



Incidence of Vestibular Impairments in Clients with Lower Extremity Amputation

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Origin of the Study:



Study Objective:

Principal objective

To investigate the incidence of vestibular impairment in people with a lower extremity amputation

Larger Study

- Investigate if there is a functional impact to having a vestibular impairment on LE amputee subjects'
- Provide a control group

Methods:

- Centre de recherche interdisciplinaire en réadaptation du Montréal métropolitain (CRIR) ethics approval
- 15 lower extremity amputees were examined for:
 - BPPV screening
 - Vestibular hypofunction testing
 - Sensory Organization Test (SOT)

Demographics:

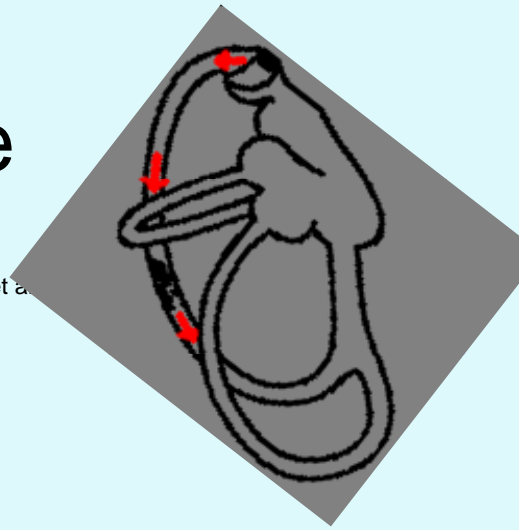
Gender	9 male 6 female
Age	68 (14.6) years
Cause of Amputation	10 diabetic 2 PVD 2 trauma 1 infection
Level of Amputation	1 partial foot 10 transtibial 4 transfemoral

BPPV: Benign Paroxysmal Positional Vertigo

Definition: a disorder of the inner ear characterized by a brief spinning sensation provoked by changes in head position (Bhattacharyya et al 2008)

Incidence of BPPV: 0.6 % general population (Breven et al 2006)

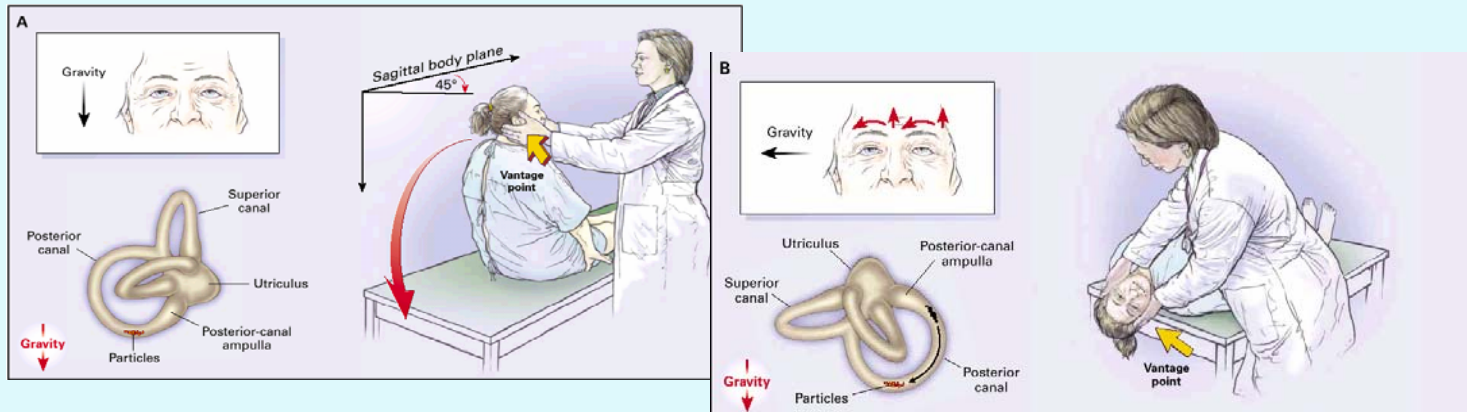
Diabetes: increases the incidence for BPPV (Cohen et al 2006)



BPPV Methods:

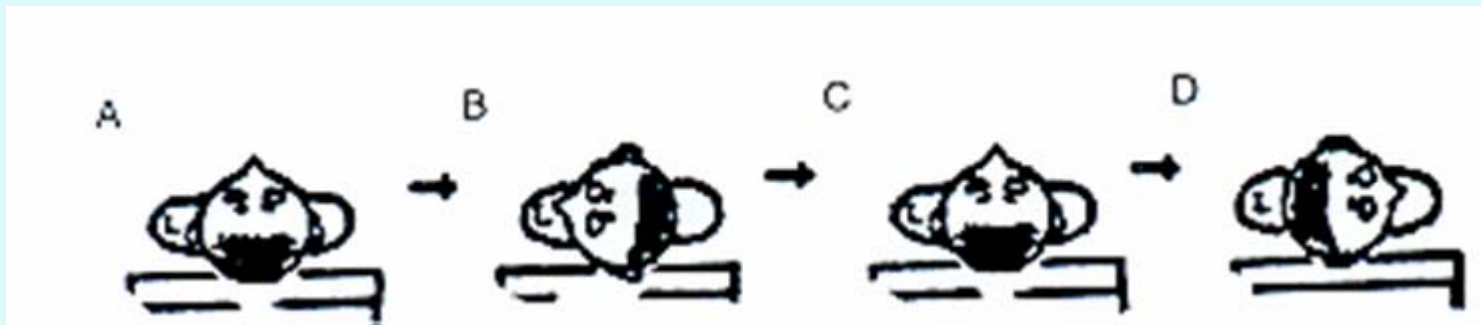


- Dix Hallpike Manoeuvre

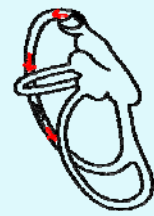


Furman and Cass, 1999

- Roll test



Herdman, 2000



BPPV Methods:



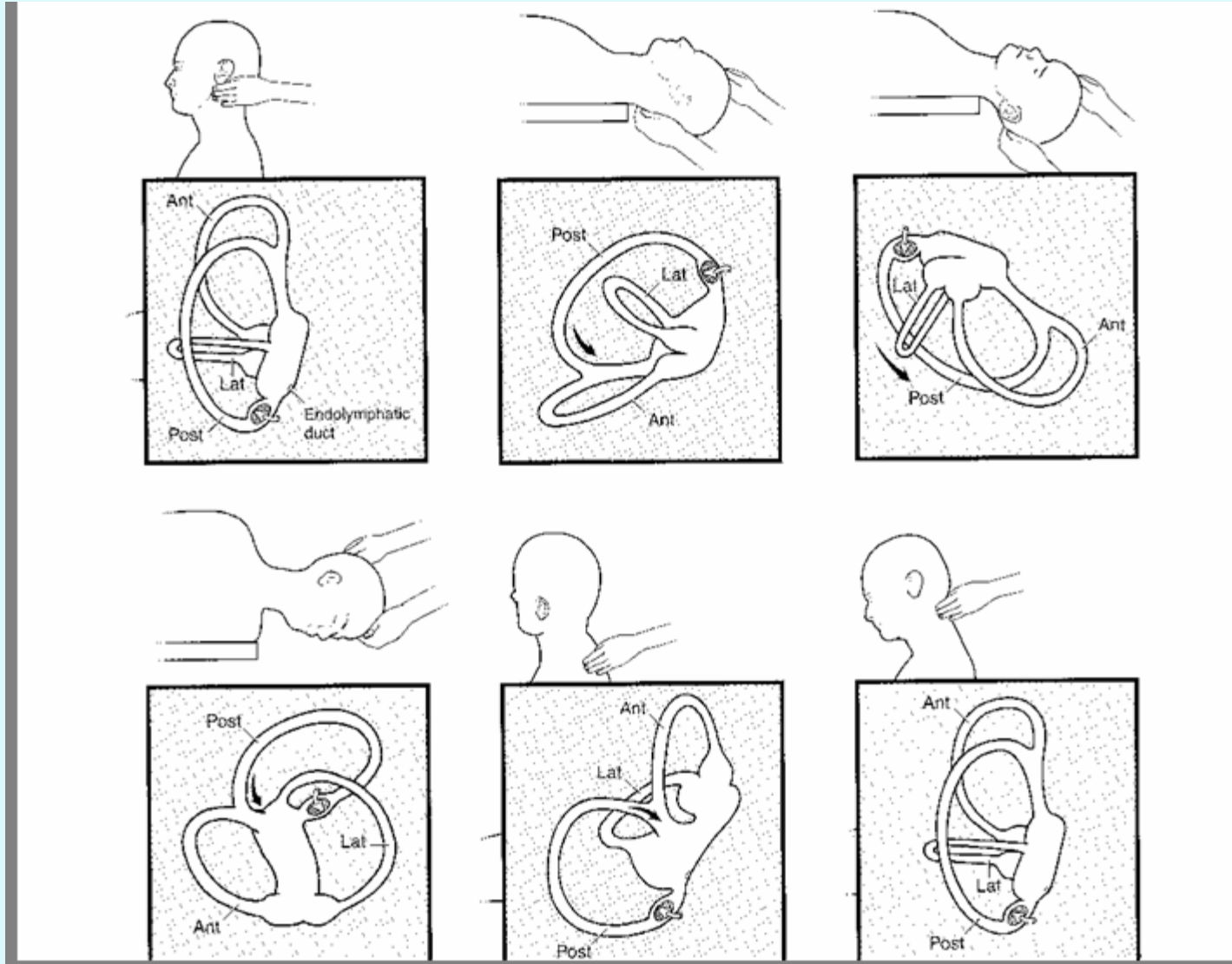
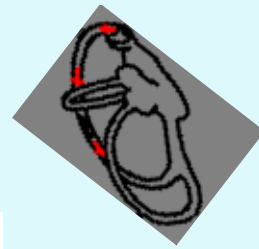
rt bppv
dix hallpike
rt

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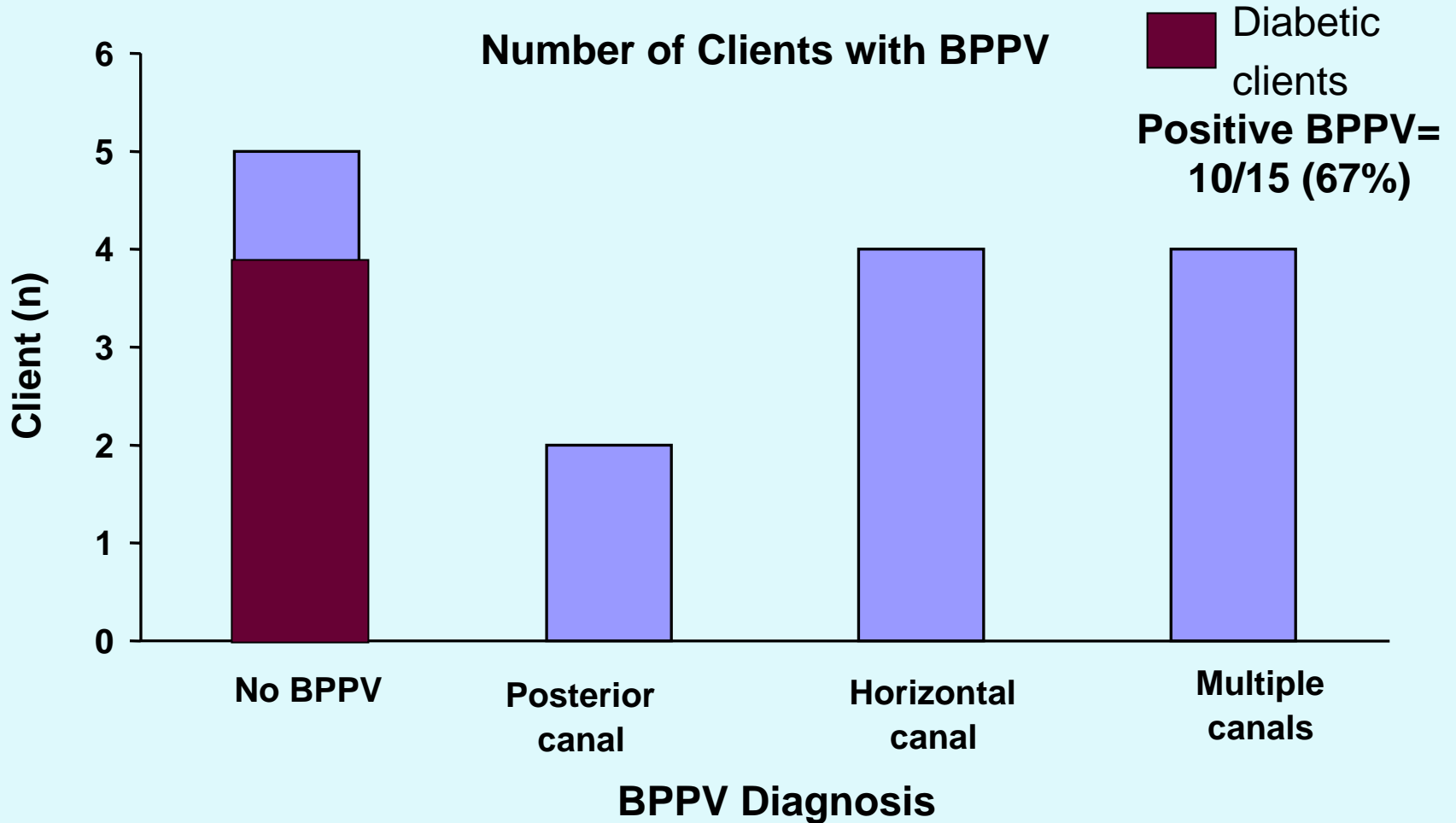
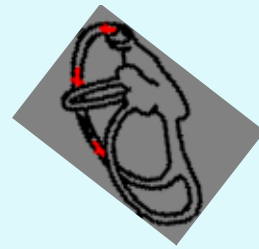


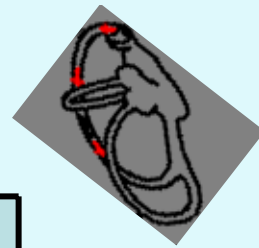
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Treatment of BPPV: Modified Epley



BPPV results:

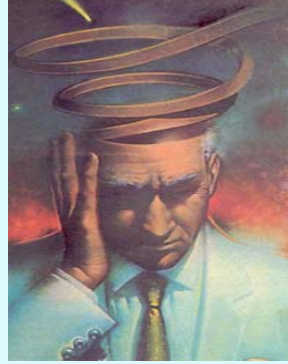




BPPV results:

BPPV diagnosis	No. clients reporting dizziness on direct questioning
Posterior canal	2/2
Horizontal canal	1/4
Multiple canal	3/4
No BPPV	0/5

Vestibular Hypofunction:



- Definition:

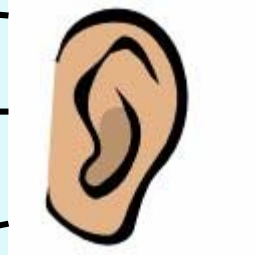
Vestibular information from one or both vestibular systems is not processed adequately.

- Typical Symptoms:

oscillopsia

visual vertigo

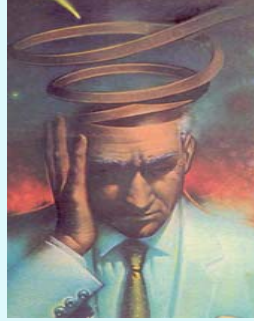
heavy headedness



vertigo

imbalance

Vestibular Hypofunction and diabetes:



- Literature Review:

- vestibular function is decreased in DM1

- (Biurrum et al 1991, Klagenberg et al 2007, Rigon et al 2007, Petrofsky et al 2005)

- Rigon et al 2007: n=30 type 1 DM, 7-56 yo

- 60% clients had vestibular involvement

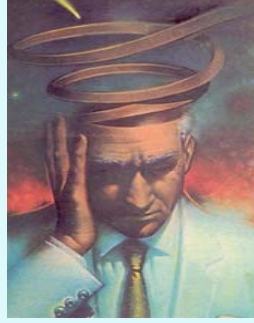
- 10% clients had auditory symptoms

- No studies were found correlating vestibular loss and

- DM Type II clients

- Amputee clients

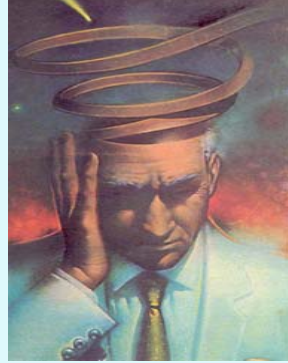
Vestibular Hypofunction and diabetes:



Possible underlying mechanisms:

- Microangiopathy to inner ear blood supply (Baloh 2000)
- The inner ear is dependent on a dynamic flow of glucose since it does not store energy. Therefore minor variations in blood glucose, both up and down, affects its function (Rigon et al, 2007)

Vestibular Hypofunction: Methods



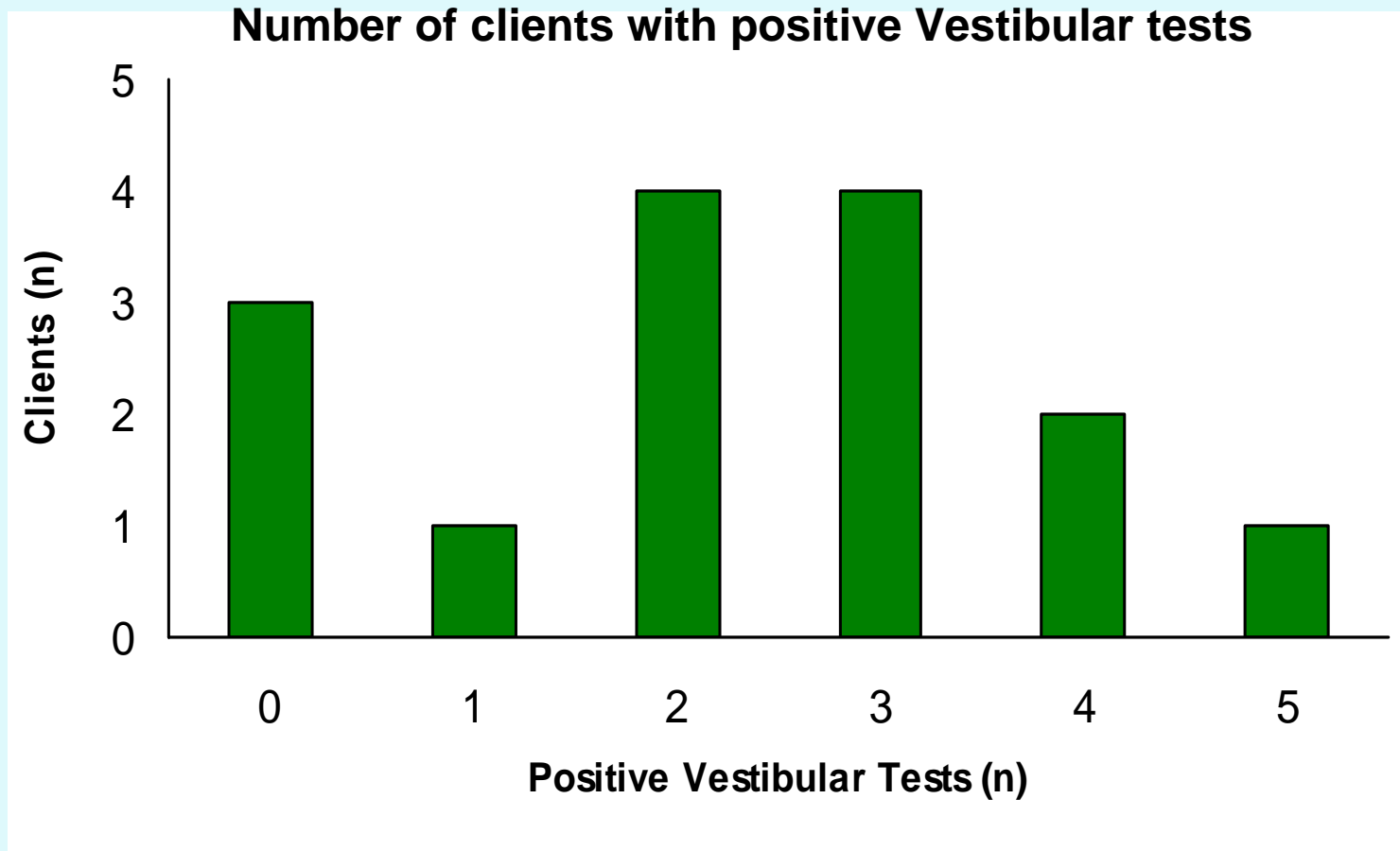
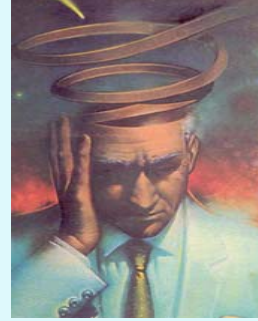
Vestibular tests performed:

1. Head thrust test
2. Spontaneous nystagmus
3. Spontaneous nystagmus with 30 deg right gaze
4. Spontaneous nystagmus with 30 deg left gaze
5. Mastoid oscillation
6. Head shake nystagmus
7. Supine spontaneouse nystagmus
8. Non directional changing horizontal nystagmus on roll testing

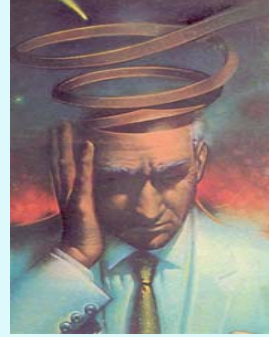
Gaze stability test: Dynamic visual Acuity

Questionnaire: Dizziness Handicap Inventory

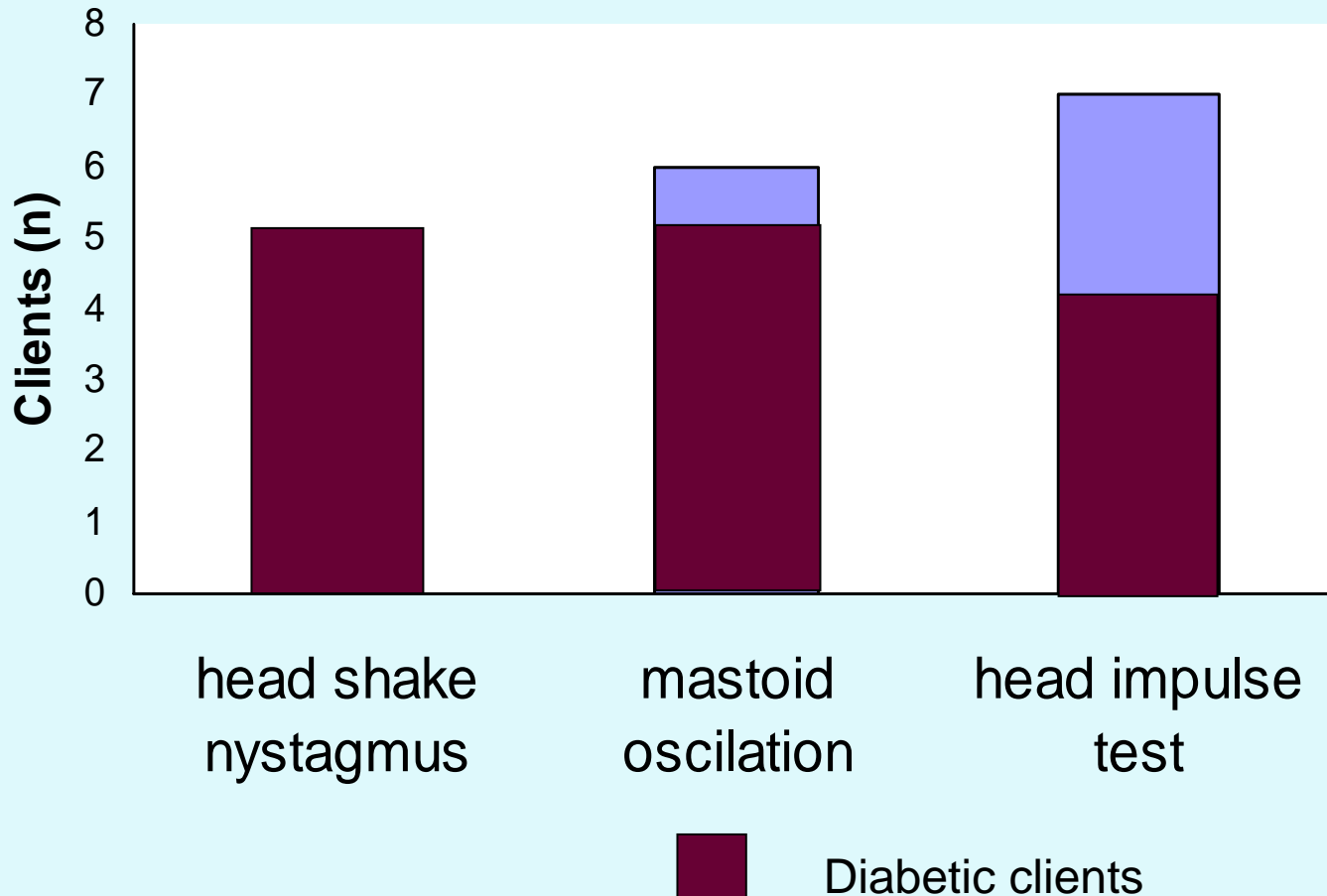
Vestibular Hypofunction results:



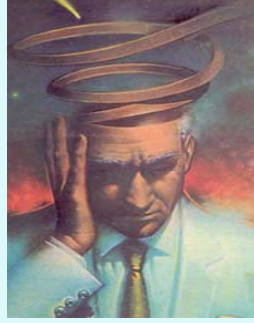
Vestibular Hypofunction results:



Number of clients with a positive result for three specific tests



Vestibular Hypofunction results:

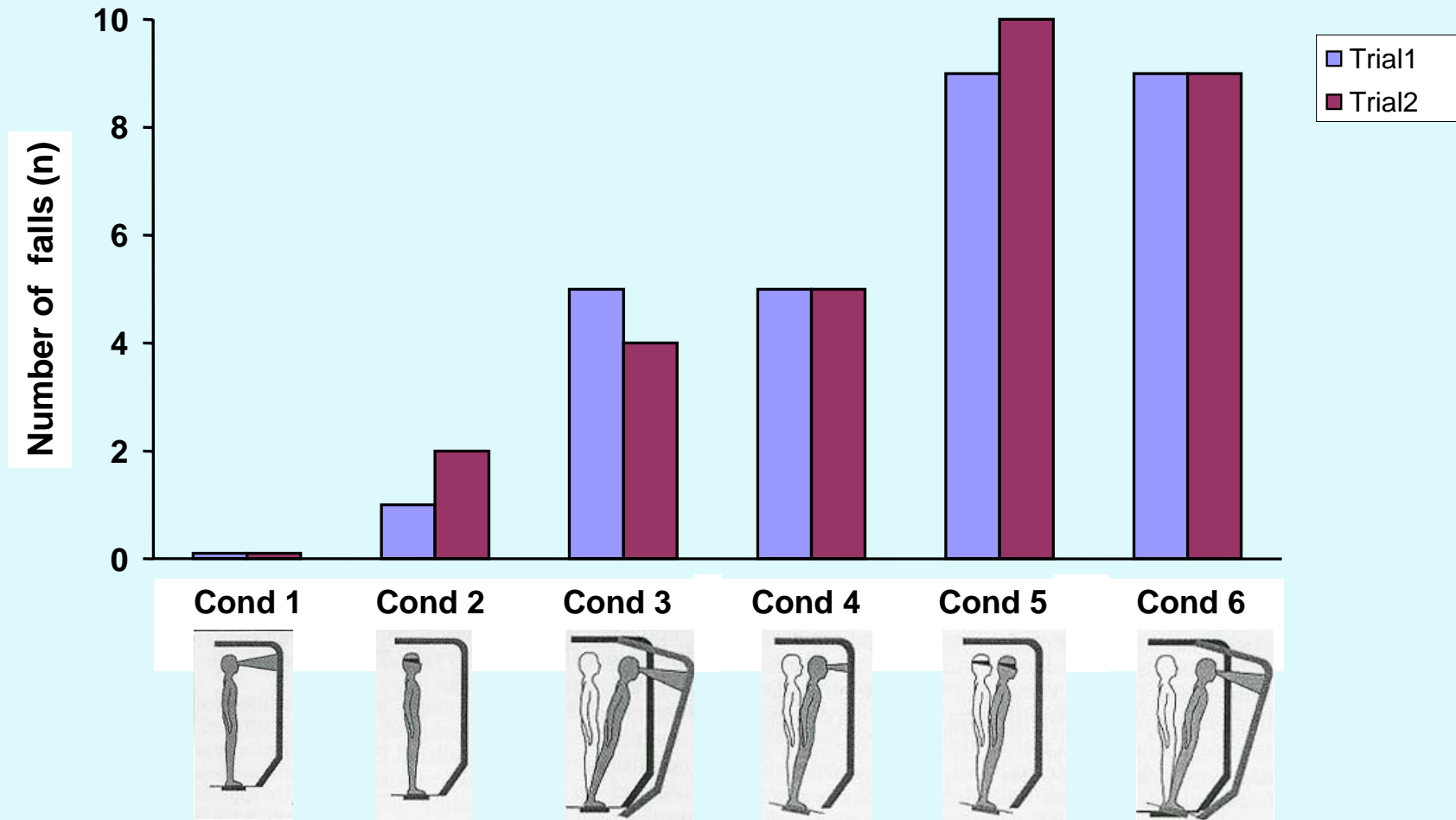


- Dynamic Visual Acuity:
 - 6/15 clients static acuity was inadequate to perform the test
 - 4/9 impaired DVA
 - 5/9 normal DVA
- Dizziness Handicap Inventory:
 - mean and standard deviation score: $4.3 \pm 7.8/100$

Sensory Organization Test results:

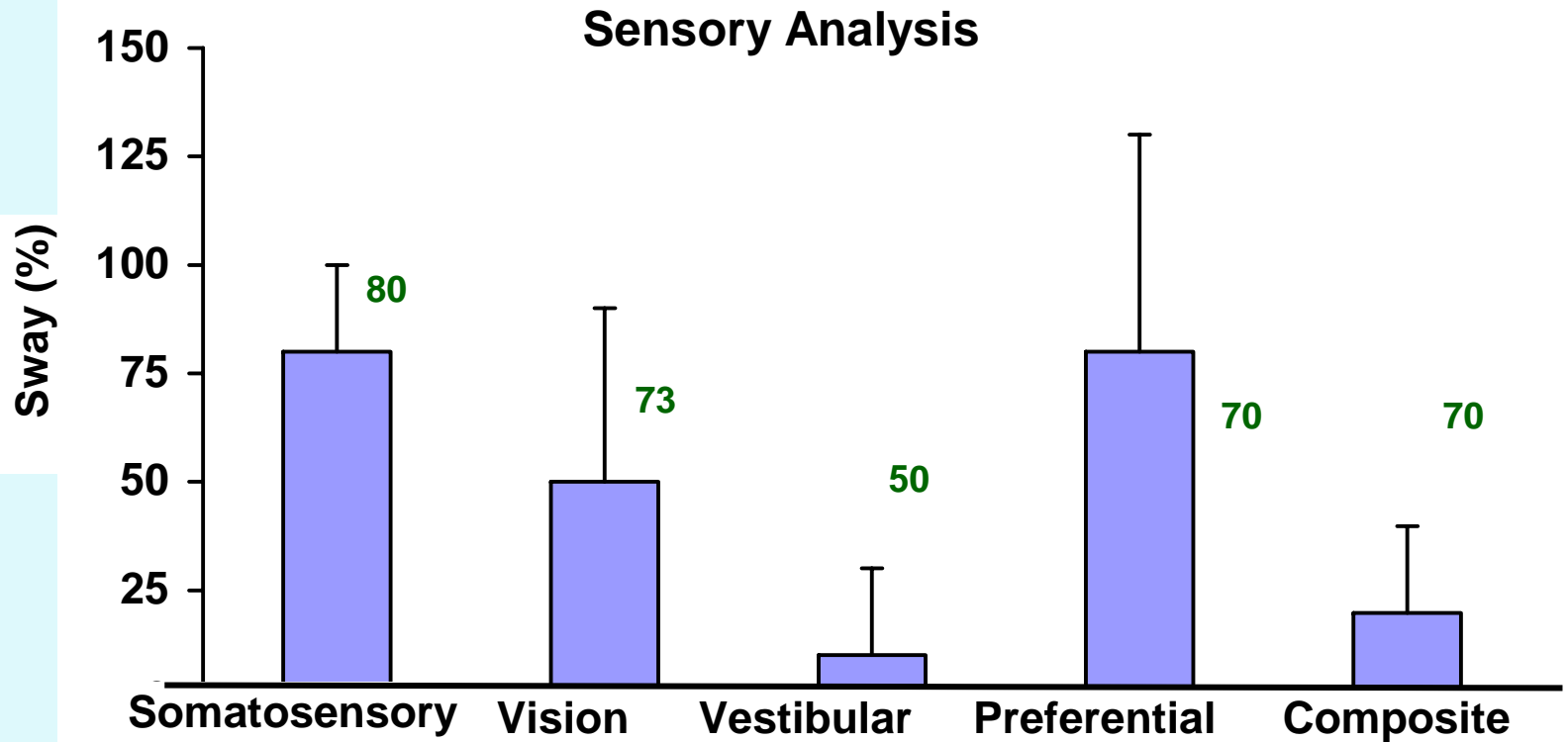


Number of falls during Sensory Organization testing



N= 11

Sensory Organization Test results :

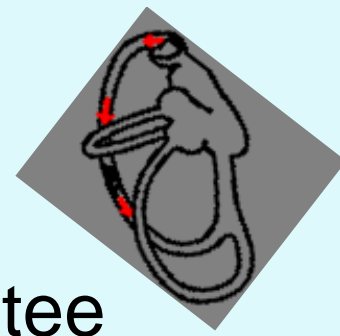


N= 11

Norms for Sensory Analysis score for 70-79 yrs

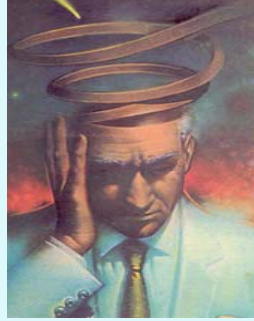
Composite <38 = risk of falls (Whitney et al 2006)

Conclusion Part 1: BPPV

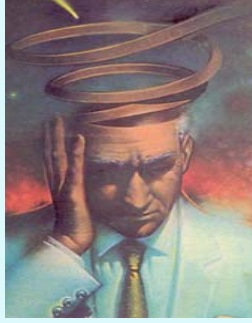


- Higher incidence of BPPV in the amputee subjects studied than in the general population
- Importance of asking amputated clients if they experience dizziness, since they rarely spontaneously identify it as a difficulty
- BPPV screening seems recommended
 - Dix Hallpike Manoeuvre
 - Roll test

Conclusion Part 2: Vestibular Hypofunction



- There is a high incidence of positive vestibular tests, especially in amputee clients secondary to diabetes and possibly PVD
- Therefore,
 1. **we suggest incorporation of sensory retraining principles into amputee training:**
 - **Balance exercises with eyes closed**
 - **Quick movements**
 - **Head movements while walking**
 2. **The Impact of vestibulopathy and its potential for rehabilitation on gait and balance in people with amputation is the next step in our research study**



Conclusion Part 2: Vestibular Hypofunction

Explanation for clients' lack of reporting dizziness

- avoidance of situation that provoke dizziness
- concern for more pressing medical issues
- habituation secondary to chronic onset
- bilateral impairment

Conclusion Part 3: SOT



- **Balance is WNL if it is not challenged**
The clients were able to stand bipodally without support with eyes open.
- **With increasing demand of the balance task → balance ability is decreased**
Subjects fell when the platform moved, and did not correct their center of mass when it was displaced
- **Significant reduction in endurance**
Inability to perform 3 repetitions of each of the 6 conditions

Future Research Plans:

- Time line of static and dynamic norms for people during prosthetic training to show their progression with rehabilitation
- Impact on vestibular impairment on lower extremity amputees' function
- Investigation if vestibular rehabilitation, as an adjunct to prosthetic gait training, is beneficial to mobility and balance
- A healthy age-matched control group is needed

Acknowledgements

- Gevorg Chilingaryan, M.P.H (Biostatistician at the JRH): for all the gracious help in the statistical analysis and help with the graphs
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- The subjects who volunteered to participate for this study



BPPV Assessment: Dix Hallpike manouver:



BPPV Treatment: Epley Maneuver

