A Possible Alternative to Computerized Neurocognitive Testing for Quantification of Reaction Time

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BACKGROUND AND PURPOSE

- Computer programs are widely used to assess neurocognitive function, which is adversely affected by concussion
  - Post-concussion assessments have identified prolonged ImPACT® composite reaction time (RT)[1]
- Previous research has shown moderate correlations between values derived from ImPACT® and CogSport®[2]
- A modest correlation has been established between values derived from CogSport® and a drop-stick RT method[3]
- Disadvantages of neurocognitive testing are cost and impracticality of large-group pre-participation testing
- Prolonged ImPACT® composite RT has also been associated with non-contact anterior cruciate ligament injury[4]
  - Simple RT derived from an inexpensive instrument may provide an alternative to computerized assessment
  - Such an inexpensive method may have utility for pre-participation assessment of injury risk
- The purpose of this study was to assess the association between Choice RT quantified by ImPACT® testing and Simple RT measured by an inexpensive and rapidly administered method that utilized a "drop-stick" instrument

PARTICIPANT CHARACTERISTICS

- 107 college students (20.9 0.12 years, 1.79 0.12 meters, 84.51 20.80 kilograms)
  - 63 males and 44 females; 53 athletes and 54 non-athletes; 34 participants had a history of concussion
- Exclusionary criterion: Concussion occurrence within 2 months prior to testing

Table 1

Group			N	Mean	Std. Deviation
Non-Athlete	Simple RT	Female	40	211	21.2
		Male	13	208	24.5
	Choice RT	Female	40	550	69.6
		Male	13	536	66.1
Athlete	Simple RT	Female	4	207	21.6
		Male	50	200	20.9
	Choice RT	Female	4	590	107.4
		Male	50	573	63.3

METHODS AND PROCEDURES

- RT drop-stick instrument was constructed from regulation hockey puck and a 7/16-inch dowel rod
  - Dowel rod was covered by Grip Tape (Unique Sports Product, Inc., Alpharetta, GA)
  - Marks made along length of dowel rod every 0.5 cm up to 80 cm (Figure 1)
- Participant seated; forearm supported on table (slightly pronated position to avoid 5th digit interference)
  - Ulnar styloid process aligned with table edge (Figure 2)
  - Top of drop-stick puck aligned with superior margin of participant's cupped hand (Figure 3)
  - Participant instructed to react to drop-stick movement, grasping with thumb and index finger (Figure 4)
  - Distance between the superior margin of puck and superior margin of thumb/finger recorded
- 10 measurements were recorded to nearest 0.5 cm
  - First 2 trials considered practice; trials 3-10 used to calculate 8-trial average
  - Average distance converted to RT:

$$RT = 1000 \quad \sqrt{[(2 \quad \text{Average Drop Distance}) \quad 980^2]}$$

- ImPACT® neurocognitive testing performed according to standard procedures
  - Both RT measurement procedures performed on same day for non-athletes
  - ImPACT® results for athletes derived from pre-participation testing (4-16 months prior to drop-stick testing)
- Simple RT derived from drop-stick procedure compared to Choice RT derived from ImPACT® neurocognitive test
  - Descriptive statistics, independent t-test, and Pearson r correlations calculated

Figure 1

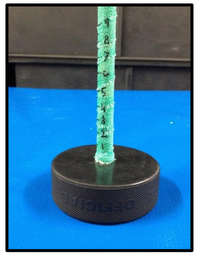


Figure 2

Figure 3

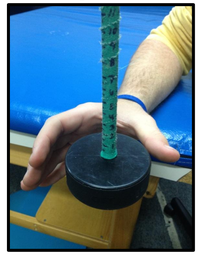


Figure 4

RESULTS

- Means and standard deviations presented in Table 1
- No meaningful correlation evident between RTs derived from drop-stick procedure and ImPACT® testing (Figure 5)
  - Pearson r=.058; p=.550
- Both Choice and Simple RT values were smaller for males than females, but there were no significant differences

Figure 5

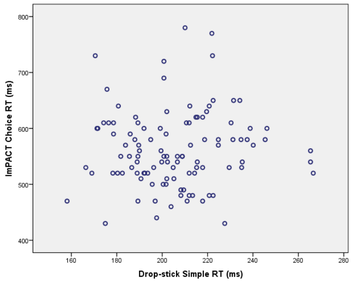
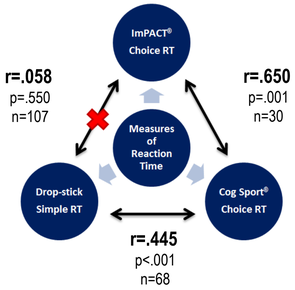


Figure 6



CONCLUSIONS

- Previous research has demonstrated a modest correlation between ImPACT® and CogSport® Choice RT values[2]
- A relatively weak correlation has been reported between drop-stick Simple RT and CogSport® Choice RT[3]
- No meaningful correlation was observed between drop-stick Simple RT values and ImPACT® Choice RT (Figure 6)
  - Simple RT appears to represent a visual-motor response that does not require cognitive processing
- Simple RT may still be a valid indicator of a neurological capability that may be adversely affected by concussion
  - The drop-stick procedure may have value for acquisition of baseline Simple RT values for athletes
- Further research is needed to establish the possible relevance of Simple RT to injury risk and concussion recovery

REFERENCES

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4. Swanik CB, Covassin T, Stearne DJ, et al. The relationship between neurocognitive function and noncontact anterior cruciate ligament injuries. *Am J Sports Med.* 2007;35:943-948.