0.60	p = 0.007
Mid turning	r = 0.65	p = 0.003
Return gait	r = 0.66	p = 0.002
Max rot speed in end turning	r = -0.58	p = 0.009

Tab 3. QuickDash – 10MWT correlation.

10MWT parameters	r_s	p-value
Time to completion	r = 0.71	p < 0.001
Cadence	r = -0.55	p = 0.015
Speed	r = -0.78	p < 0.001
Gait cycle duration (both sides)	r = 0.60	p = 0.007
Stride length	r = -0.64	p = 0.003
%Stride length (less affected side)	r = -0.68	p = 0.001
%Stride length (paretic side)	r = -0.69	p < 0.001
N° of steps (less affected side)	r = 0.61	p = 0.006
N° of steps (paretic side)	r = 0.63	p = 0.004

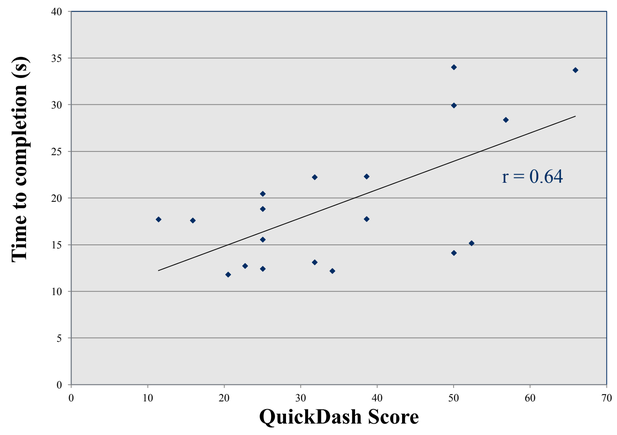

Fig 4. QuickDash – TUG time to completion correlation.

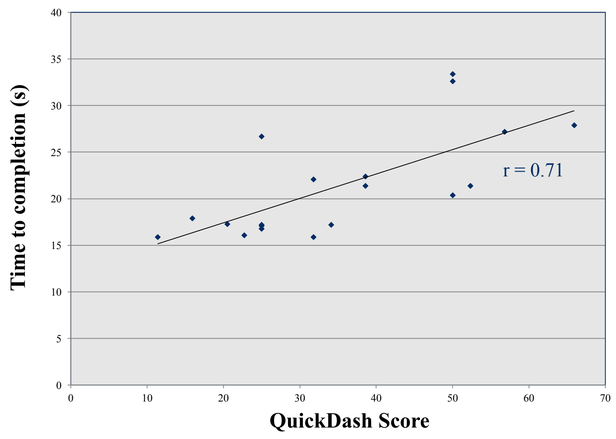

Fig 5. QuickDash – 10MWT time to completion correlation.

Discussion

The application of IMU wearable sensors to field tests has proven to be a useful, valid and user-friendly mode for assessing motor skills in stroke patients within clinical practice. Valuable correlations were demonstrated between the disability of upper limb and residual motor skills in stroke subjects: the higher the motor disability of the upper limb, the lower the performance in movement tests, and vice versa. These findings may open an alternative way to assess and thinking of the rehabilitation intervention in stroke patients, suggesting the possibility to enforce upper limb rehabilitation not just *per-se*, but in a wider and comprehensive program of motor skills recovery.

References

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