Exploratory data in support of the upper limit values and reproducibility of the Box & Block and Jebsen-Taylor tests following stroke

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Abstract

**Purpose:** To present preliminary data on the upper limits values and reproducibility of the Box & Block (B&B) and Jebsen-Taylor (J-T) lightweight object lift tests performed by patients recovering from ischemic stroke.

**Method:** Five patients consented to several sessions of testing 4 weeks apart. Each session consisted of 3 trials using the paretic and 3 trials using the non-paretic hands. One patient was not able to perform the 2 tests with the paretic hand. The number of blocks transferred in 60 seconds (B&B) and the number of seconds required to complete the transfer of 5 empty aluminium cans over a barrier (J-T) were collected and analysed.

**Results:** The 3-trials ICCs ranged from 0.90 to 0.99. Group mean B&B reached 51.3±7.1 blocks (nonparetic) and 21.8±11.4 blocks (paretic). The mean upper limit of number of blocks transferred by the non-paretic hand ranged between 39 and 58 blocks. The J-T upper limit time with the nonparetic hand was 5.0±0.7 seconds. Group mean J-T time improved slightly from 13.1 to 11.3 and 5.7 to 5.0 between the 1st and 3rd trials using the paretic and non-paretic hands respectively.

**Conclusion:** The data imply good repeatability and that there is a quantifiable upper limit of non-paretic extremity performance that may guide the management of functional deficits of the paretic extremity.

1 Introduction

The box and blocks (B&B) [1] and the Jebsen-Taylor (J-T) [2] tests are used frequently as representative of upper limb functional recovery following stroke.[3-7] The J-T represent the ability to grasp and move large objects and the B&B represents more fine manipulation of smaller objects. B&B normative values for age adjusted healthy subjects are published [1] but similar reproducible data regarding patients who recover from cerebral vascular accident (CVA) have not been reported. In particular, not knowing the upper limit of performance with the non-paretic upper limb makes it very difficult to determine the performance deficit of the paretic limb. The purpose of this presentation is to report preliminary data on the upper limits values and reproducibility of the B&B and J-T lightweight object lift tests performed by patients recovering from ischemic stroke.

2 Methods

To date 5 patients (mean age 73.4 years) having survived a first time ischemic stroke and left with upper limb paresis consented to participate in 4 testing sessions 4 weeks apart. The mean time elapsed between stroke onset and testing was 79.2 days (range 16-393). One patient completed 4 sessions, one patient 3 sessions, 2 patients 2 sessions and 2 patients 1 session.

A testing session consisted of performing both B&B and J-T, first with the non-paretic then with the paretic hand. The 2 tests were ordered and each was performed 3 times. The B&B test included a box divided by a partition and containing 150 blocks located in one side. The box was placed in front of the subject bisecting the midline of her/his body. Patients were instructed to pick-up one block at a time and transfer it to the other side of the box as fast as possible. The number of transferred blocks in 60 sec constituted the outcome measure.

Jebsen-Taylor light object lift was performed while the subject sat in a standardized environment (seat height of 46 cm, desk height of 76 cm,) facing 5 empty aluminium cans (11 cm height, 8 cm diameter) placed in a row 5 cm apart in front of a board that was placed on the
desk, 13 cm from its front edge. Upon command she/he grasped the can, lifted it over a 5 cm vertical barrier and placed it back on the board. The time it took to move all 5 cans was measured (sec) with a stopwatch.

ANOVA tests (p=0.05), multiple comparisons post-hoc (Bonferroni method) and ICC were used to establish test-retest repeatability and reliability while means and confidence intervals were used to report upper limits of tests performance.

3 Results

Only the non-paretic B&B test showed significant difference between trials. The 2nd and 3rd trials were statistically equal and both showed more blocks transferred than in trial 1. In all other tests scores improved slightly but insignificantly between the 3 trials. The 3 trials’ ICCs (2,1) for the paretic and non-paretic B&B and J-T ranged between 0.90 and 0.99.

The means and 95% confidence intervals of the non-paretic B&B and J-T are shown in figure 1 and 2.

Whereas the group mean B&B reached 51.3±7.1 blocks with the nonparetic upper extremity the group mean paretic hands only transferred 21.8±11.2 blocks - a group deficit of about 57%. The mean upper limit of blocks transferred ranged among patients between 39 and 58 blocks (nonparetic) and 5 and 42 blocks (paretic) upper extremity. The J-T upper limit task time was 5.0±0.7 sec with the nonparetic and 11.3±3.6 sec with the paretic extremity – a 65% deficit. As a group, the mean J-T time improved slightly from 13.1 to 11.3 sec and 5.7 to 5.0 sec between the 1st and 3rd trials using the paretic and non-paretic hands respectively.

Two patients were tested in 3 separate sessions 4 weeks apart as they continue with formal rehabilitation. The nonparetic extremity showed no change of the J-T test time, but transferred on the average about 4 additional blocks after 8 weeks of inpatient rehabilitation. Figure 3, illustrate these data where 1 represents baseline, while 2 and 3 represent testing after 4 and 8 weeks respectively.

4 Discussion

The aim of this limited and preliminary data presentation is to draw attention to the need to establish both the upper limits values and test repeatability and reliability of two common clinical tests (B&B and J-T) used to document upper limb functional recovery following stroke.[4, 6] At the risk of being premature, we suggest that the data, once supported by an acceptable sample size could become a very useful, simple and objective way to document functional deficits and recovery profile of the upper extremity following stroke.

The use of the nonparetic extremity as an individual patient’s reference of neuromuscular deficits in the paretic extremity has been used in recent studies.[8, 9] It provides a quantifiable clinical method to control for the considerable variability among patients. Our findings that the maximum number of blocks transferred in 60 sec with the nonparetic hand may vary by 19 blocks among patients having average of 80 days post stroke add support to the premise of
individual variability. Indeed, the deficits of the paretic extremity should be referenced to the individual patient nonparetic extremity and not to normative generalized data derived from healthy population. Within patients referencing is likely to help clinicians to focus on documenting deficits as well as progress that are more meaningful to the individual patient and concurrently reduce variability associated with statistical group analyses in clinical studies. [8]

The preliminary data that the B&B but not the J-T scores of the nonparetic extremity improve over the 8 weeks of data collection may imply that there are some motor control deficits in the nonparetic limb that can improve with practice in the early phases of rehabilitation. The observation that unlike the B&B, the nonparetic J-T time did not change, may lead to the hypothesis that not all upper extremity functions are impaired and that the two studied functional tests may be independent particularly on the paretic side. Within our very small sample the correlations between B&B and J-T scores were $r=-0.7$ and $r=-0.01$ for the nonparetic and paretic extremities respectively.

Finally, our data suggest improvement in both B&B and J-T of the paretic and nonparetic extremities from trial 1 to 3 with no statistically significant change between trials 2 and 3. Clearly there is some learning associated with performing these tasks. Allowing 2 practice trials before data collection may decrease performance variability and improve the documentation of the upper limits of performing the B&B and J-T tasks.

5 Conclusions

Clear conclusions may be premature. Tentatively we conclude that the upper limits of performing the B&B and J-T light objects lift by stroke survivors can be objectively and reliably documented. Additionally, functional deficits and progress towards full recovery of the paretic extremity should be referenced to the nonparetic performance rather than reported independently.

References


