Use of the Equilibrate System as a Diagnostic Tool for Concussion; and for Tracking Recovery after Incident – A New Case Study

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Case Brief – In August of 2011, Balance Engineering LLC had the opportunity to test the balance function of 16-year-old student-athlete Hank J. using the EQUILIBRATE System, an objective and non-invasive system for quantitative, whole-body assessment of human balance. Hank suffered a concussion playing basketball five weeks earlier. Since October 2009 Hank has suffered four concussions; two playing football and two playing basketball:

#1 – Oct. '09 (initial) #2 – Jan. '10 (△3 mo's) #3 – Oct. '10 (△9 mo's) #4 – Jul. '11 (△9 mo's)

Hank has exhibited symptoms of concussion that have extended beyond the 72-hour post-concussion period, as described by both he and his family. These symptoms include "fogginess," ease of distraction, and loss of orientation and balance.

In the current study, Hank was given a battery of eight standard balance assessment tests on EQUILIBRATE, each repeated 3 times as per normal protocol. A more difficult test type – standing single-legged with eyes closed – was avoided due to a perceived risk for a fall during assessment.

As shown in Table 1, testing revealed *significantly reduced balance function in all but the least challenging test type* (standing normally with eyes open). In seven other test types, Hank's balance scores were significantly below average, compared both with his peer age group as well as the broader population. Though not comparable with Hank's scores as a direct baseline, simultaneous testing of Hank's fraternal twin brother revealed balance scores very close to peer averages and significantly improved over Hank's.

Table1: EQUILIBRATE Scoring for Hank J. (left) and twin brother Victor (right):

Equilibrate Test Summary	Overall	AgeGrp	AvgLT%	AvgRT%	Overall	AgeGrp	AvgLT%	AvgRT%
1 - Both Feet Eyes Open	91.09	95.32	49.01	50.99	94.63	95.32	54.19	45.81
2 - Both Feet Eyes Closed	71.56	94.24	48.07	51.93	95.13	94.24	51.26	48.74
3 - Right Foot Eyes Open	30.59	90.31	0.00	100.00	89.03	90.31	0.00	100.00
5 - Left Foot Eyes Open	33.54	90.31	100.00	0.00	90.71	90.31	100.00	0.00
7 - Right Foot Forward Eyes Open	69.45	95.05	56.65	43.35	93.98	95.05	69.95	30.35
8 - Right Foot Forward Eyes Closed	48.08	91.88	63.46	36.54	91.44	91.88	66.05	33.95
9 - Left Foot Forward Eyes Open	59.17	95.05	28.78	71.22	93.02	95.05	39.75	60.25
10 - Left Foot Forward Eyes Closed	38.15	91.88	29.66	70.34	85.68	91.88	37.23	62.77

Notes: Overall Balance Score on the Equilibrate System (Balance Engineering LLC) is based on a scale of 0-100, with a higher score reflecting superior postural control. Equilibrate data are shown for various test types which measure postural control during quiet standing for the conditions described over a period of 15 seconds. Peer-age values are based on normative data from a broad population of healthy subjects. Colors indicate stability impairment: Green = low, Yellow = moderate, Red = high.

Initial quantitative balance scores from the EQUILIBRATE System suggested a condition of reduced balance function in Hank. These results were recommended for consideration along with other factors in the decision to clear Hank for sports activity.

Follow-Up and Improvement – In subsequent weeks following initial testing, Hank's balance scores showed marked improvement (Table 2), and correlated to reduced concussion symptoms as described by Hank, including improved balance around the home, increased ease of routine mobility, and a decrease in "fogginess." Hank's mother commented on his improved condition during normal activity at home, and expressed relief at his progress.

Table 2: Overall balance improvement during weeks 5 through 11 post-concussion:

	9-Aug	16-Aug	23-Aug	22-Sep
Equilibrate Test Summary	Overall	Overall	Overall	Overall
1 - Both Feet Eyes Open	91.09	96.42	94.96	94.45
2 - Both Feet Eyes Closed	71.56	87.36	92.44	89.39
3 - Right Foot Eyes Open	30.59	85.33	86.26	94.96
5 - Left Foot Eyes Open	33.54	85.72	88.64	92.44
7 - Right Foot Forward Eyes Open	69.45	91.20	91.91	91.11
8 - Right Foot Forward Eyes Closed	48.08	75.27	82.36	82.50
9 - Left Foot Forward Eyes Open	59.17	90.59	90.78	93.77
10 - Left Foot Forward Eyes Closed	38.15	78.89	78.51	69.75

Although a substantial body of concussion data demonstrates wide variation in symptoms and time for recovery based on the individual, the persistence of Hank's symptoms and balance dysfunction appeared to exist over a slightly longer timescale than average. It is hypothesized that this persistence may be due to the instance of multiple concussions over a relatively short time.

An additional point to note: Hank was cleared for play on August 5 by his physician following neuro-cognitive testing using a software based tool along with traditional concussion assessment methods.

The results highlight the capability of the Equilibrate System for objective and sensitive detection of the neuro-physical effects of concussion and mild traumatic brain injury (mTBI).

For additional information regrading the EQUILIBRATE System of objective human balance testing and balance function therapy, visit ***www.balanceengineering.com***
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