

The Test

Box stands for **Brain Injury Associated Ocular Motility Dysfunction**.

The score from 1-20 determines if you have a concussion or not. The machine has been approved to say whether you do, or do not, have a concussion. Not if you have a mild/moderate or severe one. It is FDA approved to be used within 7 days of injury and can be repeated to establish a trend

The patient must be 5 y/o, have 2 eyes, no significant previous eye injury, or cataracts. No baseline is needed. Visual acuity must be 20/80 or better for results to be valid and the patients cannot be wearing glasses nor contacts.

The BOX score is NOT a stand-alone tool but rather must be used in conjunction with your clinical evaluation.

The Report

The report generated will indicate if eye tracking was of poor quality. If it states no, the report should not be interpreted

Next the report will show the score

1. A BOX score less than 3 has been shown consistent with no concussion
2. A BOX score greater than 10 is consistent with concussion
3. A BOX score from 3-10 may be interpreted as falling between the range of normal and concussed and may be consistent with mild injury or initial stages of recovery.

The Cranial Nerves that are assessed by this test are optic nerve II, oculomotor nerve III, and the motility nerves III, IV and VI

The patient follows an image moving inside the perimeter of a video screen 5 times at a rate of 10 seconds per side

And each of these cycles is recorded in and plotted in a separate way so that one can plot the Cartesian coordinates XY of the pupils over time.

PUPILS POSITION

If the left and right eyes are moving together, their plots should overlap. The report also plots this as conjugacy Delta X (difference in horizontal pupil position between the left and right eye plotted over time) and Delta Y (difference in vertical pupil position between the left and right eye plotted over time). This way one can determine whether the problem is with horizontal eye movement coordination versus vertical eye movement coordination. These are different pathways in the brain.

PUPIL SIZE

Pupil size is a function of many different pathways in the brain. In most people the right and left pupils will both constrict and dilate at the same rate of speed. Traumatic brain injury or concussion are both known to impact pupil size. Cranial Nerve II detects light, and CN III constricts the pupil (if disrupted, pupil cannot constrict). Cervical sympathetic nerves also impact pupil size and their disruption results in a pupil that cannot dilate.

PUPIL DILATION SPEED

In concussed subjects, there is a change or an inability to dilate the pupils as quickly relative to normal.

BLINKS

Blinks are mediated by Cranial Nerves V and VII. Concussed subjects demonstrate alterations in blink.

EYE MOVEMENT

Three different Cranial Nerves mediate movement. Cranial Nerve III, IV and VI. Cranial Nerve III innervates the superior and inferior rectus, which moves the pupil up and down. Cranial Nerve VI innervates the lateral rectus that pulls the pupil out to the side and then Cranial Nerve III innervates the medial rectus that pulls the pupil medially. In this manner, one can differentiate between a lesion that affects either the nerve or the pathway by looking at whether it is gross movement that is impaired or whether it is coordination that is impaired.

PUPIL VELOCITIES

We see that where our patient is relative to normal controls.

OCULOMOTOR STABILITY

The width (horizontal movement) informs regarding Cranial Nerve VI. The height (vertical movement) informs regarding Cranial Nerve III. Aspect Ratio is height divided by width.

SACCADES

Saccades are known to be both hyperkinetic and hypokinetic in patients with concussion. Sometimes they are abnormally slow and sometimes they are abnormally fast. It depends on which pathways in the brain are disrupted. Conjugacy is the difference between the right and left eye. The difference in a normal person should be small and in an abnormal subject will be increased.