

Computerized Dynamic Posturography (CDP)

- Measure sway on a platform that can rotate about the ankles and modify visual input.

Neurocom device



Micromedical device

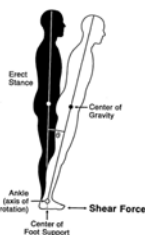


Computerized Dynamic Posturography (CDP)

- 6 different sensory tests

		VISUAL CONDITION		
		FIXED	EYES CLOSED	SWAY-REFERENCED
SUPPORT CONDITION	FIXED	1	2	3
	SWAY-REFERENCED	4	5	6

Many possible disturbances to Balance



- Sensory inputs
 - Somatosensory
 - Visual
 - Vestibular
- Central
 - Internal model
 - Integration
- Motor
 - Output (weak, spastic)

CDP – current uses

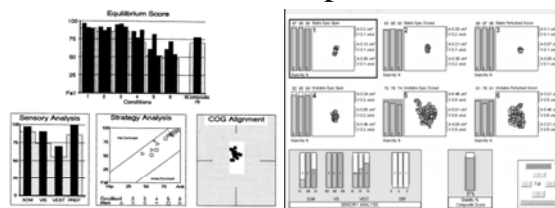
- Objective measure of static balance
- Quantify use of senses to maintain balance
- Detect malingering

CDP: Diagnostic Patterns

- Normal
- Poor balance
- Vestibular
- Central
- Multisensory
- Aphysiologic

		VISUAL CONDITION		
		FIXED	EYES CLOSED	SWAY-REFERENCED
SUPPORT CONDITION	FIXED	1	2	3
	SWAY-REFERENCED	4	5	6

CDP: Normal pattern

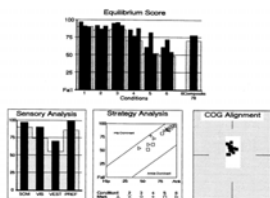


Neurocom device

Micromedical device

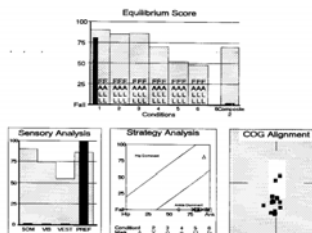
- Scoring
 - Should gradually decline with difficulty
 - Composite > 70

CDP: Normal pattern – doesn't mean balance is perfect



- This patient has severe orthostatic hypotension, but normal CDP – orthostatic HPN should not impair CDP.

CDP – just terrible balance

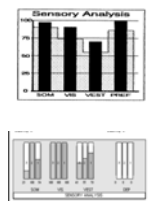


Patient with bilateral vestibular loss.
No useful information here other than bad balance.

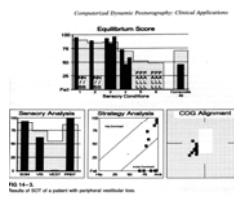
CDP: Sensory Analysis

- Sensory Analysis – low means

- Som – somatosensory (stable eyes open vs stable eyes closed)
- Vis – visual (stable eyes open vs unstable eyes open)
- Vest – vestibular (stable eyes open vs unstable eyes closed)
- Pref – uses too much visual (vision perturbed vs eyes closed)



“Vestibular Pattern”



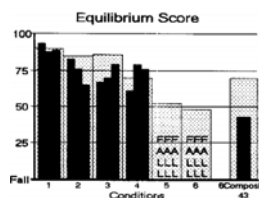
- Also called 5-6 pattern
- Increased sway (decreased score) with unstable support surface, with vision absent or distorted
- Also positive in CNS balance disturbances

Nashner in Jacobson, Newman and Kartush, 1993

Central ataxia – usually another “vestibular pattern”

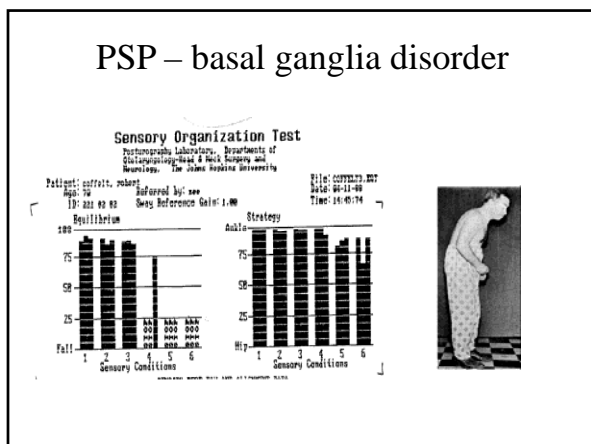
- Many variants – examples
 - Sensory
 - Cerebellar
 - Periventricular Leukomalacia
 - Basal Ganglia
- They all look the close on CDP
- Some are “aphysiologic”

Cerebellar – SCA3



Patient with cerebellar lesion has same pattern as vestibular lesion

PSP – basal ganglia disorder



CDP often detects Malingerers

- Six “sensory tests”--> gradient of difficulty
- Maligner tries to “fail” test, and adjusts sway to appear very unsteady on all tests
- Maligner fails easy tests.
- Examiner must not tell subject how to behave.
- Cevette algorithm -- linear discriminant score

		VISUAL CONDITION		
		FIXED	EYES CLOSED	SWAY-REFERENCED
SUPPORT CONDITION	FIXED	1	2	3
	SWAY-REFERENCED	4	5	6

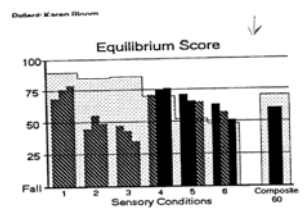
Linear discriminant algorithm (From Cevette et al, 1995)

$$\text{Aphysiologic Score} = -158.2 + (1.94 * ST1) + (1.09 * ST2) + (1.37 * ST4) - (0.15 * ST6)$$

$$\text{Normal Score} = -238.11 + (2.24 * ST1) + (1.45 * ST2) + (1.7 * ST4) - (0.13 * ST6)$$

$$\text{Vestibular Score} = -251.21 + (2.31 * ST1) + (1.54 * ST2) + (1.89 * ST4) - (0.58 * ST6)$$

Aphysiologic Patterns



Patient litigating after blood loss in hospital.

Balance got WORSE months after blood replaced.

Patient performs worse on easy tests than hard tests !

Aphysiologic Patterns

Patient may simply score very poorly – composite < 20, but walks into clinic under own power.

“Aphysiologic” is not the same as malingering

- Algorithms to detect malingering were trained with just a few disorders.
- Patients with organic disorders other than the Cevette algorithm trained may be falsely positive

CDP
Diagnostic Bottom Line

- Sensitive but non-specific
- Detection of malingering is best documented diagnostic use
- May be helpful in sorting out mixed pictures

CDP – as an objective measure of balance

- Quantify sway
- Quantify postural reactions

CDP issues in quantification

- Center of pressure is not center of mass. The hardware doesn't measure sway.
- Sway isn't necessarily bad – error margin is more important
- It is not yet clear how measurements on CDP relate to real world risks of fall.

CDP quantification bottom line

- It's the best we have at present.
- Useful test for disability

Future of CDP

- Diagnostic
 - Larger sets of data in a variety of conditions
 - Map out specific vs. nonspecific patterns
- Quantification of balance
 - Standardized performance by age on relevant measures.