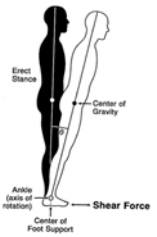
Computerized Dynamic Posturography (CDP)

- Measure sway on a platform that can rotate about ankles and translate.
- 6 different sensory tests
- numerous "movement" tests measuring latency and strength of reactions

Balance is actively maintained



- Sensory
- Central
- Motor

CDP –uses

- Diagnosis of disorders of balance
  - Normal
  - Malingering
  - Everything else (vestibular, central, etc)
- Objective measure of sway
  - Response to rehabilitation
  - Response to therapeutic maneuvers (e.g. LP for NPH)

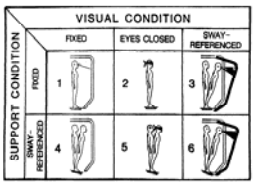
CDP is still controversial

Dobie (1997). "In mid 1995, after more than a decade of use, no clinical population has been identified for which CDP reliably distinguishes between disorders or states that might otherwise be confused, adds information to that already available, and leads to a change in management that is beneficial to the patient.

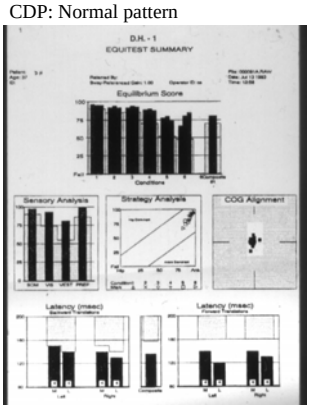
- Medline search – about 12 new papers/year with "Computerized Dynamic Posturography" -- its not going away !

CDP: Patterns

- Normal
- Poor balance
- Vestibular
- Central (?)
- Multisensory
- Aphysiologic

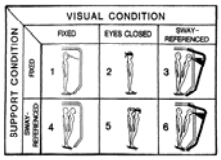


CDP: Normal pattern



CDP for Malingerers

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



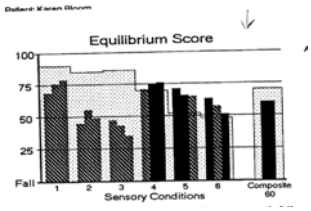
Linear discriminant algorithm (From Cevette et al, 1995)

Aphysiologic Score = -158.2 + (1.94*ST1) + (1.09*ST2) + (1.37*ST4) – (0.15*ST6)

Normal Score = -238.11 + (2.24*ST1) + (1.45*ST2) + (1.7*ST4) – (0.13*ST6)

Vestibular Score = -251.21 + (2.31*ST1) + (1.54*ST2) + (1.89*ST4) – (0.58*ST6)

Aphysiologic Pattern It works



"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 ones that trained the algorithm may be falsely positive

Aphysiologic scores in persons with organic disorders

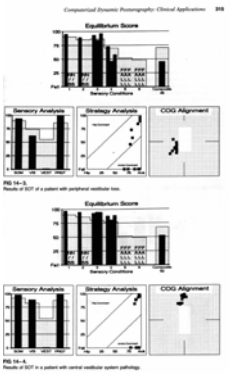
	Cevette Classification n, (%)			
Population	Normal	Vestibular	Aphysiologic	Total
NL	95 (95)	0	5 (5)	100
BVL	0	8 (53)	7 (47)	15
PSP	4 (22)	11(61)	3 (17)	18
SG	1 (10)	0	9(90)	10

Valika and Hain, 2001

Other kinds of ataxia It doesn't work (for diagnosis)

- Many variants – examples
  - Sensory
  - Cerebellar
  - Periventricular Leukomalacia
  - Basal Ganglia
  - Vestibular
- They all look the same on CDP

Vestibular

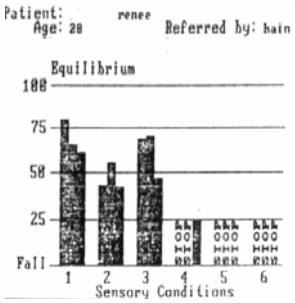


Also called 5-6 pattern

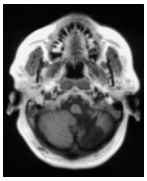
Increased sway (decreased eq score) with unstable support surface, with vision absent or distorted

Nashner in Jacobson, Newman and Kartush, 1993

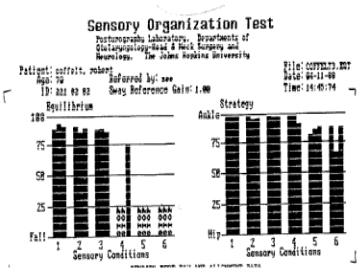
Cerebellar



Patient with cerebellar lesion



PSP – basal ganglia disorder



Case of multisensory ataxia

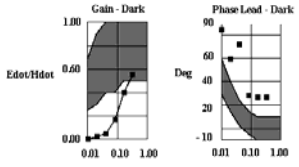
An 85 year old woman was brought to the clinic by her daughter because she was unsteady.

Case of multisensory disequilibrium

Her vision had been failing for years due to cataracts and macular degeneration.

Case of multisensory disequilibrium

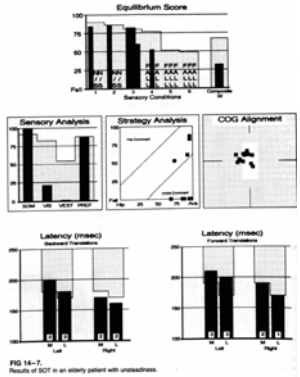
On rotational vestibular testing, she had symmetrical but decreased vestibular function, similar to a mild bilateral vestibular loss.



Case of multisensory ataxia

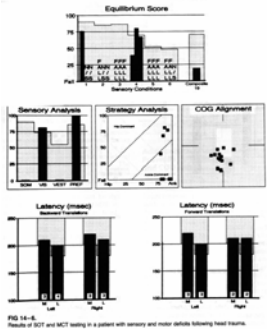
On clinical exam, she was unable to feel a tuning fork at her ankles.

CDP: Elderly Patient with ataxia



Nashner in Jacobson, Newman and Kartush, 1993

Multisensory pattern



Nashner in Jacobson, Newman and Kartush, 1993

CDP
Diagnostic Bottom Line

- Sensitive but non-specific
- Generally does not make diagnoses
- Detection of malingering is best documented diagnostic use
- May be helpful in sorting out multisensory problems

CDP – objective measure of balance

- Quantify sway
- Quantify postural reactions

- Potentially provides a measurement to follow during rehabilitation.
- NPH treatment

CDP to follow rehabilitation

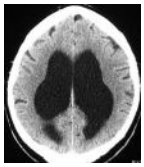
- Can measure changes in sway pattern
- Multiple authors have used CDP in their studies of vestibular rehabilitation:
  - (Bonan, Yelnik et al. 2004; Cohen and Kimball 2004; Tsang and Hui-Chan 2004; Medeiros, Bittar et al. 2005)

Does it mean anything ? O'Neill et al (1998)

- Subjects were tested before and after 6-8 weeks of vestibular rehabilitation with Equitest posturography sensory organization test (SOT), with timed quasistatic bilateral standing in tandem, on foam, and one leg; and with functional balance measures including gait velocity, a modified Timed Up & Go, gait with head rotation, gait with eyes closed, and tandem gait. RESULTS: Changes in SOT were not predictive of, nor often even directly correlated with, changes in quasistatic standing or functional performance.

CDP for NPH

- Normal Pressure Hydrocephalus: NPH
- Imbalance that responds to CSF drainage
- CDP may provide objective method of deciding if drainage helps
- Difficult to do placebo



CDP issues in clinical quantification

- It is not yet clear how measurements on CDP relate to <u>real world risks of fall</u>. (O'Neill et al suggested no correlation)
- <u>Sway isn't necessarily bad</u> – error margin is more important.

CDP quantification bottom line

- It's not great but its the only somewhat objective test that we have at present.
- Useful test for NPH

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.