EFFICACY OF HOME BASED PARTICLE REPOSITIONING MANEUVER IN TREATMENT OF POSTERIOR CANAL BENIGN PAROXYSMAL POSITIONAL VERTIGO

A dissertation submitted to the Tamil Nadu Dr. M. G. R. Medical University, Chennai in partial fulfilment of the requirement for the MS Otorhinolaryngology (Branch IV) degree examination to be held in May 2019.

EFFICACY OF HOME BASED PARTICLE REPOSITIONING MANEUVER IN TREATMENT OF POSTERIOR CANAL BENIGN PAROXYSMAL POSITIONAL VERTIGO

Dissertation submitted to the

THE TAMIL NADU DR. MGR MEDICAL UNIVERSITY, CHENNAI

In partial fulfillment of the requirements for the degree of

MASTER OF SURGERY

IN

OTORHINOLARYNGOLOGY

By

RANJU R L

Register number: 221514354

DEPARTMENT OF OTORHINOLARYNGOLOGY

CHRISTIAN MEDICAL COLLEGE

VELLORE

MAY 2019

CERTIFICATE

This is to certify that "**EFFICACY OF HOME BASED PARTICLE REPOSITIONING MANEUVER IN TREATMENT OF POSTERIOR CANAL BENIGN PAROXYSMAL POSITIONAL VERTIGO"** is the bonafide work of Dr. Ranju. R. L under my supervision in the Department of Otorhinolaryngology, Christian Medical College Vellore in partial fulfillment of the requirements for the M.S ENT Examination Branch IV of the Tamil Nadu Dr. M.G.R Medial University to be held in May 2019 and no part thereof has been submitted for any other degree.

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CERTIFICATE BY THE HEAD OF THE DEPARTMENT/ PRINCIPAL

This to certify that "**EFFICACY OF HOME BASED PARTICLE REPOSITIONING MANEUVER IN TREATMENT OF POSTERIOR CANAL BENIGN PAROXYSMAL POSITIONAL VERTIGO"** is the bonafide work of Dr.Ranju.R .L under the supervision of Dr.Anjali Lepcha, Professor and Head of ENT unit 4 in the Department of ENT, Christian Medical College Vellore.

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DECLARATION

I, Ranju R L, do hereby declare that the dissertation titled "**EFFICACY OF HOME BASED PARTICLE REPOSITIONING MANEUVER IN TREATMENT OF POSTERIOR CANAL BENIGN PAROXYSMAL POSITIONAL VERTIGO"** is a genuine record of research done by me under the supervision and guidance of Dr Anjali Lepcha, Professor and head, Department of ENT-Unit 4, Christian Medical College, Vellore and has not previously formed the basis of award of any degree, diploma, fellowship or other similar title of any university or institution.

Vellore

Date

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Post graduate student

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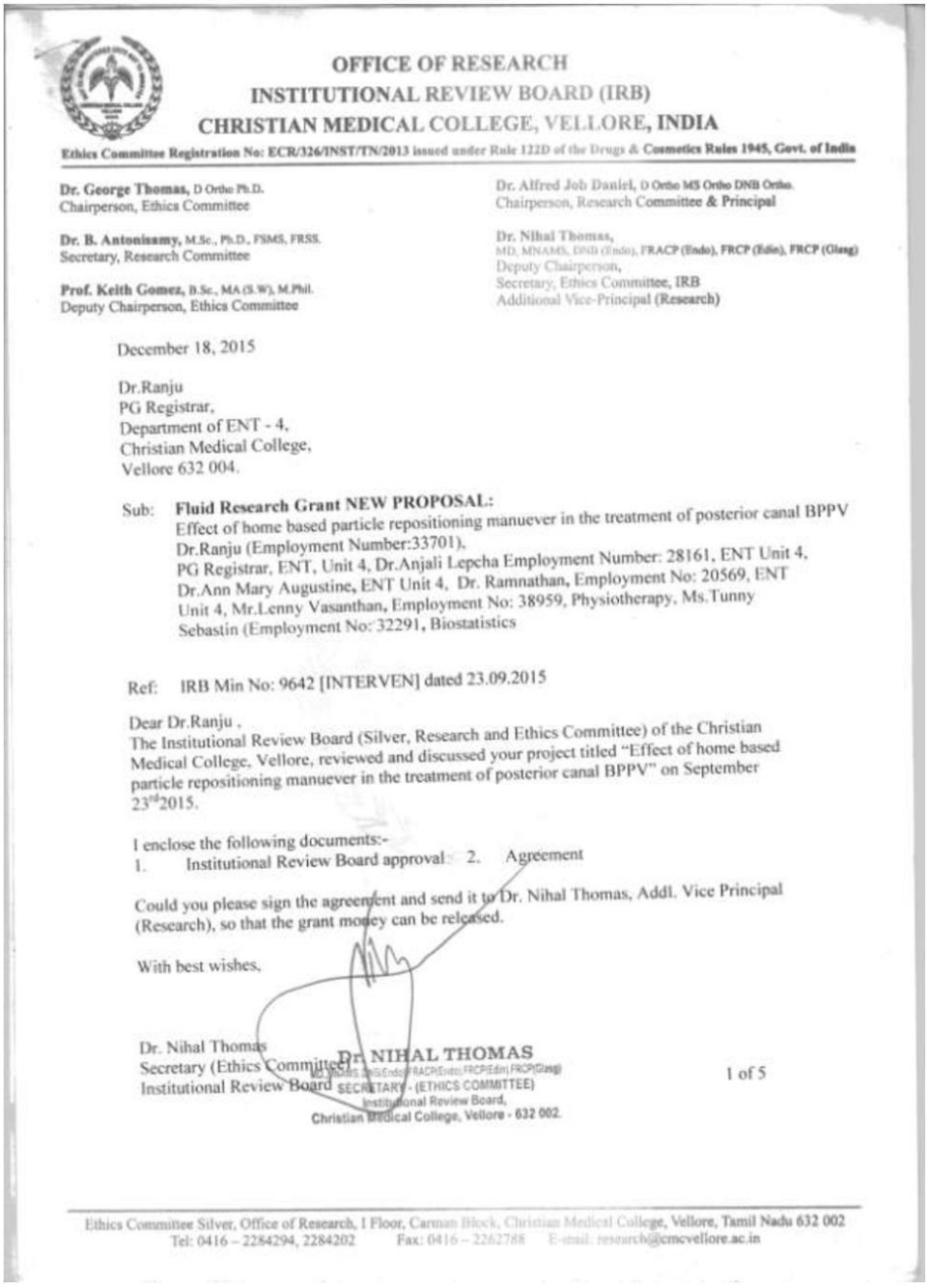
Lastly, I am thankful to God, my husband, my parents, my parents in law and my brothers for all the moral support, technical help and fine tuning my work and continuously cheering me to accomplish what I am assigned with.

INSTITUTIONAL REVIEW BOARD CERTIFICATE



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Effect of home based particle repositioning manuever in the treatment of posterior canal BPPV
Dr.Ranju (Employment Number:33701),
PG Registrar, ENT, Unit 4, Dr.Anjali Lepcha Employment Number: 28161, ENT Unit 4,
Dr.Ann Mary Augustine, ENT Unit 4, Dr. Ramnathan, Employment No: 20569, ENT
Unit 4, Mr.Lenny Vasanthan, Employment No: 38959, Physiotherapy, Ms.Tunny
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The Institutional Review Board (Silver, Research and Ethics Committee) of the Christian Medical College, Vellore, reviewed and discussed your project titled "Effect of home based particle repositioning manuever in the treatment of posterior canal BPPV" on September 23rd2015.

I enclose the following documents:-
1. Institutional Review Board approval 2. Agreement

Could you please sign the agreement and send it to Dr. Nihal Thomas, Addl. Vice Principal (Research), so that the grant money can be released.

With best wishes,

Dr. Nihal Thomas
Secretary (Ethics Committee)
Institutional Review Board

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The Committee reviewed the following documents:

1. IRB Application format
2. Proforma
3. Patient Information Sheet and Informed Consent Form (English, Tamil, Hindi, Bengali, Hindi)
4. Cvs of Drs. Ranju, Anjali Lepcha, Ramnathan, .Ann Mary Augustine, , Mr.Lenny Vasanthan, Ms.Tunny Sebastin
5. No. of documents 1 – 4

The following Institutional Review Board (Silver, Research & Ethics Committee) members were present at the meeting held on September 23rd 2015 in the CREST/SACN Conference Room,Christian Medical College, Bagayam, Vellore 632002.

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Dr. Prasanna Samuel	MSc, PhD	Lecturer, Biostatistics, CMC, Vellore	Internal, Statistician
Dr. B. Poonkuzhali	MSC, PhD	Professor, Haematology, CMC, Vellore	Internal, Basic Medical Scientist
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Dr. Biju George	MBBS, MD, DM	Professor, Haematology, CMC, Vellore	Internal, Clinician
Dr. Deepak Abraham	MBBS, MS	Professor, Endocrine Surgery, CMC, Vellore	Internal, Clinician
Dr. Sathya Subramani	MD, PhD	Professor, Physiology, CMC, Vellore	Internal, Clinician
Dr. George Thomas	MBBS, D Ortho, PhD	Orthopaedic Surgeon, St. Isabella Hospital, Chennai, Chairperson, Ethics Committee, IRB.	External, Clinician
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Mrs. Pattabiraman	BSc, DSSA	Social Worker, Vellore	External, Lay person
Dr. Shirley David	MSc, PhD	Professor, Head of Fundamentals Nursing Department, College of Nursing, CMC, Vellore	Internal, Nurse

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We approve the project to be conducted as presented.

The Institutional Ethics Committee expects to be informed about the progress of the project, any **adverse events** occurring in the course of the project, any **amendments in the protocol and the patient information / informed consent**. On completion of the study you are expected to submit a copy of the **final report**. Respective forms can be downloaded from the following link:

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http://172.16.11.136/Research/IRB_Polices.html in the CMC Intranet and in the CMC website link address: http://www.cmch-vellore.edu/static/research/Index.html.

Kindly provide the total number of patients enrolled in your study and the total number of withdrawals for the study entitled: "Effect of home based particle repositioning manuever in the treatment of posterior canal BPPV" on a monthly basis. Please send copies of this to the Research Office (research@cmcvellore.ac.in)

Fluid Grant Allocation:

A sum of 19,000/- INR (Rupees Nineteen Thousand only) will be granted for 2 years and out of which a maximum of Rs.5000/- can be spent for stationery, printing, Xeroxing and computer charges(If computers used are within the institution)

Yours sincerely

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Secretary (Ethics Committee)
Institutional Review Board
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Sources included in the report:

https://www.drugs.com/mcd/benign-paroxysmal-positional-vertigo-bppv
https://www.hindawi.com/journals/ijoto/2011/835671/

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CONTENTS

ABSTRACT

BACKGROUND: Benign paroxysmal positional vertigo (BPPV) is one of the most common causes of vertigo in patients visiting the outpatient department (OPD). Many patients find it difficult to visit the hospital numerous times for a standard Epley's maneuver which has to be performed only by a specialist.

OBJECTIVE: Our aim is to compare the efficacy of a home based particle repositioning procedure (HBPRP) with the standard Epley's maneuver in treating patients with posterior canal BPPV.

METHODS: This was a prospective non blinded randomized controlled study comparing two groups, where one group received the standard treatment and other received a new HBPRP. The vertigo scale, nystagmus duration during Hallpike test and frequency of vertigo, were documented on first, second and third visits. Complications if any were also noted during second and third visit. The parameters were compared in both the groups following the treatment in all visits.

RESULTS: Thirty patients were randomized into 2 groups. There were 15 patients in each arm. Group 1 received Epley and group 2 received HBPRP. There was no significant difference in the baseline characteristics of patients like age, gender, co morbid illness in both groups. Statistical analysis showed that there was no difference in the reduction in vertigo scale, duration of nystagmus following Hallpike test, frequency of vertigo in both groups.

CONCLUSIONS: This study showed that HBPRP is a safe and effective procedure and can be taught as a home based treatment for patients diagnosed with posterior canal BPPV.

Key words: BPPV, Epley maneuver, Dix – Hallpike test, home based particle repositioning maneuver

INTRODUCTION

Benign paroxysmal positional vertigo (BPPV) is one of the most common vestibular disorders. It accounts for about 17 % to 20% of all vertigo cases(1–3) . The prevalence of disease is 11 -64 / 10000. The life time prevalence is 2.4%(4) . There is a 1 year prevalence of 1.6% and 1 year incidence of 0.6% (4). BPPV presents with short episodes of vertigo lasting for a few seconds, usually precipitated by changing head positions with respect to gravity and associated with nausea, vomiting and nystagmus(3) . The disease is benign and usually self limiting but can be troublesome for the patient. It usually lasts for about 2 weeks. It can recover spontaneously in 20% by 1 month and in 50% by 3 months(5,6). The mean age of incidence is fourth and fifth decades, but it also can occur in childhood(7). The most commonly affected canal is the posterior semicircular canal(60-90%), second most common is the horizontal canal (5-30%) and anterior canal is rare(3,8,9). BPPV is most commonly found in elderly and in women(4,10), though there are studies which report the contrary. (11)

'Romeo and Juliet' by Shakespeare gives the earliest reference of BPPV. In medical literature, Adler first described the positionally induced vertigo. (12) Later in 1921 Barany described BPPV for the first time. He described it as an otolith disease .(12) The diagnosis is by a simple test which can be performed in the outpatient clinic itself and treatment is cheap and effective. In 1952, Dix and Hallpike described the classic positioning which induced the characteristic nystagmus and it is now used as the diagnostic test for BPPV.(13) This enabled easier clinical diagnosis of the disease.

The most common cause of BPPV is that following head injury(14,15). It is also seen following an episode of vestibular neuronitis(16) and following prolonged bed rest(17). Such patients usually undergo multitude of investigations instead of a simple test for BPPV.

Earlier in 1992, it was Epley who first reported the canalolith repositioning procedure which is used as treatment for BPPV(2,18). It is both cheap and effective. There are other treatment maneuvers used for BPPV like Semonts maneuver and Brandt Daroff's exercise (19,20). Both Epley's manueuver and Semonts maneuver have been shown to be superior to Brant Daroff's exercise. But both these manoevres have to be performed by specialists, as there could be complications if performed by the patient him/herself or by bystanders.

There are surgical treatments for patients with recurrent BPPV. The surgical treatment is considered in patients with refractory symptoms, even after undergoing multiple particle repositioning maneuvers (21). The various surgical treatments used are laser assisted partitioning, posterior semicircular canal occlusion, utricular ablation and singular nerve section (22–26).

Another recent technique for diagnosis and management of BPPV is the mechanical assistance chairs. Epley Omniax System developed by Dr. John M. Epley and TRV chairs developed by Thomas Richard-Vitton are examples (27,28).

The conventional Epley’s maneuver is difficult in patients with neck pain and cervical spine diseases. It also needs a physician to perform the maneuver. The patient has to visit the hospital multiple times for repeating the maneuver.

Home based particle repositioning procedure is a potential alternative to the Epley's maneuver since it circumvents the inconveniences related to the latter. The patient can perform the exercise by themselves without the need of a physician or health personnel.

AIMS AND OBJECTIVES

AIMS

- To compare the efficacy of a Home based particle repositioning procedure (HBPRP) with the standard Epley's maneuver in treating patients with posterior canal BPPV.

OBJECTIVES

- To assess the decrease in intensity of vertigo and nystagmus in posterior canal BPPV in patients undergoing HBPRP
- To assess the decrease in frequency of symptoms in posterior canal BPPV in patients undergoing HBPRP
- To note any difficulties or complications associated with the use of the HBPRP

LITERATURE REVIEW

ANATOMY

PARTS OF EAR

The ear is a multifaceted organ that connects the central nervous system to the external head and neck. This structure as a whole can be thought of as 3 separate organs that work in a collective to coordinate certain functions, such as hearing and balance. Ear has 3 parts- external ear middle ear and inner ear (fig 1).

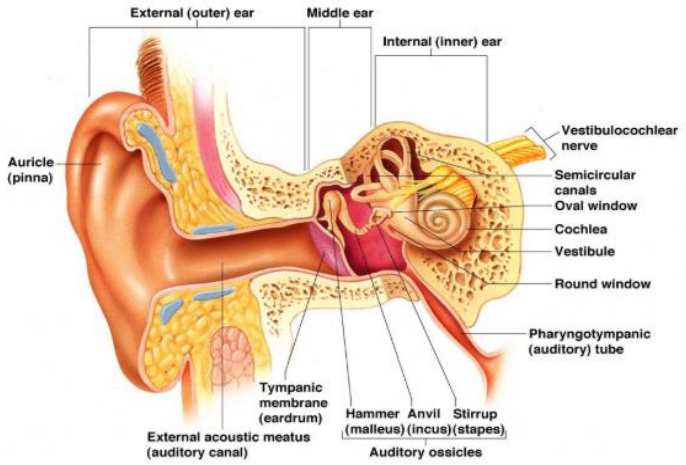


Fig 1: Anatomy of ear(29)

The three parts of ear helps in the detection, conduction and transformation of auditory signals to electrical stimuli. The signals are transmitted to the central nervous system by the afferent auditory nerve fibers

The external ear consists of the pinna, which is situated in the lateral part of temporal bone. It is connected to the external auditory canal. It extends from the concha of pinna to

the tympanic membrane. That canal is skin lined and ends at the tympanic membrane, or eardrum, the outer surface of which is skin lined. The tympanic membrane has a middle portion, which is fibrous tissue and an inner layer which is mucous membrane.

The middle ear consists of the inner surface of the tympanic membrane, the middle ear mucous membrane in which the ossicles of hearing, the malleus, incus and stapes is situated. The stapes is the smallest ossicle. It is found at the junction of the middle ear with the inner ear. The middle ear is an air containing compartment. The middle ear together with Eustachian tube,aditus, antrum and mastoid air cells is called middle ear cleft.

The inner ear lies deep within the petrous temporal bone, in a chamber of communicating ducts and cavities known as the bony labyrinth. The inner ear, or membranous labyrinth, a fluid-filled membranous structure with a shape similar to that of the bony labyrinth, is suspended within the bony labyrinth by a supportive network of connective tissue.

The membranous labyrinth may be functionally and anatomically divided into two main portions: the peripheral auditory apparatus, or cochlea, and the peripheral vestibular apparatus. The peripheral vestibular apparatus incorporates five structures: the three semicircular canals (SCCs), and two otolith organs, the utricle and saccule

VESTIBULAR SYSTEM

Our vestibular system ia a very complex system. It helps in the maintenance of our balance. It involves peripheral sensory system, central processor and motor output..

Peripheral sensory apparatus – helps to detect and to transmit information to central processing system about head position, angular and linear velocity(30)

Central processing system - all informations from sensory inputs are processed, helps to decide body and head orientation in space (30)

Motor output system – helps in the eye movements and body movements which happens during head & postural adjustments

The peripheral system involves membraneous labyrinth and bony labyrinth. It lies within the inner ear .Its lateral, medial and anterior borders are formed by middle ear, temporal bone and cochlea respectively

Bony labyrinth

The parts of bony labyrinth are the three semicircular canal, the cochlea and vestibule. The bony labyrinths is filled with fluid called perilymph . it was found to be having similar composition of cerebrospinal fluid and also is in continuation with CSF.(30) Perilymph communicates with cerebrospinal fluid through a duct called cochlear aqueduct. It was found that the function of inner ear was affected by the disorders affecting the pressure of the spinal fluid. The fluid has high concentration of sodium than potassium.(31)

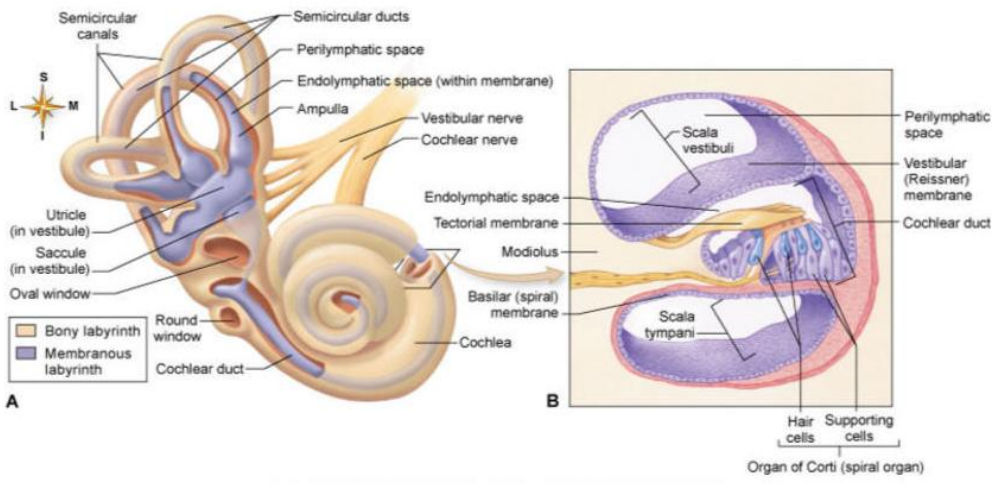


Fig 2: Anatomy of bony and membranous labyrinth(32)

Membranous labyrinth

The membranous labyrinth is situated within the bony labyrinth (fig 2). It is surrounded by perilymph. Within the membranous labyrinth, there is endolymph. In terms of electrolyte composition, endolymph is very much similar to intravascular fluid. There is high concentration of potassium than sodium. Three semicircular canals and otolith organs are parts of membranous labyrinth. Each semicircular canal end in a dialated end called ampulla. Utricle and saccule are the two otolith organs. The sensory neuroepithelium is present in ampulla and in macula with otolith organs. It is supplied by the vestibular part of vestibulocochlear nerve, the 8th cranial nerve.

Vestibular sensory system

Vestibular system has a resting vestibular tonus. It is due to the constant continuous influx of impulses from the vestibular nerve to CNS. It is because of this that any disturbance in one of the two vestibular organs will cause imbalance

Vestibular nerve

Approximately 18000 afferent nerve fibres are present in the human vestibular nerve. It is found that in scarpa's ganglion, with increasing age, there is a reduction in number of hair cells and nerve cells(33,34). Bipolar neurons are present in scarpa's ganglion. They are located lateral part of internal auditory canal. There is superior and inferior vestibular nerve and associated with it, there is superior and inferior group of cells. Cristae of superior and lateral canals, anteroposterior part of macula of saccule and macula of utricle are innervated by superior vestibular nerve. Main position of macula of saccule and crista of posterior canal are supplied by the inferior vestibular nerve. Large and small fibres are seen in the nerve. Type 1 hair cells seen in the summit of crista or the striola are innervated by large fibres. The periphery of macula and slope of crista has more of small fibres. Bimodal innervation is seen in auditory system. Type II cells, the phylogenitically older cells make direct contact with efferents. Efferent terminals contact the terminal or afferent nerve fibre in type 1 cells. Effect of efferent system is weak and inhibitory in nature on the afferent system. Hence as a response to stimulation, the primary it may allow afferent receptors to decrease or increase their activity. There are evidence to suggest the higher motor center modulation. It was noted labyrinthine stimulation

involved in initiating eye or body movement cause efferent activity preceding movements(35).

Sensory cells

There two types of sensory cells type I and type II (36).

The afferent nerve fibre form a nerve chalice at the terminal end and it surrounds the flask shaped type I cells (fig 3). There are collateral extensions found in many calices which end in type II cells(37). It is found that apart from collaterals synapsing with the type II cells, they synapse directly with the outer membrane of nerve calyces which surrounds the type I cells. It was also observed that efferent nerve endings also terminate on type II hair cells and on the afferent nerve calyce. Microvilli are present in the apical surface of hair cells. These microvilli forms the stereocilia. One of the stereocilia is elongated to form kinocilia. It is the true cilia with 9+2 microtubule arrangement. The steriocilia are arranged in increasing height towards the kinocilia. The stereocilia, which are nonmotile and rigid, are not true cilia but instead consist of actin filaments in a paracrystalline array with other cytoskeletal proteins. The kinicilia is the longest stereocilia and is located eccentrically which will impart a polarization of the hair cell. Approximately 70 stereocilia and one kinocilium are found in the upper surface of hair cells(34). The stereocilia extend their rootlets into the cuticular plate which is the thicker region on the upper surface of hair cells. The stereocilia in macula and crista are slightly different in length. They a few microns of length in macula whereas in crista they are longer upto 35micrometers(38).

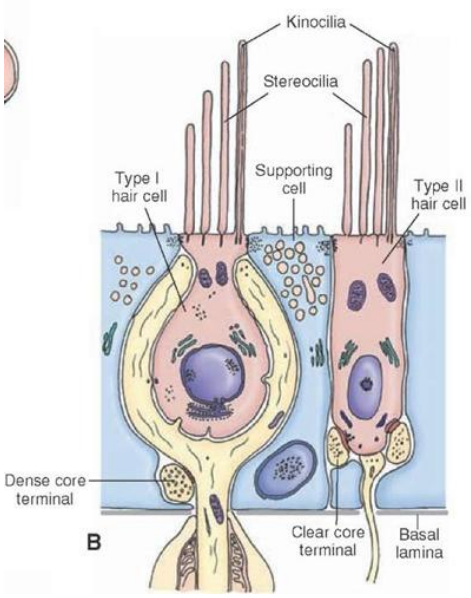


Fig 3:Anatomy of type I and II hair cells(39)

The phylogenitically older cells are type II cells. They are cylindrical in shape. The arrangement of steriocilia and kinocilia are same as type 1 cells.

Saccule and utricle

The utricle lies superior to saccule and it slopes anteriorly upwards at an angle of approximately 30 degree. It is oblong and irregular. In the superior dialated part of utricle, lies the macula utriculi. It lies mostly in the horizontal plane. Macula of both the sides are in the same plane. It was found to have almost 33000 hair cells(40).

The saccule is hook shaped. It is found in the vertical plane. It lies in the medial wall of the vestibule in a spherical recess. The mean area was found to be 2.4meter square(41). Approximately 18000 hair cells are found in saccular macula. A curved line, named 'striola' divides the macula into two area(42,43). The part which is on the convex side is

called pars 'externa' and the part which is on the concave side is called pars 'interna'. It is found that type I cells are seen in high density in the striola(44). Based on the location of the kinocilium facing the striola each hair cell is structurally polarized. The kinocilium is found to be polarized away from the striola in saccule. In utricle it is toward the striola. The striola of the utricle have a thinner otoconial layer compared to that of the one found in saccule.

There are a number of small hexagonal and cylindrical shaped bodies with pointed ends, which are called otoconia or statoconia overlying the neuroepithelium (fig 4). They are calcium carbonate particles. They are embedded in the otoconial membrane which is a gelatinous substance. The hair cells project into the gelatinous membrane. They are displaced by the otoconial mass relative to sensory epithelium.

Otoconial layer

A gelatinous layer, a subgelatinous space and otoconia are present in otoconial layer. The length of each otoconia is 3 -19 micrometers. It is made of organic protein matrix along with inorganic calcium carbonate in crystallized form of calcite and has specific gravity of 2.71. The atypical cytoplasm of supporting cells produce the organic material which form the core on which inorganic material is seeded. The enzyme carbonic anhydrase present over the epithelium helps in the reaction which lead on to the formation of calcium carbonate crystals. They are in turn trapped in the matrix which will result in formation of otoconia. It was found that the otoconia undergoes chemical change with ageing(45). It is related to the degeneration of the neuroepithelium(46). The otoconia

were found to undergo turnover. The dark cells found in utricle help in this.

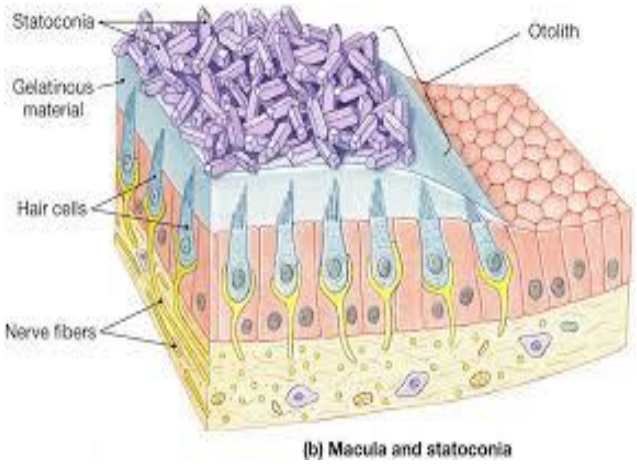


Fig 4: Anatomy of otoconial membrane with neuroepithelium(47)

Semicircular canals

- The openings of semicircular canals are widened to form ampulla. The ampulla is supplied by Eighth cranial nerve (vestibular division). The ampulla has crista ampullaris which is the specialized sensory epithelium(48). It has specialized hair cells, cupula, supporting cells other than connective tissue, nerve fibres and blood vessels. The crista forms a raised section of the wall and is found to extend across floor of ampulla. It is saddle shaped. The crista has a apex which is the central part and peripheral sloping part. The shape helps in packing maximum number of hair cells (fig 5).

- It is found that the lateral semicircular canal is polarized towards the utricle, whereas the posterior and superior canals are polarized away from utricle(48).

The hair cells are not in direct contact with endolymph. They are embedded into cup7ula, a gelatinous membrane. The investigations has shown that the structure of cupula is extremely hydrous structure. It results in distortion during fixation which contains proteoglycans arranged in a filamentous network(49–51). Studies have given evidence that it is secreted by supporting cells(52,53). It has same specific gravity as the endolymph surrounding it-prevents from floating in it. The transferring of endolymph fluid movement stimuli to the hair cells is by the help of cupulla in the ampulla of SCC(54). This will in turn produce kinetic reflexes.

The cupula is attached to the ampulla wall firmly and it is considered as a physiological necessity. The cupula studies has shown that it has a diaphragm like displacement in the central section and at the base (55). It was also found that the endolymph pass through the subcupular space (56). It was found in studies using ultrafine particles of dextran magnet which was injected into the membranous canal , that the fluid was able to pass through the subcupular space under very low pressure. There was no evidence of obvious increase in ampullary pressure. In the midpoint of cupula there was a displacement of as small as 0.76micrometers(57).

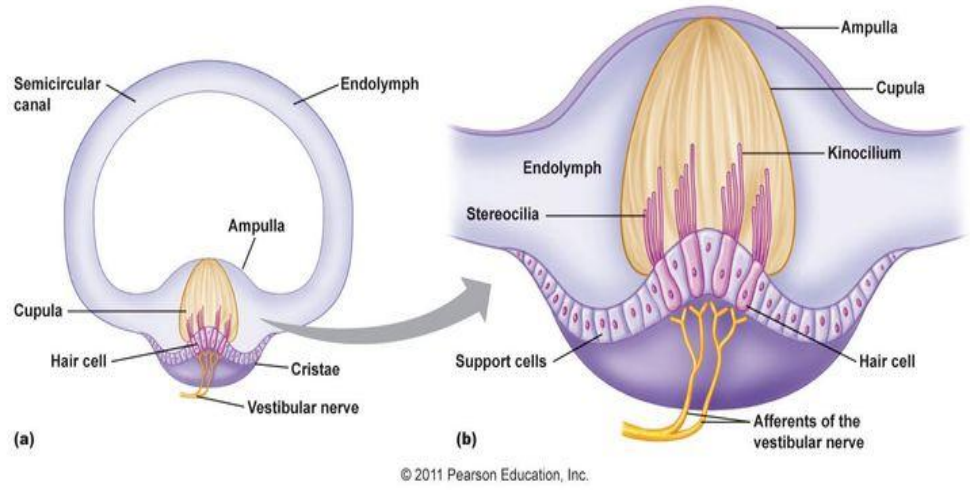


Fig 5: Anatomy of crista ampullaris(58)

Supporting cells are the cells which surrounds the sensory cells. They are secretory in nature. The sensory cells are provided insulation by them. Precursor cells which give rise to sensory cells are also formed by them. The dark cells are found in membranous labyrinth in sensory epithelia, except saccule(59). They are believed to produce endolymph. Associated with dark cells, there are pigmented cells or melanocytes. They help in development and maintenance of unique composition of endolymph.

PHYSIOLOGY

Motion decomposition and orientation in the head

The inner ear has an anatomical design in which the peripheral system reflects six degress of freedom. The rotational motion is detected by semicircular canals whereas the macules detect the translations. The orientation of semicircular canals are in such a way that left and right canals act as parallel systems (fig 6). The right anterior canal is parallel to left posterior canal, similarly left anterior canal and right posterior also lies in the same plane.

In the lateral plane both horizontal canals are parallel. It has to be noted that in upright position, with respect to horizontal axis, the horizontal canal make an angle of 30 degree. With the sagittal plane of the head, vertical canals make an angle of 45 degree.

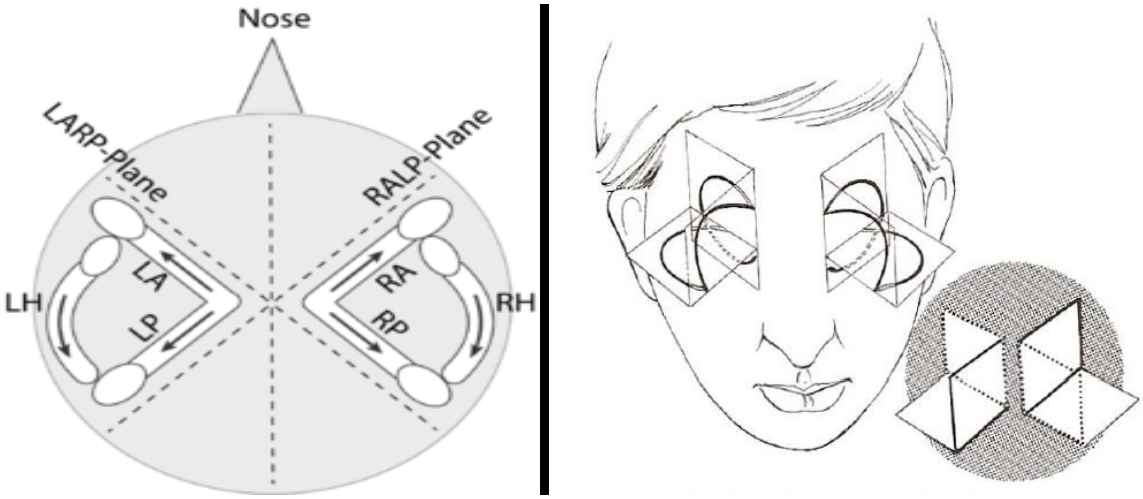


Fig 6: Orientation of semicircular canals(30)

Movement detection

The movement detection and orientation of vestibular system follows the laws of physics. Whenever the head and body movement occurs, they are related to accelerations. These are sensed by the vestibular organ. It is due to the rigid coupling of sensory epithelium and bony structure. The inertial forces drive the fluid filled system, which is attached to the skull. There is a fluid lag during any motion of head. This relative displacement is trigger for the detection of movement. In order to limit the hair cell movement during head movements, the design of the canal system in a way that defection of hair cells and head velocity are proportional.

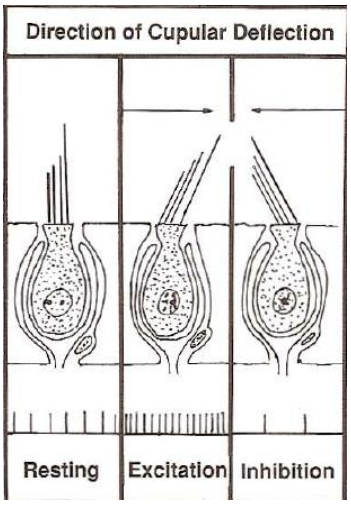
Role of semicircular canals

The detection of movement in head is due to the trigger produced by movement of endolymph in the SCC. The centripetal force is the only force acting on object which is rotating in a constant angular speed. During constant rotatory motion , the sensory epithelium is not triggered by any force in a way it stimulates the cupula. It detects only changes in rotation that is they are rate sensors (fig 7a).

Through evolution, SCC is also adapted to detect all natural human movements including transient rotations such as back and forth movements. The generation of eye movement that matches the head velocity is with the help of sensory input by the SCC. It helps to maintain the eye position during head movements.

The SCC which has a coplanar pairing of the canals results in push pull change in quality of SCC output. In a shared plane when angular motion occurs, the endolymph is displaced in opposite directions. The neural firing increases in one vestibular and decreases on the other (fig 7b).

There are certain advantages of push pull arrangement. The first advantage is sensory redundancy, that is if one SCC is affected by any disease, the input to the CNS will not be stopped because of the other other pair. The second is common mode rejection. Because of this pairing, any simultaneous changes in the neural firing (for example the change which can occur due to raised body temperature) will be ignored by the brain. The third is that it assists in compensation of sensory overload.

a) 

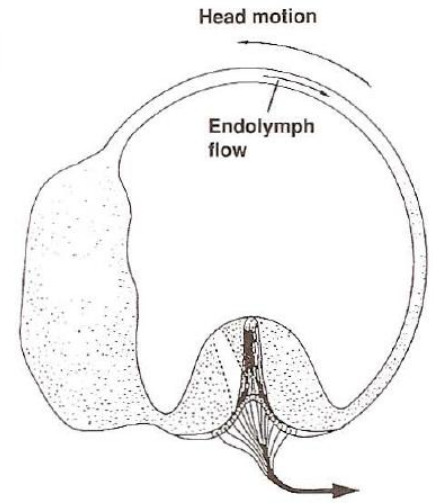
b) 

Fig 7: a)Direction of cupular deflection ; b) direction of head movement with endolymph movement(30)

Role of Otolith organs

The otolith organs are oriented in such a way that the utricle is horizontal whereas the saccule is in vertical plane. Most of the movements are detected by both the organs because of the curved structure.

Thus the translational movements causing linear acceleration along with static tilts of head are detected by both utricle and saccule. The ototlith membrane has a density higher than the endolymph surrounding it. Any movement of the membrane causes the defection of hair follicles, which are embedded at its base. They produces a signal which is sent to brain.

According to Equivalence principle of Einstein, no single physical device can distinguish gravity from linear acceleration. Since otolith cannot distinguish between linear acceleration and tilt, this gives difficulty to CNS. The sum of all accelerations are sensed by the otolith organs during natural movements. By interpreting these signals, they are able to initiate postural changes and eye reflexes which are mediated by vestibular nuclei. They enable in diverting the appropriate signals either to trunk, limb and neck muscles with the help of vestibulospinal tract or to the eye muscles with the help of vestibuloocular reflex. The central nervous system of humans distinguish between tilt and linear accelerations since vestibular, visual and proprioceptive senses functions together.

In short, during both active or passive movements, the gravitational acceleration that is the sum total of all accelerations acting on head are detected by the otolith organs. The direction of gravity is detected by otolith organs when there is no movement. The gravitational acceleration due to gravitational force is is a linear acceleration. The otolith organs detect the gravitational acceleration as tilt (fig 8). The head tilt laterally causes excitation of utricle due to the shear force exerted on utricle, this force is lessened on saccule. The sensory ambiguity problem arises since two sources contribute to gravitational acceleration- gravitational field and linear motion. The signals to the brain for higher level processing

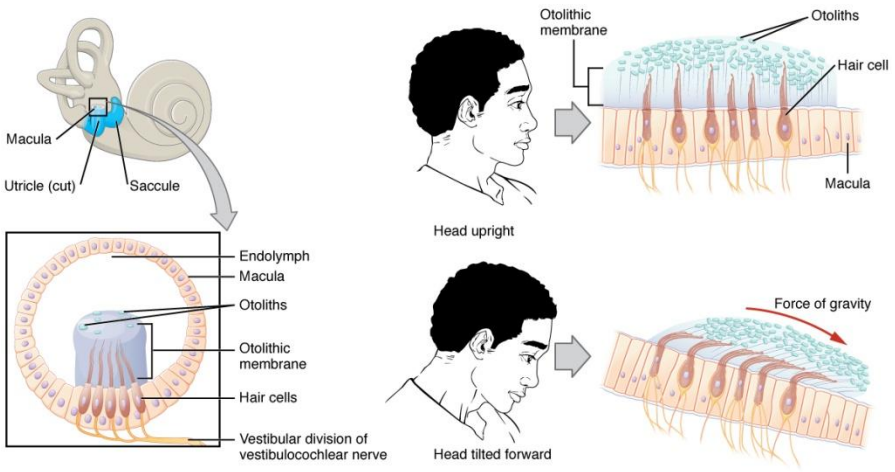


Fig 8: Direction of movement of stereocilia with accelaration(60)

Similar to that of semicircular canal, otoliths also has redundancy. Push pull mechanism is also involved in otoliths.

Role of Vestibular nerve

From bipolar neurons of vestibular ganglion, afferent fibres passes through vestibular nerve fibres. There are two different types of vestibular afferent neurons. The regular afferents have a tonic rate and also there is little variability between spike intervals. The irregular afferents has no firing at rest and they have variable interspike intervals. For VOR, regular afferents play an important role. Irregular afferents are important for VSR.

Central processing

The vestibular inputs from afferents goes to vestibular nuclear complex and cerebellum. The primary processor is vestibular nuclear complex. The adaptive processor is cerebellum.

Vestibular nucleus

There are four major nuclei in the complex. Superior, medial, lateral and descending along with seven minor nuclei present. VOR relays in superior and medial nuclei. VSR relays on lateral nuclei. Descending nuclei has no primary outflow of its own but is connected to all other nuclei. Between the two vestibular nuclei on either sides, there is a system of mutual inhibition.

Blood supply

Posterior inferior cerebellar arteries are the important supplying arteries for central vestibular arteries. Anteroinferior cerebellar arteries are the important supply for peripheral vestibular system.

Cerebellum

From the vestibular nucleus complex, major outflow is towards the cerebellum. Vestibulocerebllum is the term given to parts of cerebellum which has direct input from vestibular afferents. The projections from cerebellum to the nuclear complex is inhibitory. Cerebellar flocculus is the part which maintain the gain of VOR. The cerebellar nodulus is involved in adjusting the duration of VOR and processing of otolith input. The vermis is involved in VSR.

Neural integrator

Neural integrator is a brain stem structure which transform the velocity to position. For the horizontal occuomotor system, the nucleus prepositus hypoglossi which is situated below medial vestibular nucleus provide this function. For vestibulospinal system, though a neural integrator must exist, the location is unknown.

Motor output of vestibular system

VOR output

The motor neurons of occulomotor nuclei serves as output neurons for VOR. The extraoccular muscles are paired with semicircular canals. This helps in the conjugate movements of eyes in the plane of head motion.

The tracts involved are ascending tract of Deiters and medial longitudinal fasciculus. Ascending tract of Deiters carry information from vestibular nucleus to ipsilateral abducens nucleus. MLF carry output to the occulomotor nuclei.

VSR output

Anterior horn cells of spinal cord are the output neurons for VSR. The connection between mototr neurons and VSR are more complex. The pathways involved are lateral vestibulospinal tract, medial vestibulospinal tract and reticulospinal tract. The lateral vestibular tract is from the ipsilateral vestibulat nucleus that receives informations from otolith and cerebellum. The medial vestibulat tract is originating from contralateral medial, superior and descending vestibular nuclei. It helps in postural changes with

respect to sensory output from SCC. The reticulospinal tract has input from all vestibular nuclei, all sensory and motor systems involved in maintenance of balance

Vestibular reflexes

Vestibulo-ocular reflex

It has two components, angular and linear VOR. Rotation is compensated by angular VOR which is mediated by SCC. Translation is compensated by linear VOR which is mediated by otolith.

Vestibulospinal reflex

Stabilizing the body is the purpose of VSR. It has different reflexes as its component including dynamic, static or tonic and sensory input from canal and otolith.

Vestbulocolic reflex

Its action is mainly on neck muscles for the stabilization of head. The movement detected by semicircular canals and otoliths are counteracted by reflex neck movements because of the pathways mediated by VCR.

Cervical reflexes

Cervico-ocular reflex

This reflex mostly interacts with VOR. In certain situations, COR helps in the eye movements which are driven by proprioceptors in neck. The clinical significance of this reflex is less. It is facilitated in situations where the vestibular apparatus gets injured.

Cervicospinal reflex

This reflex is mediated by neck afferent activity which bring about limb position changes. By means of altering motor tone of body, CSR supplement VSR. CSR is also an assembly of several reflexes. It mediate certain reflex signals, from medullary reticular formation- an inhibitory pathway and from vestibular nucleus – an excitatory pathway.

Cervicocolic reflex

The head on the body is stabilized by this reflex. There is reflexive contractions of neck muscles in response to the afferent sensory changes that are caused by changes in neck position. Mostly in vertical plane, CCR works to stabilize head movements. After labyrinthine loss, it may also be facilitated.

Visual reflexes

Visual system influences the vestibular circuit, drives the postural reactions and visual after response. Visual responses occur at a longer latency due to the delays in the multisynaptic visual mechanisms. After vestibular loss these visual tracking reflexes may be facilitated.

Somatosensory reflexes

They play a role in maintaining postural stability, especially in people who has bilateral vestibular loss. Compared to normal subjects, they use these reflexes to a greater extent(61).

Nystagmus

When head rotates, the eye response has a slow phase which is a drift till the eyes reaches the outer canthus and fast phase where the eyes returns to its initial position. The fast phase determines the direction. The slow phase is the one which represent the vestibular output. It follows Ewald's law and Alexander's law

Ewald's law

- Ewald's first law: "The axis of nystagmus parallels the anatomic axis of the semicircular canal that generated it".
- Ewald's second law: "Ampullopetal endolymphatic flow produces a stronger response than ampullofugal flow in the horizontal canal"
- Ewald's third law: "Ampullofugal flow produces a stronger response than ampullopetal flow in the vertical canals (anterior and posterior semicircular canals)

Alexander's law

Alexander's law refers to nystagmus that occurs after acute unilateral vestibular loss.

It has 3 elements :

- The first element says that nystagmus after an acute vestibular impairment has the fast phase directed toward the healthy ear.
- The second element says nystagmus is greatest when gaze is directed toward the healthy ear, is attentuated at central gaze and may be absent when gaze is directed toward the impaired ear.
- The third element says that nystagmus with central gaze is augmented when vision is denied. This became apparent with the implementation of electrographic testing

BENIGN PAROXYSMAL POSITIONAL VERTIGO

BPPV is said to be one of the most common cause of peripheral vertigo with a life time prevalence of 2.4%. It is more common seen in elderly.

SYMPTOMS

The clinical symptoms are the patient has a rotational vertigo feeling when the position of body is shifted especially when there is a change in head position. Hence the patients usually complain that they had sudden onset of vertigo while turning in the bed or extending the neck. There can be associated lightheadedness or nausea. There is usually a latency of a few seconds before the vertigo starts, after any change in head position. Associated auditory symptoms like hearing loss or tinnitus are no usually present. The vertigo last for a few seconds to a minute and then disappears. It is a self limiting disease. Usually patients are affected for a brief period of time. It may be lasting for a few weeks

to months. It is also noted that in a very minority of patients, the disease lasts for a longer time.

EPIDEMIOLOGY

The prevalence of BPPV in general population is found to be varying in different studies. It varies from 11 to 64 per ten thousand population in different studies(1). It is found to be more common in elderly and in women(4,10). It is also noted in studies that it affect the right side more than the left(62). Posterior canal BPPV is the most commonly encountered BPPV. Second most common is horizontal canal BPPV. Anterior canal is rarely involved(63). BPPV can also arise from multiple canals(8,64).

CAUSES

Mostly the cause of BPPV is unknown(idiopathic). There are studies which showed the role of hormonal factors in BPPV since it is common in middle ages women. It was also shown that there is a relation between bone mineral density and incidence of BPPV. In both women and men with BPV, the rates of osteopenia and osteoporosis were found to be in a higher side. Impaired calcium metabolism is also proposed as a cause for BPPV. It is calcium which is present in otoconia in the form of calcite crystals. Because of change in estrogen levels calcium metabolism can be affected. In turn leading to disturbance in internal otoconia structure, interconnections and also the attachments to gelatinous membrane. The capacity of endolymph to dissolve dislodged otoconia may also decrease as a result of increase in the free calcium concentration in endolymph any inner ear

damage which causes the otolith detachment from macula can cause BPPV(65,66). Patients who engage in a persistent head –tilt position or after mastoid surgery rarely develop BPPV.

Mechanical damage due to head trauma is a common cause for BPPV(67,68). Traumatic BPPV is mostly bilateral and with involvement of multiple canals on same side. It is usually seen in younger age group with equal incidence among men and women. There is more chance of recurrent episodes and is also more difficult to treat. It is also found to be seen in patients with inner ear diseases like vestibular neuritis, Meniere's disease and labyrinthitis that cause degeneration and detachment of otoconia. The incidence is also found to be higher in patients with migraine. Diseases like Giant cell arteritis, diabetes, and hyperuricemia have also been found to have association with BPPV.

PATHOPHYSIOLOGY

For BPPV, a pathophysiological concept was first given by Schucknecht. The theory of cupulolithiasis was proposed by him in 1962. He proposed that the disease might be due to the detached otoconia from utricle which is acting on the cupula of posterior SCC. He called it theory of cupulolithiasis. At the time proposal of this theory there was no confirming studies, it was mainly from a theoretical point of view. In 1969 Schuknecht found confirmatory findings. He found basophilic staining masses which were attached to cupula in patients with BPPV symptoms. It was assumed that they were utricular otoliths which got detached by decalcification. Further support for this theory was given by Gacek. He reported that resection of posterior ampullary nerve resulted in abolishment of

BPPV symptoms in five patients. Thus Cupulolithiasis became the main theory for almost thirty years, though it could not explain the latency and fatiguability of nystagmus. Later Epley suggested the theory of canalolithiasis in the attempt of explaining latency and fatiguability. He suggested that the free-floating particles in canal were the cause for BPPV. The latency in the nystagmus caused because of BPPV was studied. It was found that movement of detached otoconia through ampulla is the cause for latency. It was also found that until otoconia enter narrow duct of semicircular canals, the pressure caused by moving otoconia is negligible(69). Another observation was that particle – wall interactions account for the variability in latency and duration of BPPV. A neural component for BBPV was suggested by Brandt and Citron(70)
and Hallpike(71). Degenerative changes in inferior vestibular nerve were demonstrated in temporal bones of patients with BPPV by Gacek and Gacek(72). Inflammatory changes and focal degeneration of inferior vestibular ganglion and nerve was demonstrated in the temporal bones of patients with BPPV. These findings were similar to the features found in infection of ganglion cells by neurotropic virus(73,74). This probably explains the concurrence of BPPV along with other diseases like vestibular neuronitis and Meniere's(75–77).

TREATMENT

TREATMENT MANEUVERS

The treatment of BPPV started almost 50 years back dating back to the time of Cawthorne(78) and Brandt & Daroff(79). They gave different exercise protocols to

patients, mainly to decrease the symptoms. These exercises were mostly based on habituation than concentrating on reposition or dislodgement of debris from semicircular canals. Cawthorne did not consider whether the symptoms are due to canalolithiasis or cupulolithiasis. Cawthorne treated the patients by instructing the patients to repeat the movements which caused vertigo. This was based on the concept of central adaptation. Brandt & Daroff instructed the patients to lie down on the provocative side, sit up for thirty seconds and then to lie down on opposite side ever three hours. It was found that more than 60% of the patients were free of symptoms after repeating the same for seven to ten days. The treatment was aimed at detaching the particles from posterior canal cupula. Semont, a physiotherapist in France and Sterkers where the ones who modified it to a more acceptable physician controlled treatment called Liberatory maneuver or Semont maneuver. It is done as follows (fig 9):

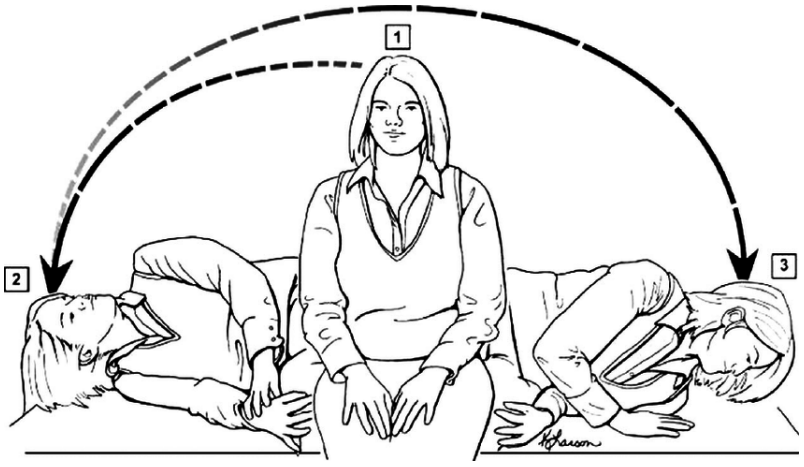


Fig 9: Semont's maneuver(80)

1. The patient is asked to sit on the edge of the bed. Turn the patient's head 45 degrees to the unaffected side.
2. Then patient is asked to quickly lie down on the affected side. Ask them to maintain the position for 30 seconds.
3. Then quickly ask the patient to move and lie down on the opposite end. The patient is instructed not to change the direction of the head. They are instructed to keep it at 45-degree angle and lie down for 30 seconds,looking at the floor.
4. The patient is returned slowly to the sitting position and wait a few minutes.

In 1992, Epley suggested repositioning procedure following the proposal of canalolithiasis theory. After one year, Herdman along with Tusa and Zee modified the Epley's maneuver to a one treatment method which had high success. There has been many modification of the classical Epley's maneuver since then. Today most commonly it is done as follows (fig 10):

1. The patient is asked to sit upright on a table or bed and is positioned in a way that the patient's shoulder should meet the edge of table or bed when the patient lie down
2. The examiner takes a position close to the bed to prevent falls
3. Then the patient is asked to turn the head towards the affected side about 45°

a. The patient also asked to keep the eyes open so that the examiner can observe nystagmus

4. Then the make the patient lie down quickly with head hanging over the side of table

5. The examiner holds this position for 30 seconds
6. Then the patient's head is rotated 90° to opposite side while keeping the patient still lying back flat and head hanging over edge of table or bed
7. Then that position is held for 30 seconds
8. The patient is asked to turn or the assistant is made to turn the patient's body and head so that the body is facing to the side and head is facing towards the ground at a 45° angle
9. Then that position is held for 30 seconds
10. The patient is returned to upright sitting position
    - We have to ensure that the patient should not lean head backwards but should maintain a forward and downward position of head
        - The patient is asked to sit upright with head still for a time period of 10-20 minutes

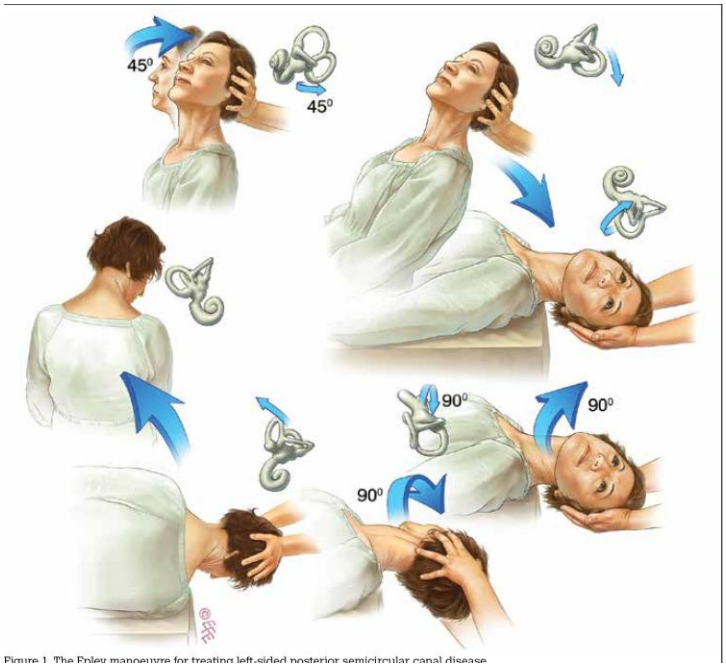


Figure 1 The Epley manoeuvre for treating left-sided posterior semicircular canal disease

Fig 10: Epley maneuver(81)

Another hybrid maneuver is Gans repositioning maneuver which was developed in 2000. It was specially designed for people who had vertibrobasilar insufficiency, cervical spondylosis, hip disease, obesity etc. It is also found to be effective. The steps include (fig 11):

1. In first position, the patient's head is turned 45 degree to the unaffected side and patient is made to lay down on the side of vertigo. This position is expected to move the otolith debris to center of posterior canal
2. Then the patient is made to roll over to unaffected side, maintaining the same position of head – 45 degree to the unaffected side. This will move otolith debris move to common crus.
3. The patient is made to shake the head side to side 3 to 4 times in that position. This helps the otolith debris to traverse the common crus.
4. The patient is returned back to initial position, then head turned forward to centre position. This makes otolith debris enter the utricle.

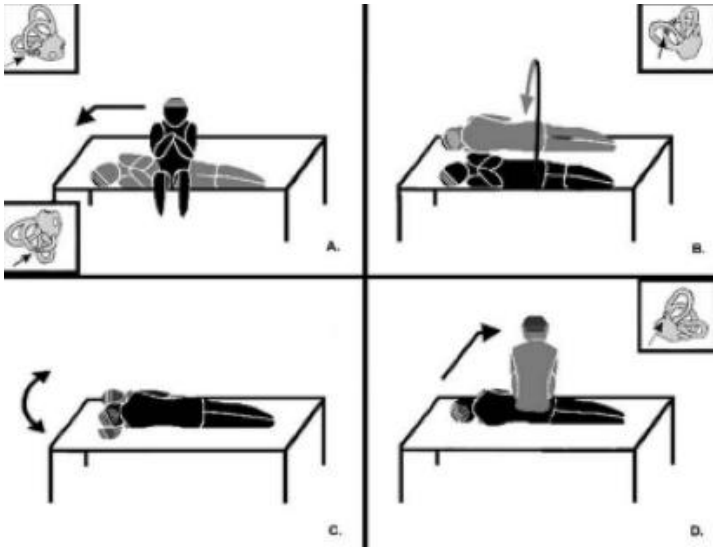


Fig 11: Gans repositioning maneuver(82)

There are home based treatment maneuvers used in the treatment of BPPV like Brandt-Daroff exercise was developed as a habitual physical therapy which has repetitive movements. It did not concentrate on detachment or replacement of otoconia.

The Brandt – Daroff exercise is done as follows (fig 12):

1. The patient sit upright in a bed
2. The patient move to lying down position on one side with nose pointing up about 45 degree
3. The patient maintain the position for 30 seconds
4. Then the patient sit upright in a bed
5. The patient repeat the same on the other side

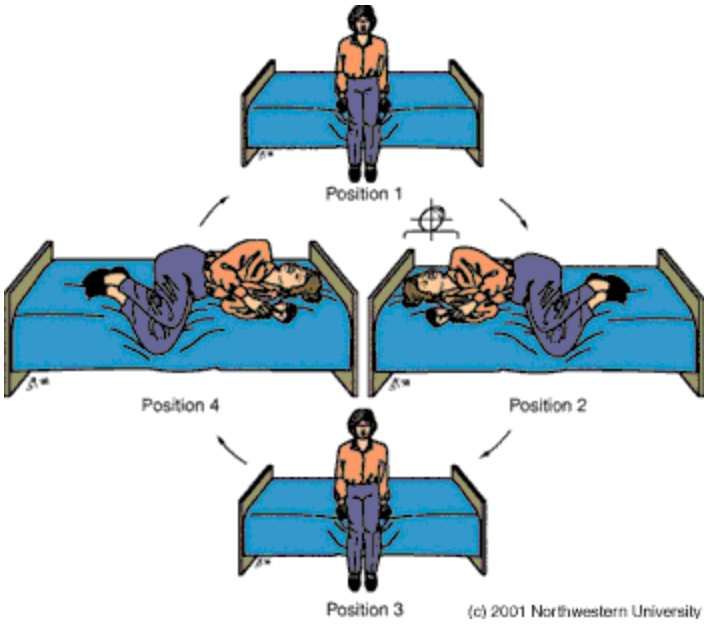


Fig 12: Brandt – Daroff exercise(83)

Half somersault exercise or foster maneuver

Another home based exercise is Half somersault exercise or Foster maneuver. It is a comparatively newer maneuver. It was devised by Dr.Carol A Foster who herself was suffering from vertigo. The maneuver intends to reposition the displaced otoconia.

It is done as follows (fig 13):

1. The maneuver starts with the patient in a kneeling down position, then patient should sit back on his/her calves. The patient should keep their palms on floor just ahead of knees at shoulder width.
2. Then patient should bend the head down in such a way that the top of head touches the floor in front of the knees. The patient can bend the elbows. This the usual starting position to do a somersault

3. Then the patient should turn the head 45 degree towards that direction where he/she have worst vertigo. The patient should be looking at the elbow on that side
4. Then the patient should raise the head and body so that they are parallel to the floor at the level of shoulder. The head should be kept turned towards the side during this entire time
5. Then the patient should lift the head above the level of the body by the neck
6. After that patient can return to the starting position
7. Each position should be maintained for 15 sec or till the vertigo subsides
8. Then the patient should rest for 15 min

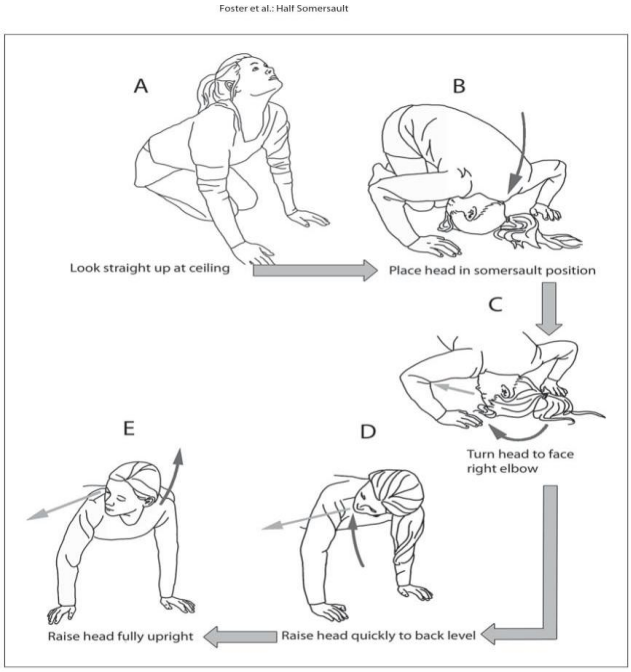


Fig 13 : Half somersault exercise or foster maneuver(84)

COMPARISION OF DIFFERENT MANEUVERS IN TREATMENT.

As told earlier majority of patients present with posterior canal BPPV and majority come with canalolithiasis. Different clinicians give different treatment modalities based on whether the patient is having canalolithiais or cupulolithiais. Usually canalolithiasis is treated by Canalolith repositioning maneuver and cupulolithiais is treated by Semont's maneuver. However the choice of treatment depends on the clinician and also depend upon the comfort of patient.

For most of the patients, canalolith repositioning maneuver is more comforatable. The debris are adherent to cupula according to Schuknecht's theory of cupulolithiais. Based on this theory, the Semont's Liberatory maneuver takes into consideration the fact that rolling the head is not enough for repositioning the particles

There have been different studies comparing different treatment modalities. Ultimately the treatment depends on the condition of patient, his comorbid illness and the choice of the physician. There have been a lot of studies conducted comparing the efficacy of different treatment modalities.

In a randomized study by Dispenza et al, he compared Epley repositioning maneuver, Semont repositioning maneuver and a Hybrid maneuver. The study also showed no statistical difference in efficacy of treatment(85).

A randomized controlled trial conducted by Sushil Gaur et al in the department of ENT in a tertiary care centre compared Epley maneuver and medical treatment. It showed that recovery was better with the group getting Epley maneuver as treatment. They also found

low recurrence rate with the group getting Epley maneuver as treatment. The patients with medical treatment needed more hospital visits compared to the other group(7).

In a study by Devangi S Desai et al, which was conducted in the physiotherapy department of a pioneer physiotherapy college included 35 patients in a prospective longitudinal followup study. The study involved patients randomly divided into two groups. One group was treated with Epley maneuver only and the other group was treated with Epley and Brandt Daroff exercises. Both the groups gave significant improvement in the DHI score and Dix Halpike test. It was concluded in the study that both the treatment approaches give good results, but combined approaches could give better results(86).

Abir Omara et al conducted a randomized controlled study on 30 patients diagnosed with posterior canal BPPV. One group received Epley repositioning maneuver and other group received Gans repositioning maneuver. In their study there was no statistical difference between two groups in terms of treatment efficancy(87).

A study by Soto et al included 106 BPPV patients each undergoing a different treatment maneuver for BPPV. This was a prospective study whch compared three different physical treatments for BPPV. At the 1st week of follow up Epley and Semont maneuver showed better results than brandt daroff exercises. However on the 3rd month of follow up Epley maneuver proved to be more effective. From their findings they suggested a treatment algorithm for the management of BPPV(88).

A comparative study conducted by Abdel Kader et al compared rolling-over maneuver, Epley and Brandt-Daroff maneuver. The study demonstrated a success rate of 90% for Epley, 85% for rolling-over maneuver and 80% for Brandt-Daroff maneuver. The recurrence rate was noted to be high after treatment with Brandt-Daroff, but there was no statistically significant difference(83).

A systemic review was done comparing the efficacy of Semont maneuver and Epley maneuver by Bonnie and Melissa. It included six studies of which four studies did not show any statistically significant difference between the two. However the study concluded Semont maneuver as an alternative for patients with cervical, lumbar, cardiac, or respiratory pathologies

Zhang et al conducted a meta-analysis of ten studies based on predefined criteria, evaluated by the Cochrane evaluation system comparing the effect of Semonts maneuver with other methods for BPPV treatment. High recovery rate and low recurrence was noted compared to controls. Over all Semont maneuver displayed a similar outcome compared to Epley and Brandt Daroff exercises.

SURGICAL TREATMENT MODALITIES

It was Richard R Gacek who first proposed a surgical treatment for BPPV. He first conducted several animals and then he performed posterior ampullary nerve transection (singular neurectomy) in humans. It is the nerve which innervates the posterior SCC.

Gacek originally described the procedure as a transcanal procedure under local anaesthesia. Later many surgeons preferred general anaesthesia.

Singular nerve through the canal of Morgagni in temporal bone from posterior ampulla to saccular nerve. It is inverted J shape which has 3 segments: the part joining internal auditory canal (canalicular), the curve of J (intermediate), the part entering ampulla (cribriform). The nerve lies close to round window in the intermediate segment. It can be located 1 to 2 mm deep to posteroinferior margin of round window (fig 14).

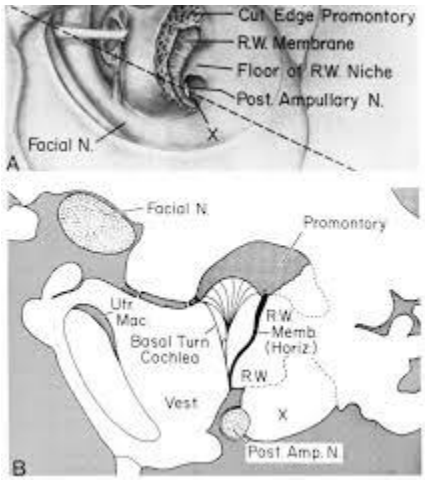


Fig 14: Landmark of posterior ampullary nerve(89)

Parnes and McClure in 1990 introduced posterior semicircular canal occlusion for BPPV. This was based on a study by Money and Scott which showed preserved function of other canals after ablation of one semicircular canal. It preserved the hearing unless membranous labyrinth was damaged. The principle of surgery was to prevent endolymph movement and to prevent movement of cupula in response to angular acceleration and gravitation by obstruction of semicircular canal. Parnes and McClure did the surgery

under general anesthesia. First the osseous part of posterior semicircular canal is exposed via a mastoidectomy. To prevent any damage, occlution of canal is made at a point far from ampulla and vestibule. The area bisected by lateral SCC, 3mm posterior to facial nerve is the target area. Then the canal is skeletoniszed 180 degree for a length of 3 to 4 mm. The membraneous canal is exposed by removal of endosteal bone (fig 15). The membraneous labyrinth is compressed completely with dry bone chips and fibrin glue is gently inserted to fill the canal. Temporalis fascia is to cover the area in order to prevent perilymph leak. The occlusion is completed by secondary fibrosis.

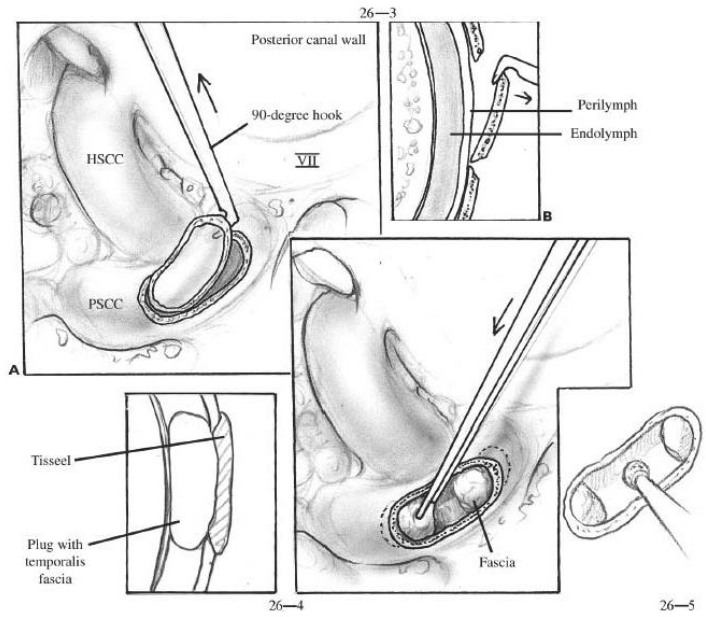


Fig 15: Posterior semicircular canal occlusion(90)

After 1990s, there was a drastic decrease in the surgical treatment of BPPV. The singular nerve section have been almost abandoned by surgeons. Studies have shown that there there is a wide variation of singular nerve course which ranges from 98% to 20% in

different studies. There have been cases where the singular nerve could not be identified intraoperatively. The studies show the success rates from 79% to 94%, probably due to the variant anatomy. The review of studies also show that success of SNS surgery compared to posterior semicircular canal occlution was low, probably because of the difficult anatomy. The SCO is more straight forward than SNS because of this reason. Most of the studies show 100% success rate with SCO. When different studies were compared, the incidence of post operative hearing loss was almost same in both the groups, almost 5%.

Literature show a decrease in number of surgical treatment after 1990's. The surgical techniques are mostly confines to the centres where it was developed. This may be due to the difficulty in procedure or the difficulty in training. The use of videonystagmography and improvement in accuracy of diagnosis has reduced the intractable BPPV.

CHAIR TREATMENT FOR BPPV

In addition to the multiple treatment maneuvers and the surgical treatments which exists for BPPV, it was found that 10 to 20% of the patients could not be treatment adequately with the conventional methods. There was lot of patients with cervical disc and hip joint problems. This led to the development of mechanical and rotational chairs. Dr.Epley developed the Epley Omniax rotator (fig 16) at Portland and Dr.Richard Vitton developed the TRV chairs in Marseille. It is possible to have a 360 degree circular movement in all planes along with simultaneous monitoring of nystagmus or any eye movements with infrared googles.

Fig 16: Epley Omniax repositioning system(91)

West et al conducted a retrospective cohort study of 150 patients diagnosed with BPPV in a tertiary care centre. Their study concluded that Epley Omniax rotator and TRV chair treatments are valuable in management of refractory and complex cases where conventional treatment is difficult(28).

Tan et al conducted a prospective study on 165 patients with a six month follow up, comparing the canalolith repositioning maneuver with chair treatment. The study concluded that there is no statistical difference between the chair treatment and conventional canalolith repositioning maneuver(92).

MATERIALS AND METHODS

This study was a prospective, non-blinded randomized control trial on the effect of home based particle repositioning maneuver in the treatment of posterior canal BPPV

The study was based in the Ear, Nose Throat (ENT) department of a tertiary care academic hospital in South India after obtaining institutional ethical committee clearance and institutional research board clearance (IRB No 9642). The patients were recruited from the outpatient department (OPD). Patients who were diagnosed with posterior canal BPPV who fulfilled the inclusion criteria and who gave written consent for this study were recruited for the study.

Inclusion criteria :

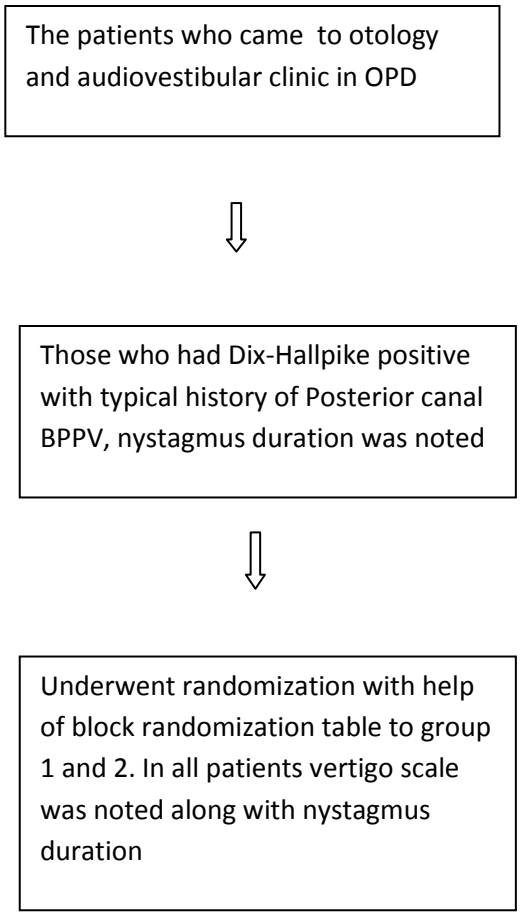
a. Adults above 18 years of either sex with typical history of BPPV
b. Dix Hallpike test positive for posterior canal BPPV
c. Willing to come for follow up at 2^{nd} week and 4^{th} week
d. Patients willing to give informed consent

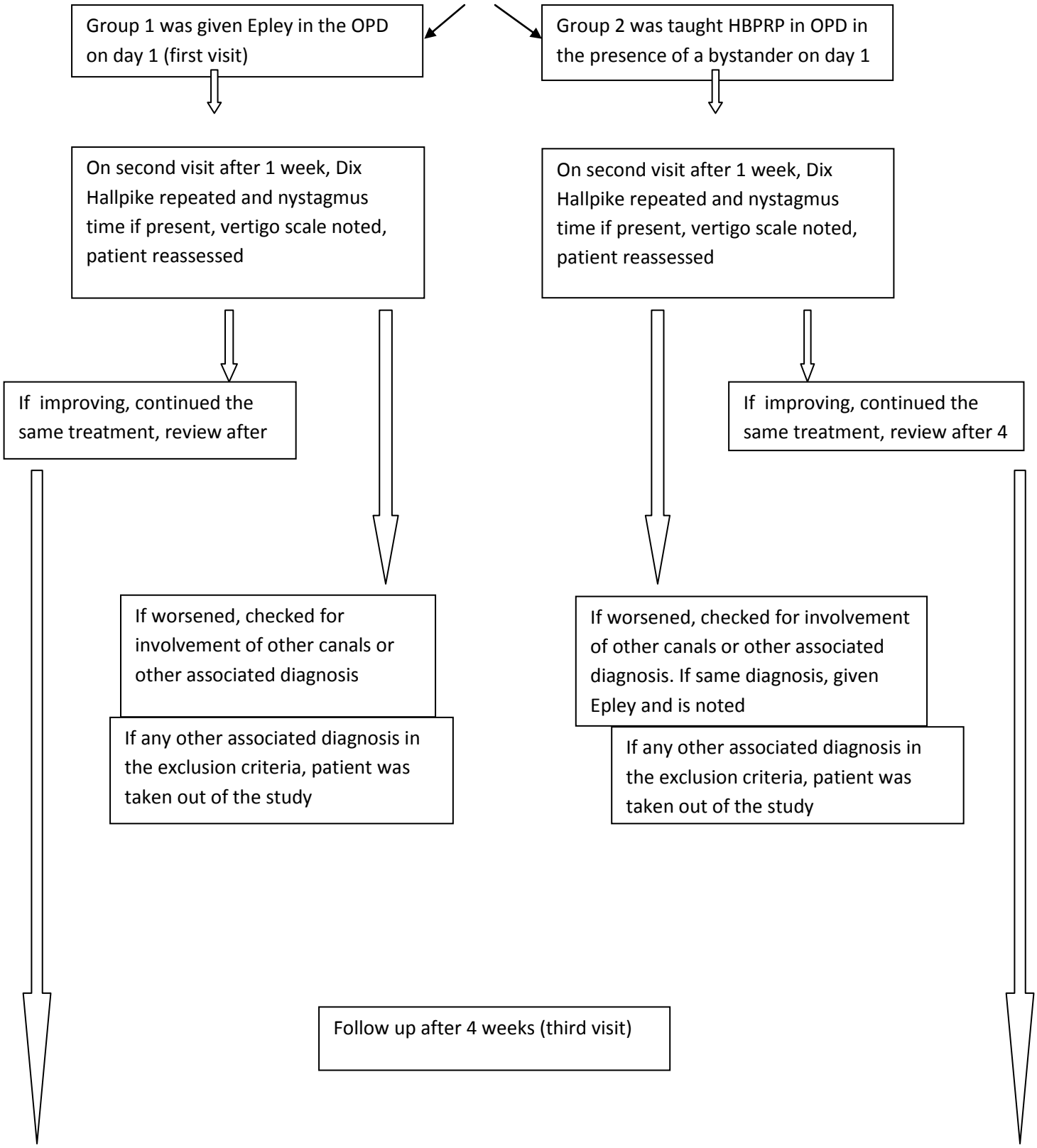
Exclusion criteria:

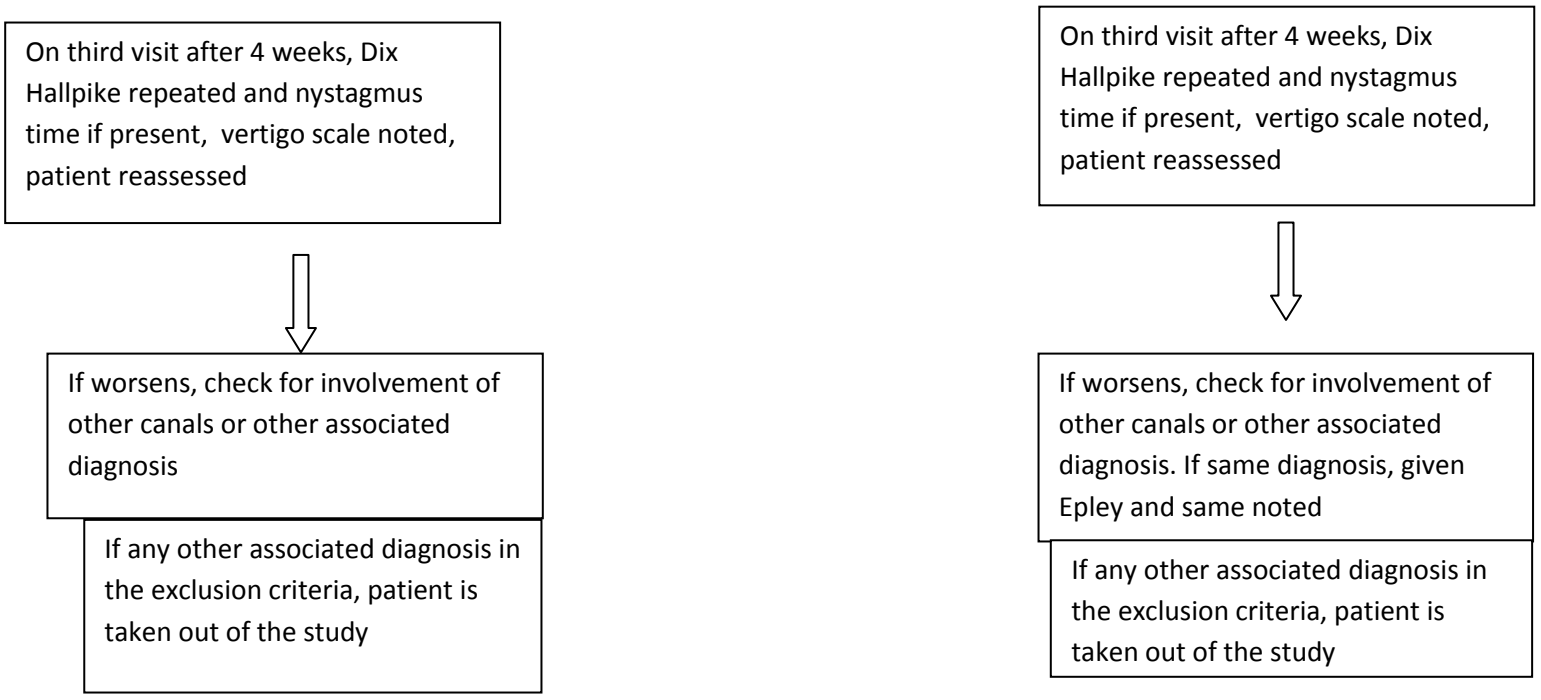
a. History of cardiac diseases like aortic aneurysm or symptoms suggestive of acute coronary syndrome.
b. History of cervical spine diseases like fracture spine/ unstable spine/ craniocervical anomalies
c. Any clinical suspicion of other coexistent vestibular disorders like migrainous vertigo or Meniere's disease

The patients who presented to the OPD with clinical features suggestive of BPPV underwent a Dix-Hallpike test. All patients who were diagnosed with posterior canal BPPV after Dix-Hallpike's test and fulfilling the inclusion criteria were randomized by the principal investigator (PI) into 2 groups using a block randomization table. A detailed history was taken and proforma was filled regarding baseline characteristics like age, gender, affected side, duration of illness, frequency of vertigo per day, duration of each vertigo episode, change with physical activities, any previous episodes, co-morbid illness including hypertension, diabetes mellitus, hypothyroidism, dyslipidemia and vitamin D deficiency.

We have elaborated the methodology as follows:




Group 1 was given Epley in the OPD on day 1 (first visit)
Group 2 was taught HBPRP in OPD in the presence of a bystander on day 1
On second visit after 1 week, Dix Hallpike repeated and nystagmus time if present, vertigo scale noted, patient reassessed
On second visit after 1 week, Dix Hallpike repeated and nystagmus time if present, vertigo scale noted, patient reassessed
If improving, continued the same treatment, review after
If improving, continued the same treatment, review after 4
If worsened, checked for involvement of other canals or other associated diagnosis
If any other associated diagnosis in the exclusion criteria, patient was taken out of the study
If worsened, checked for involvement of other canals or other associated diagnosis. If same diagnosis, given Epley and is noted
If any other associated diagnosis in the exclusion criteria, patient was taken out of the study
Follow up after 4 weeks (third visit)



DIX HALLPIKE TEST

Dix Hallpike test was done in OPD for the patients who had history suggestive of BPPV. It was done as follows:

The patient was made to sit on a couch. Then the examiner held the head of the patient, turned it to 45 degree to the right side. Then the patient was placed in supine position with head hanging down the edge of table, 30 degree with horizontal. The patient's eyes were observed for any nystagmus. Then the test was repeated on the left side. The eyes were observed for nystagmus, type, duration and latency and presence of vertigo.

NYSTAGMUS DURATION

During Dix-Hallpike test the duration of nystagmus was measured using a stop watch and noted in seconds. The nystagmus was looked for latency, duration, direction and fatiguability. In BPPV nystagmus usually appeared after a latency of 2-5 seconds, lasting for less than a minute and always in one direction that is towards the undermost ear.

VERTIGO SCALE

The patients were asked to score the vertigo on a scale of 0 to 5. It was a subjective scale where the patients gave a score from 0 to 5 depending upon the perceived intensity during each visit. They were asked to compare the intensity of vertigo with the previous visits during 2^{nd} and 3^{rd} visit.

SAMPLE SIZE

A pilot study was conducted and sample size was calculated. The main outcome measures taken were vertigo scale and nystagmus duration during Dix Hallpike test. The sample size was calculated using formula:

$N= 4S^2/D^2$

S= 1.73 (standard deviation) (MEAN=8)

D=1.0 (Precision of mean value)

N = 11

Minimum of 11 in each arm

We have taken 15 patients in each arm.

Epley maneuver

Group 1 included patients who underwent a standard Epley's manuever at the clinic by the PI. The PI performed all Epley's maneuver in the following manner after explaining the procedure to the patient:

1. The patient was seated upright on an examination table, with their legs fully extended in front of them.

2. The PI held the patient's head at a 45-degree angle towards the side they experienced the worst vertigo.

3. The patient was rapidly brought down on the bed so that they were lying down with their shoulders touching the table and head hanging down over the edge of the table. The patient's head was kept facing the side worst affected by vertigo, head hanging down the table, 30 degree from the horizontal.

4. The PI held the patient's head in this position for 30 seconds to 2 minutes, until their dizziness stopped. The patient's head was rotated to the opposite side by 90 degrees maintaining the 30 degree angle with the horizontal. Again, the PI held the head in this position for 30 seconds to 2 minutes, until their dizziness stopped.

5. Next, the patients's body was rolled 90 degree in the same direction that they faced till the nose points to the ground. They usually experienced the worst vertigo at this position.

The PI held the patient in this position for 30 seconds to 2 minutes, until their dizziness stopped.

6. Finally, patient was brought back up to a sitting position with chin tucked down to the chest. The patient was given post procedure instructions which included a) Avoid driving home after Epley. b) Patient should avoid lying on the side of the BPPV for 2 nights after the procedure. c)The patient was also asked to avoid looking up or down for 8 hours after the procedure. Epley's procedure was done after Dix-Hallpikes test at 1st visit, second visit and third visit

Home based particle repositioning maneuver

In Group 2- the patients were taught the home based particle repositioning procedure (HBPRP) by demonstration in the presence of a bystander by the PI. The steps included

1- The patient was seated upright on an examination table, with their legs fully extended in front of them.
2- The patient rotated their head at a 45-degree angle towards the side they experienced the worst vertigo.
3- The patient then lay rapidly down on the bed with the head extended but not beyond the edge of the bed. The chin was tilted 30 degree above the head and was kept facing the side worst affected by vertigo with patients nose pointing to an imaginary point at the

outer edge of the ceiling . The patient was asked to maintain this position for a period of 30 seconds to 2 minutes, until their dizziness stopped (fig 17)

4- The patient rotated his/her head 90 degrees in the opposite direction, maintaining the 30 degree tilt angle of chin with the horizontal, looking at an imaginary point at the outer edge of the ceiling on that side. Again, the patient was asked to maintain the position for a time of 30 seconds to 2 minutes, until their dizziness stopped (fig 18)

5- Next, the patient rolled 90 degree in the same direction that they were facing, onto their side with the chin almost touching the bed. Again, the patient was asked to maintain the position for a time of 30 seconds to 2 minutes, until their dizziness stopped (fig 19).

6- Finally, the patient sat up to a sitting position with the chin tucked to the chest (fig 20)

The same post procedure instructions were followed out as Group 1.

Fig 17: HBPRP position 3 (printed with permission from Dr.Kiran)

Fig 18: HPBPR position 4 (printed with permission from Dr.Kiran)

Fig 19 : HBPRP position 5 (printed with permission from Dr.Kiran)

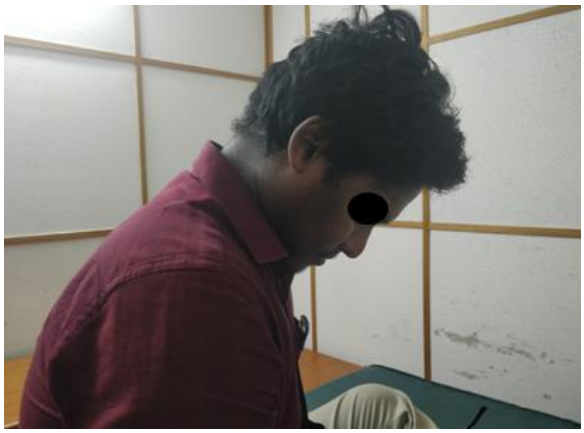


Fig 20: HBPRP position 6 (printed with permission from Dr.Kiran)

The patients were also asked for feedback on the procedure performed, including any discomfort during the procedure. This was recorded in the proforma.

Group 2 patients did this procedure once a day at home during the study. From day 1 the patients in both groups were started on Tablet Betahistine 16mg twice daily for 5 days after meals.

Both groups were followed up at 1 week (Day 7) after the enrollment into the study and again after 4 weeks.

At Day 7, the patients were asked about the symptoms of vertigo and this was noted down. Dix-Hallpike's test was repeated and duration of nystagmus if present was noted and symptoms during the test were reassessed. Nystagmus duration and vertigo intensity scale, frequency and duration of vertigo were noted. If symptoms were improving Group 1 patients underwent another Epley's manoevre and Group 2 patients were asked to continue HBPRP daily for 1 month. If symptoms worsened at follow up then other semi-circular canals were also tested for BPPV. If positive for BPPV for another canal then a new diagnosis was noted and treated accordingly. If symptoms worsened in group 2 and no other canals were found to be involved then they were given standard Epley's treatment and this was noted for analysis.

The same was repeated at 4 weeks for both groups. The data collected during 0 weeks (first visit), 1st week and 4th weeks were documented and taken into account at analysis.

STATISTICAL METHODS

The data entry was done in Epidata software and analysis was done by using Excel and SPSS 16.0 packages. Descriptive statistics -mean, standard deviation and range were used for describing continuous variables. Frequency and percentage was used for describing categorized variables. Pie chart and bar chart were used for the graphical representation of the patients' characteristics.

The demographic and clinical characteristics like age, gender, co morbid illness were compared between groups using Chi square test, t-test and Fishers exact test according to the variable type. The correlation between age and frequency of vertigo was calculated using Pearson correlation coefficient and scatter plot.

The outcome variables among the two groups were calculated using t test or Mann – Whitney U test based on the normality assumption. Histogram plot was used for normality checking. The statistical significance of reduction in vertigo scale between the groups was done using Mann-Whitney U test, reduction in nystagmus duration between two groups using t test, reduction in vertigo frequency between two groups was done using repeated measures ANOVA. The duration of nystagmus during Hallpike test in each visit was represented using box plot. The reduction in frequency of vertigo in each visit was represented using error plot.

DATA ANALYSIS AND RESULTS

DISTRIBUTION OF DEMOGRAPHIC AND CLINICAL CHARACTERISTICS

AGE

There were 30 patients in the study. Patients above age of 18 satisfying the inclusion criteria were recruited for the study. The minimum age was 20years, maximum age was 76 years with a mean age of 52.9 years (table 1). In group one, the age range was between 20 – 75years and in group two, age range was 35 – 76. Most of the patients were more than 50 years old.

Table 1: Age description

	Mean	**SD**	**Range**
Age in years	53	13	20 – 76

GENDER

There were both males and females in the study group, of whom 77% were females.

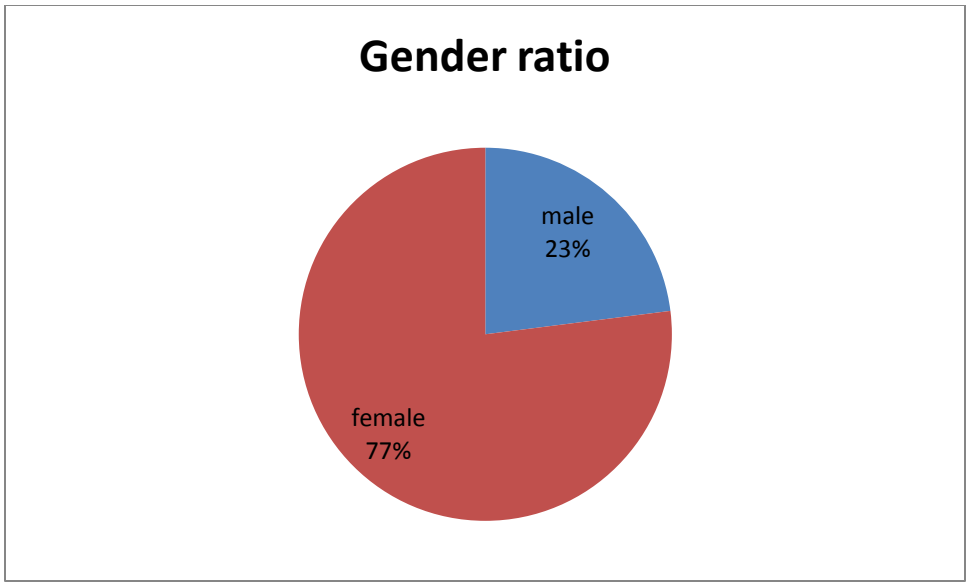


Fig 21: Gender distribution of study subjects

HYPOVITAMINOSIS OF VITAMIN D

Almost 50% of the patients recruited had vitamin D deficiency and this was more among the older population. 43% had osteoporosis or osteopenia.

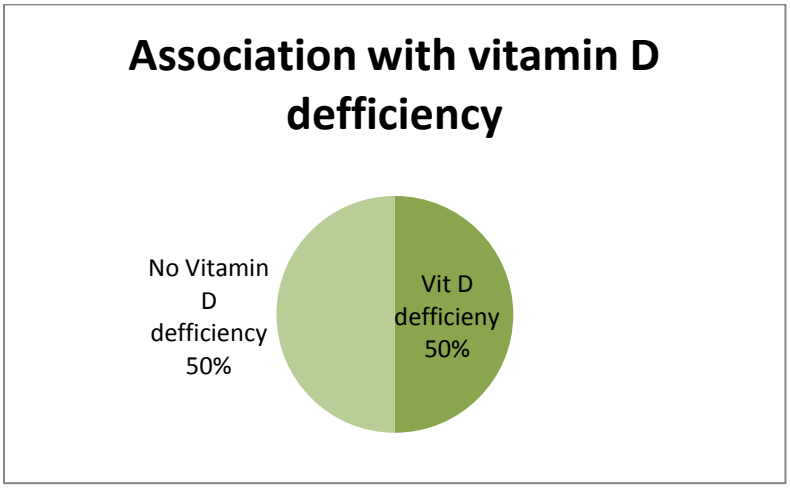


Fig 22: Percentage of patients with Vitamin D deficiency

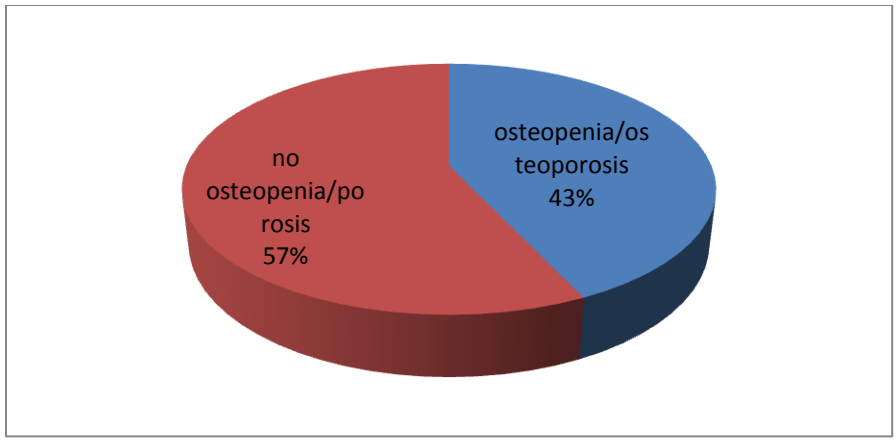


Fig 23: Percentage of subjects with osteopenia

DYSLIPIDEMIA

43% had associated dyslipidemia.

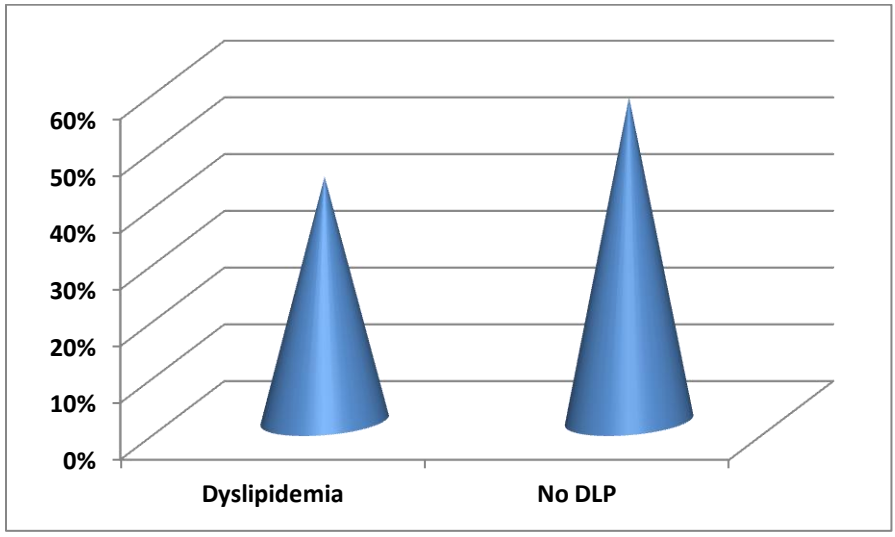


Fig 24: Percentage of subjects with dyslipidemia

DIABETES MELLITUS

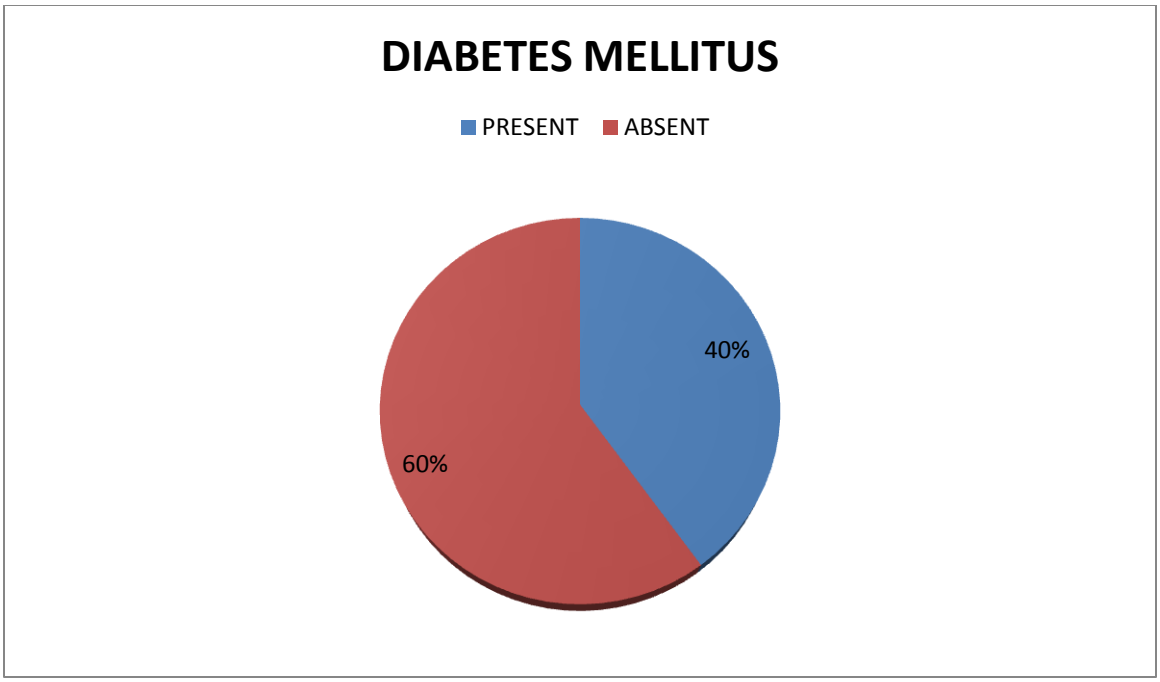


Fig 25: Percentage of subjects with Diabetes Mellitus

HYPERTENSION

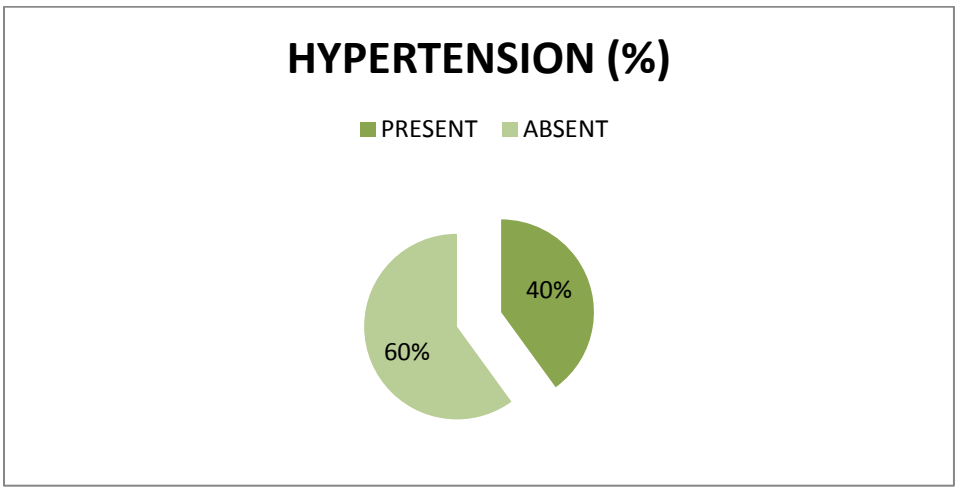


Fig 26: Percentage of subjects with Hypertension

HYPOTHYROIDISM

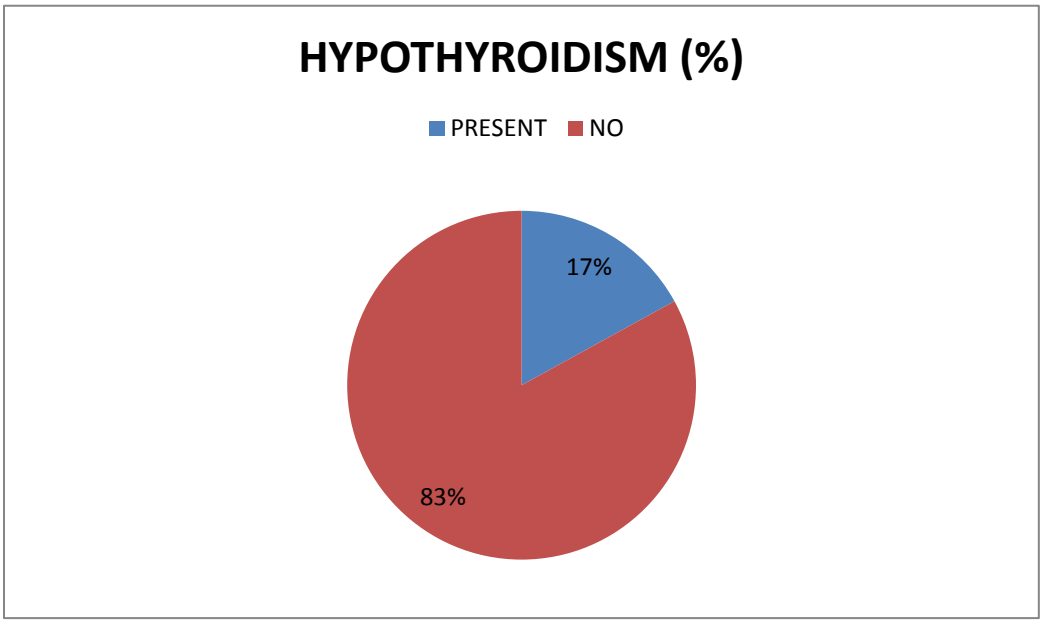


Fig 27: Percentage of subjects with Hypothyroidism

COMPARISON OF CHARACTERISTICS BETWEEN THE TWO GROUPS

There were 30 patients in the group with age ranging from 20 to 76.

Table 2: Age comparison between two groups

	Group 1		Group 2		p value
	mean	SD	mean	SD	
Age in years	50.9	11.4	54.9	14.8	0.421

Age comparison was done between groups using t test (table 2). There was no significant difference between the two groups with respect to age.

Table 3: Gender comparison between two groups

	Group 1		Group 2		p value
	N	%	N	%	
Gender Male Female	 4 11	 27 73	 3 12	 20 80	 >0.999

Gender comparison was done between groups using Fisher's exact test (table 3). There was no significant difference in the sex distribution between the two groups.

Table 4: Comparison of proportion of patients with vitamin D deficiency in both groups

	Group 1		Group 2		p value
	N	%	N	%	
Vit D deficiency	8	53	7	47	0.715

Proportion of patients with Vitamin D deficiency in both groups was compared using Chi square test (table 4) and found to be not significant.

Table 5: Comparison of proportion of patients with osteoporosis in both groups

	Group 1		Group 2		p value
	N	%	N	%	
Osteoporosis	7	47	6	40	0.713

Proportion of patients with Osteoporosis in both groups was compared using Chi square test and was found to be not significant (table 5).

Table 6: Comparison of proportion of patients with Diabetes mellitus in both groups

	Group 1		Group 2		p value
	N	%	N	%	
Diabetes mellitus	6	40	6	40	>0.999

Proportion of patients with Diabetes mellitus in both groups was compared using Chi square test (table 6). This was not significant.

Table 7: Comparison of proportion of patients with Dyslipidemia in both groups

	Group 1		Group 2		p value
	N	%	N	%	
Dyslipedemia	5	33	8	53	0.269

Proportion of patients with Dyslipidemia in both groups was compared using Chi square test (table 7). This was not significant.

Table 8: Comparison of proportion of patients with hypertension in both groups

	Group 1		Group 2		p value
	N	%	N	%	
Hypertension	6	40	6	40	>0.999

Proportion of patients with hypertension in both groups was compared using Chi square test (table 8). This was not significant.

Table 9: Comparison of proportion of patients with hypothyroidism in both groups

	Group 1		Group 2		p value
	N	%	N	%	
Hypothyroidism	1	7	4	27	0.330

Proportion of patients with hypothyroidism in both groups was compared using Fisher's exact test (table 9) and this was not significant.

As seen in the above tables there was no significant difference between the two groups with regards to the co-existence of Vitamin D deficiency, osteoporosis, diabetes, dyslipidemia, hypertension and hypothyroidism.

DURATION OF VERTIGO

The duration of vertigo varied from 4 days to 3 months. The patients who had longer duration of vertigo were referred from other speciality departments. The patients who were referred from Emergency department had lesser duration than the ones who came to OPD on their own or were referred from other specialities. The duration of vertigo and its reduction was noted in patients during the visits in both the groups (fig 28). The median duration of vertigo in group 1 was 9 days and in group 2 was 10 days. The duration of vertigo at the time of presentation between the two groups was compared , and there was no significant difference (p value was 0.643 using Mann Whitney U test)

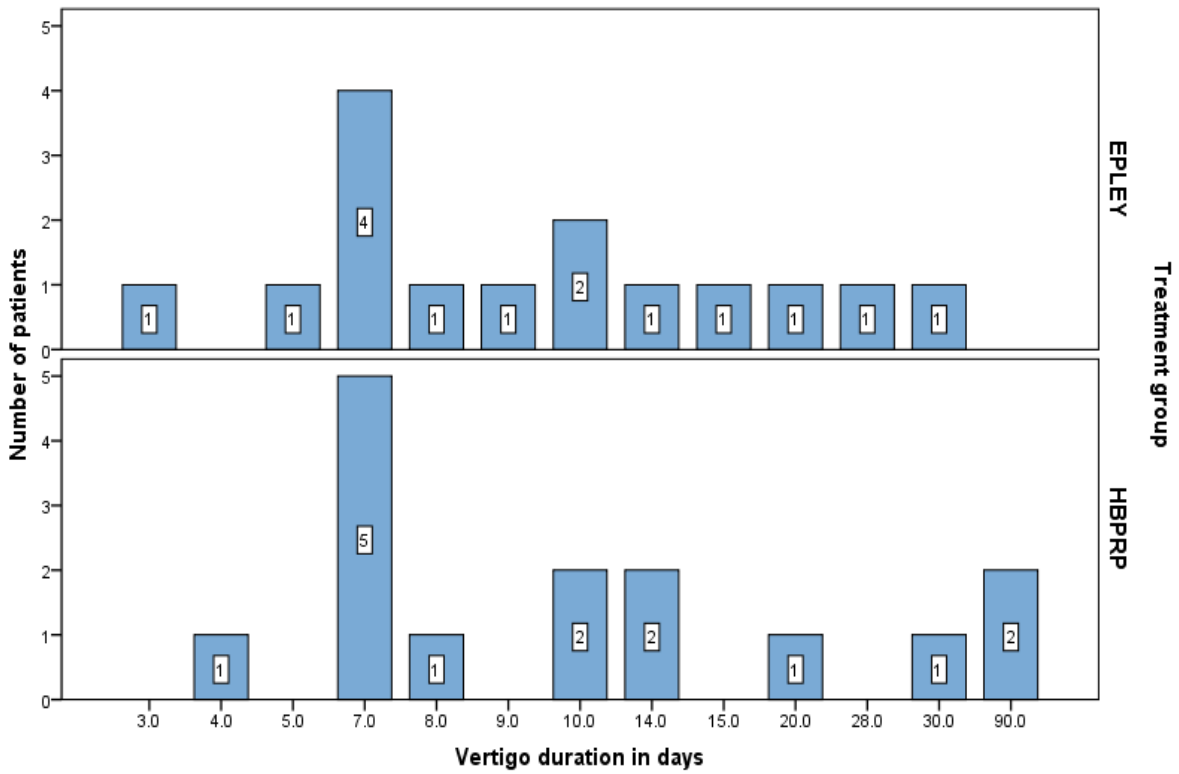


Fig 28: Distribution of duration of vertigo in both groups

FREQUENCY OF VERTIGO

The patients had a wide range of frequency of vertigo. At the time of presentation frequency of vertigo varied from 4 episodes per week to 25 episodes per day.

There was a general trend of increase in frequency of vertigo with age (fig 29). When statistical correlation between age and frequency of vertigo was calculated p value was 0.41, that is there no significant difference between the groups.

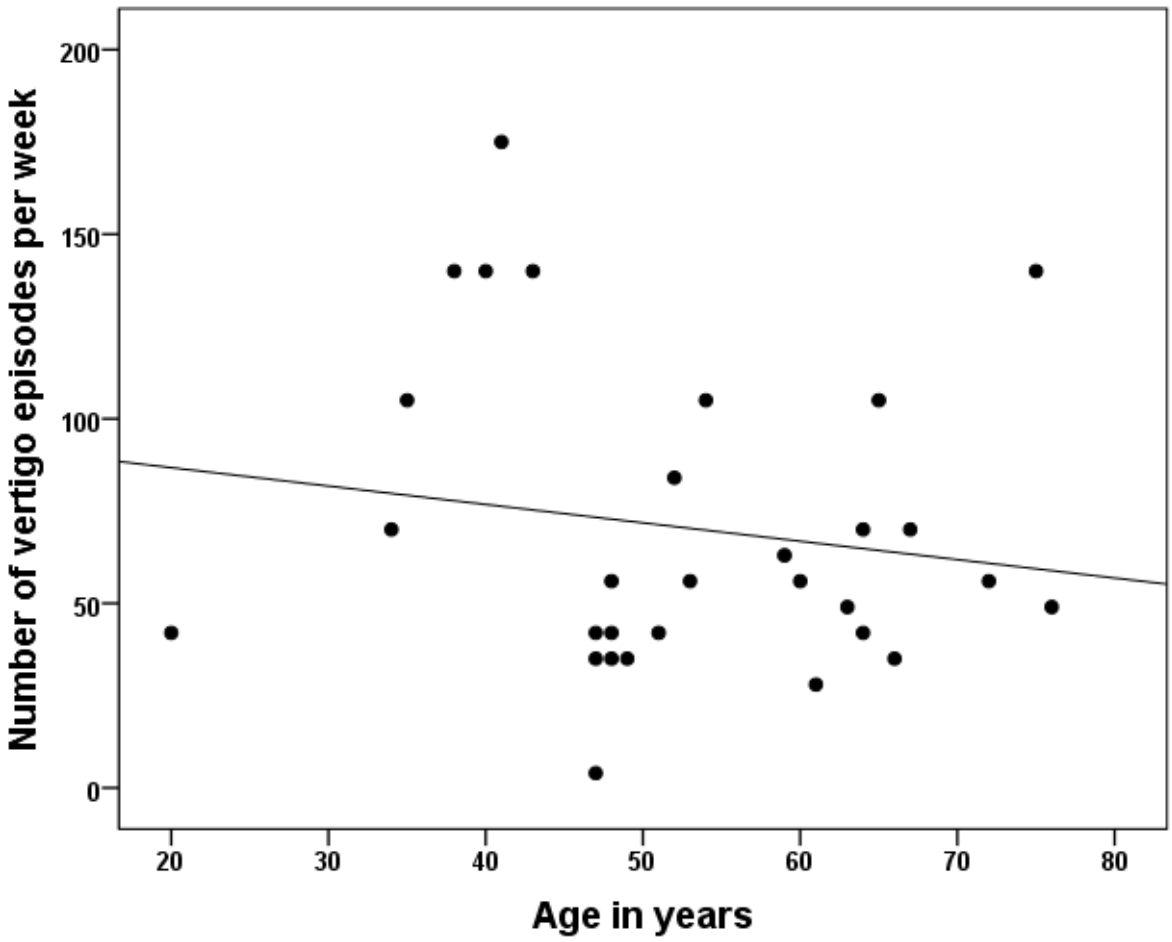


Fig 29: Distribution of frequency of vertigo in all subjects

The frequency of vertigo at the time of presentation (fig 30) between the groups was similar in both groups. p value using Mann - Whiteney U test was 0.452.

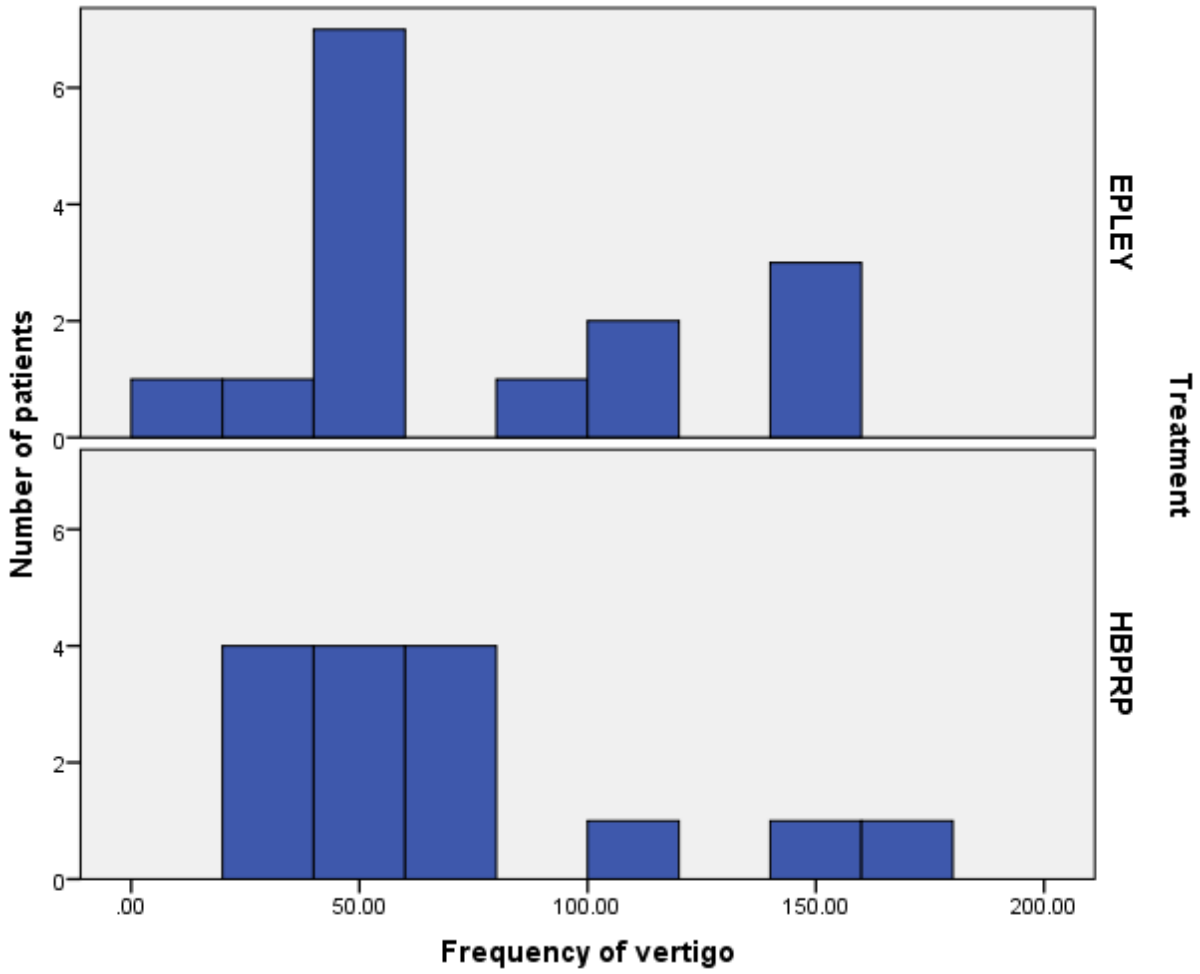


Fig 30: Frequency of vertigo(number of episodes per week) at the time of presentation in both groups

PREVIOUS CLUSTERS

There were 8 people who had previous episodes of BPPV. This amounted to 26.6% with previous episodes of BPPV (fig 31). There were 3 (20%) people with previous episodes in group 1 and 5 (33%) people with previous episodes in group 2. When statistically compared between the groups, this was not significant (p value was 0.682 using Fischer's exact test).

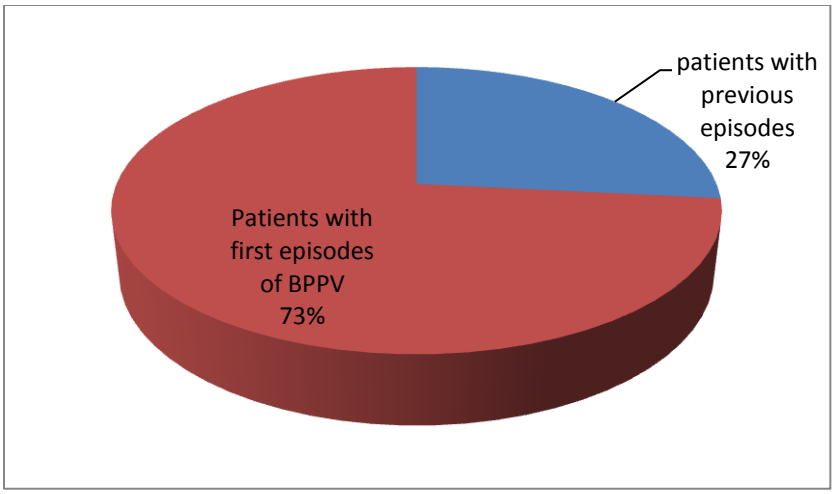


Fig 31: Percentage of patients with previous episodes of BPPV

MAIN OUTCOME MEASURES

NYSTAGMUS DURATION

The duration of nystagmus was ranging from 4 seconds to 15 seconds at the time of presentation. In group 2 the duration of nystagmus was in the range of 4 seconds to 15 seconds and in group 1, the nystagmus was in the range of 6 seconds to 15 seconds. Following the treatment the nystagmus reduced in both arms significantly. There was only one patient in each arm who had nystagmus in the second visit. But there was no worsening in the symptoms for any patients in both arms. Hence the same treatment was repeated in the second visit also. On the third visit, there was one patient who continued to have moderate symptoms in the group 2 That patient was given Epley's treatment on the third visit. The nystagmus duration in each visits in both the groups was not significant statistically(p value was 0.535 using t test)(fig 32). There was no

complications following the treatment in both arms. There was no vomiting during the treatment maneuvers or conversion to lateral canal BPPV.

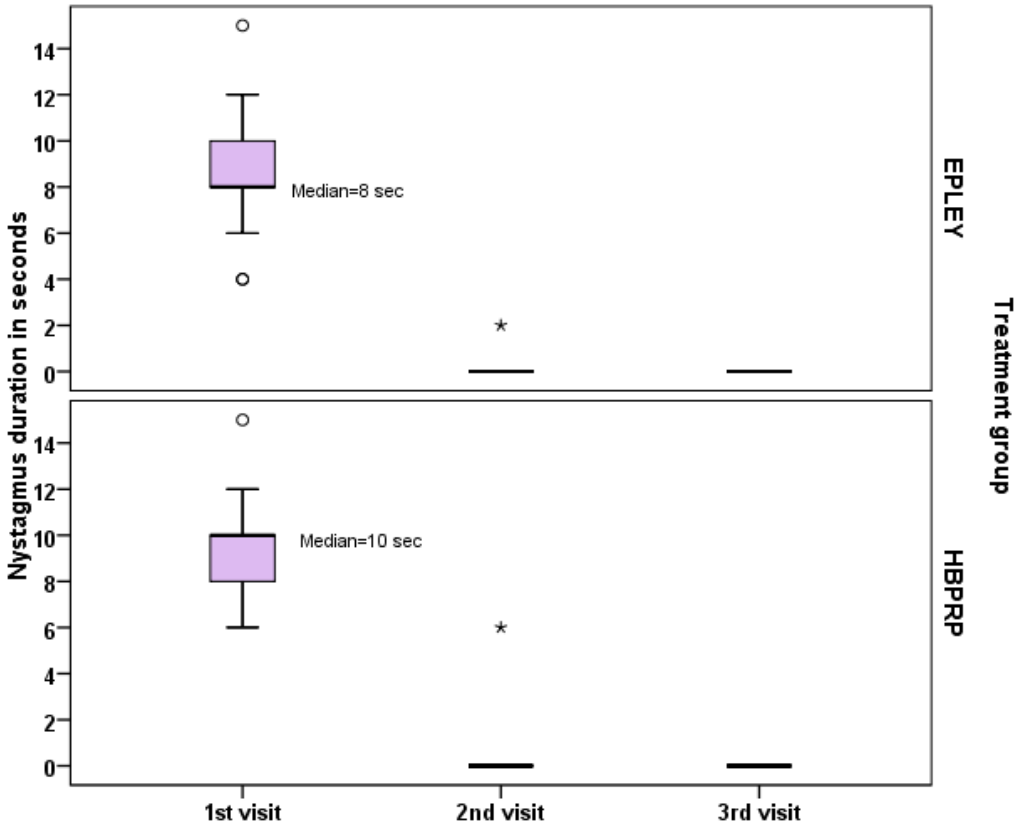


Fig 32: Median nystagmus duration in both groups

Table 10: Duration of nystagmus during 1st, 2nd & 3rd visits

Visits		1st visit	2nd visit after 1 week	3rd visit after 4 weeks
Group 1	Median	8sec	0 sec	0 sec
	Minimum	4 sec	0 sec	0sec
	Maximum	15 sec	2 sec	0 sec

Group 2	Median	10 sec	0 sec	0 sec
	Minimum	6 sec	0 sec	0 sec
	Maximum	15 sec	6 sec	0 sec

VERTIGO SCALE

The vertigo scale showed reduction in vertigo following the treatment in both arms. 7 patients out of 30 had absolutely no symptoms at the end of 4 weeks (fig:33). Four patients were in group 1 and 3 were in group 2. There was one patient in the group 2 with a vertigo scale of 4. The patient was given the standard Epley's treatment following which she improved. On detailed enquiry, it was found out that the patient was not following the exercises at home.

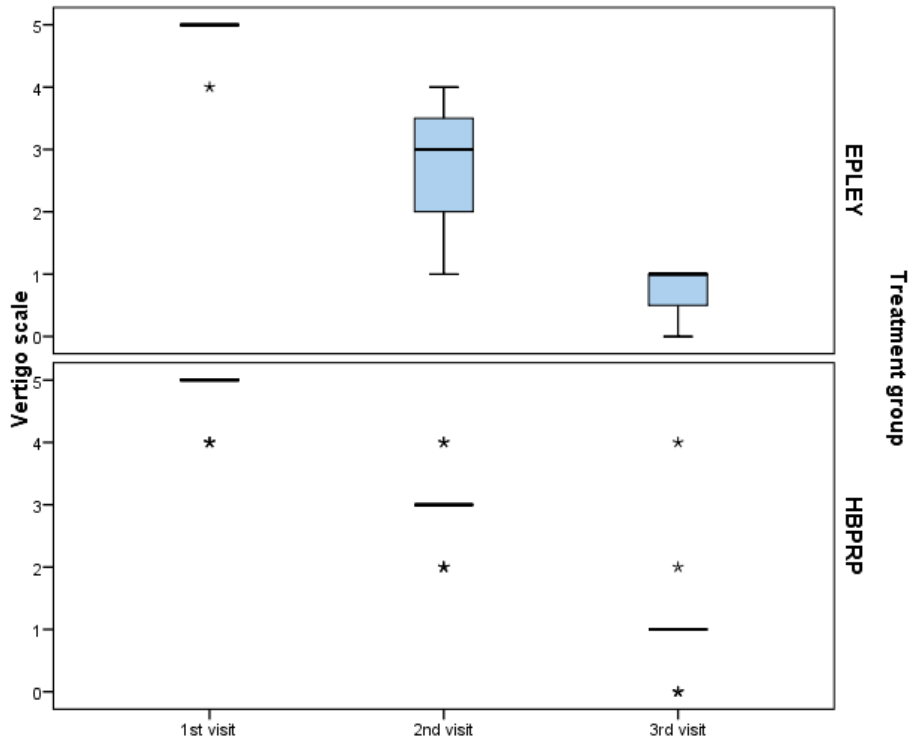


Fig 33: Vertigo scale during the visits in both groups

Comparing the vertigo scale between the 2 groups there was no significant difference;

- Using Mann - Whitney test, p value was 0.512 (reduction in 1st to 2nd visit)
- p value - 0.624 (reduction in 2nd to 3rd visit)

FREQUENCY OF VERTIGO

Following treatment, there was reduction of frequency of vertigo in both arms. The mean percentage of reduction in vertigo frequency at second visit in group 1 was 51.6% and in group 2 was 38.8%. The mean percentage of reduction in vertigo frequency at third visit

in group 1 was 81.8% and in group 2 was 73.7% (fig 34).

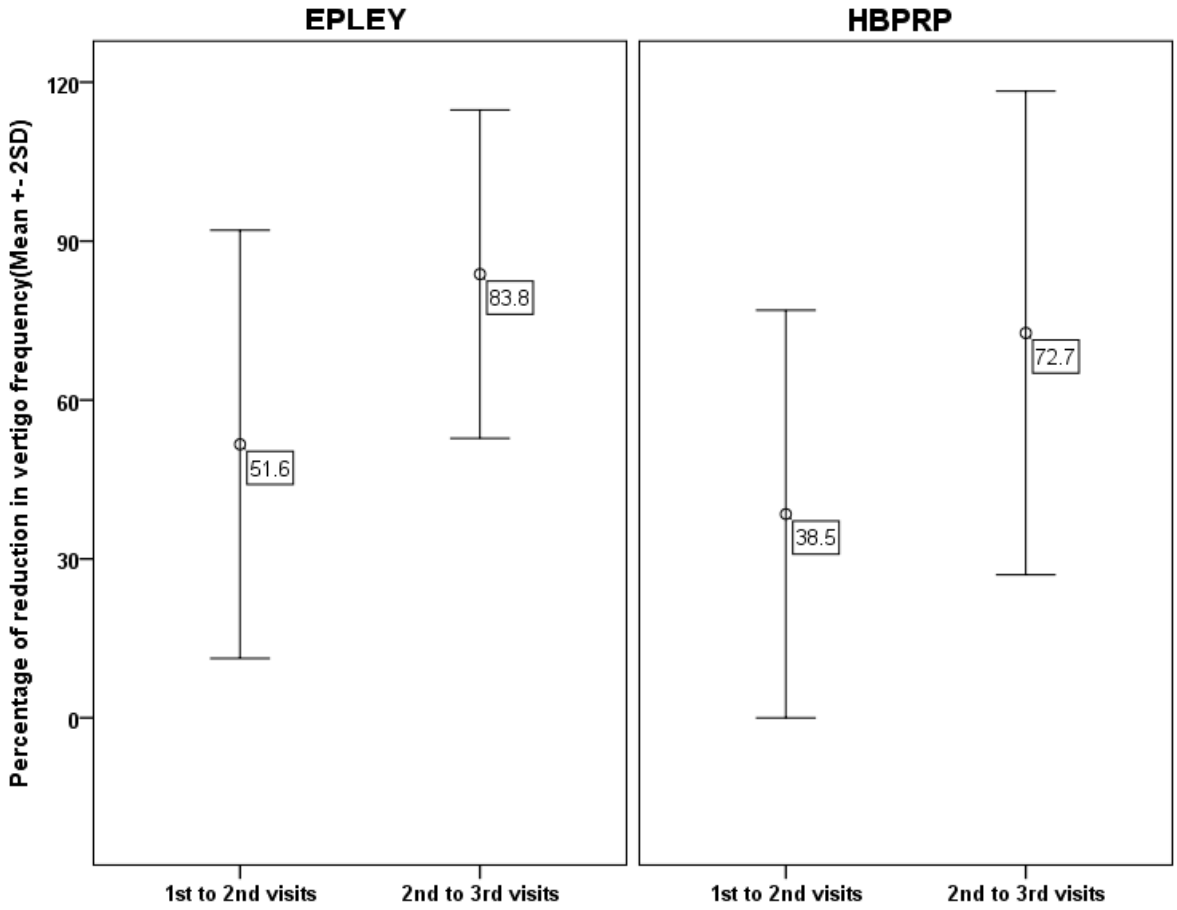


Fig 34: Percentage of reduction in vertigo frequency during follow up in both groups

The reduction in vertigo was studied in both the groups in both the visits and was found to be not significant. The p value was **0.847** (Repeated measures ANOVA).

GRADE OF SYMPTOMS

All the patients were enquired about their symptomatic relief and ability to carry out daily activities. At the time of presentation, in group 1, there were 11 patients with severe

symptoms (vertigo preventing daily activities), 4 patients with moderate symptoms (vertigo interfering with daily activities but not preventing), no patients with mild symptoms (vertigo not interfering with daily activities). In group 2 there were 14 patients with severe symptoms, 1 patient with moderate symptoms and no patient with mild symptoms. All patients showed reduction in the symptoms. In both groups after 1 week, 2 patients were having mild symptoms and 13 were having moderate symptoms. In group 1, after 4 weeks on third visit, out of 15 patients, 3 patients had no symptoms at all, 12 patients had mild symptoms. In group 2, after 4 weeks on third visit, out of 15 patients, 3 patients had no symptoms at all, 1 patient had moderate symptom and 11 patients had mild symptoms. The 1 patient with moderate symptom was reassessed and treatment was changed from HBPRP to Epley's maneuver.

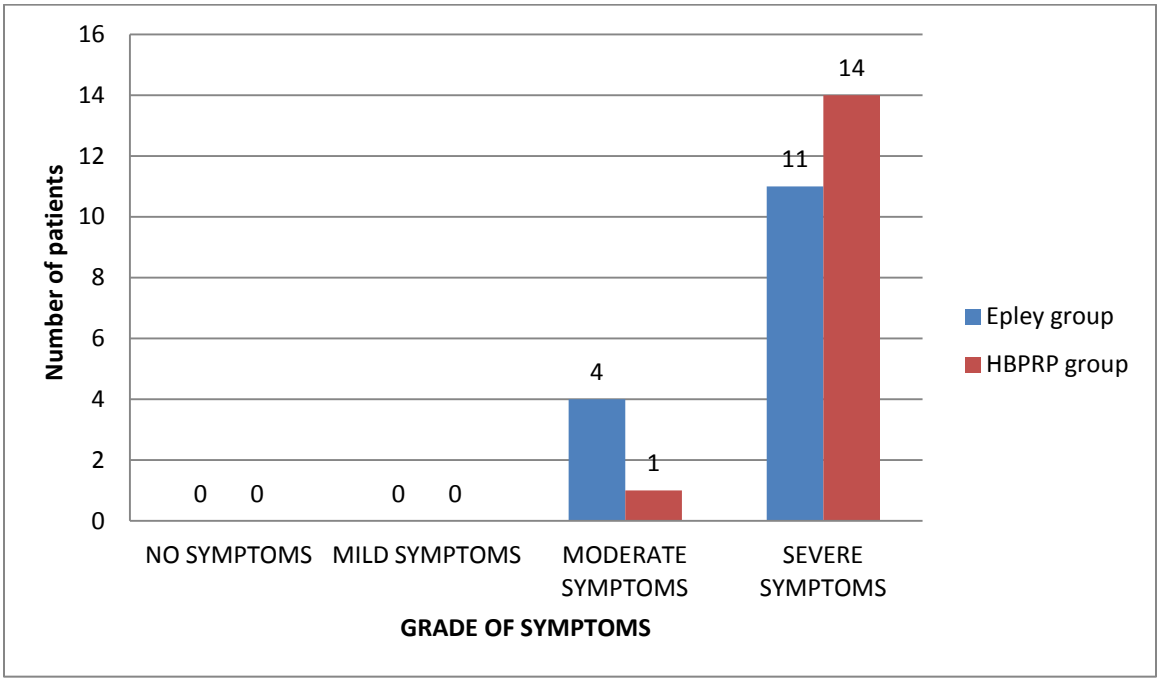


Fig 35: Grade of symptoms in both groups at time of presentation

The grade of symptoms between the two groups at the time of presentation was statistically insignificant, (compared using Fisher's exact test and p value was greater than 0.330) (fig 35)

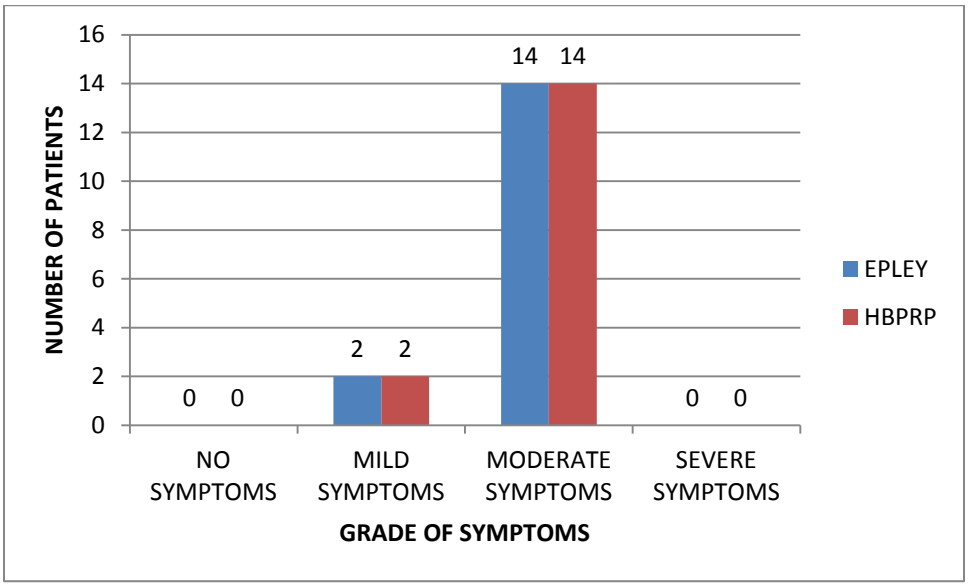


Fig 36: Grade of symptoms during second visit in both groups

The grade of symptoms in second visit between both groups was not significant (compared using Fisher's exact test and p value was greater than 0.999) (fig 36)

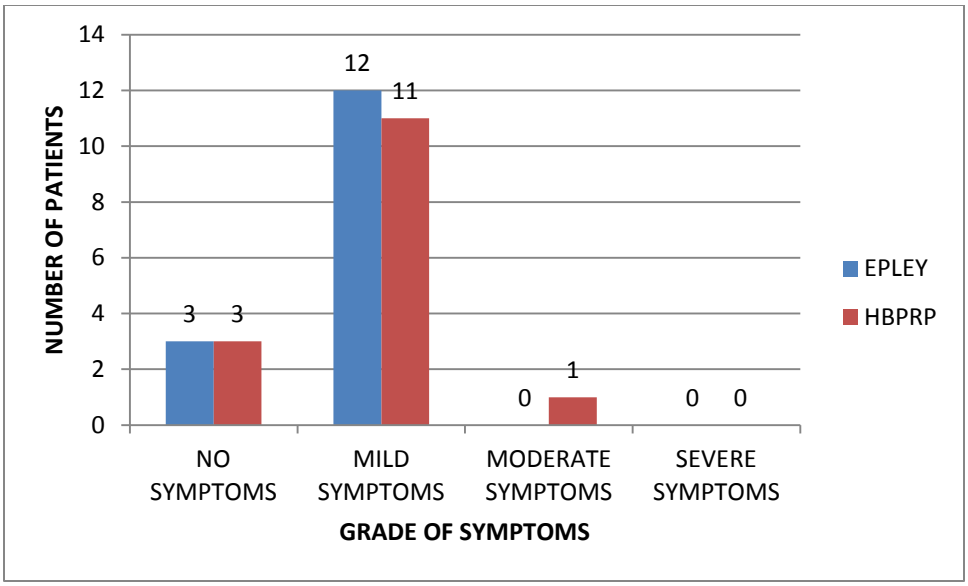


Fig 37 : Grade of symptoms during third visit in both groups

The grade of symptoms in third visit between both groups was not significant (compared using using Fisher's exact test and P value was greater than 0.999)(fig. 37)

DISCUSSION

BPPV is one of the most common causes for vertigo in patients coming to an ENT outpatient clinic. Vertigo can be a presenting complaint for multiple central and peripheral diseases. This is where a proper understanding of BPPV comes in to play. The usage of appropriate diagnostic test after taking history can avoid unnecessary expenses by the patient in the form of CT, MRI or other vestibular tests. The most popular treatment of BPPV is inexpensive in the form of some exercises or repositioning maneuvers.

BPPV is due to the displacement of otoconia from otolith membrane into the semicircular canals. The most common canal affected is the posterior semicircular canal. It is diagnosed by the Dix Hallpike test. The treatment is by repositioning maneuvers.

Different studies have been conducted all around the world comparing different modalities of treatment for posterior canal BPPV. Almost all studies show similar results. The most common and popularly used treatment is Epley maneuver. Metanalysis has also shown Epleys maneuver is very effective. There have been studies comparing Epley and other maneuvers also. When Epley and Semonts maneuver were compared in a randomized controlled trial there was no statistically significant difference between the two treatments. Epley and Brandt Daroff exercise has also been compared. In a study by Abdel Kader et al both groups showed significant improvement. Another study comparing the Epley and Gans repositiong maneuver by Abir Omara et al also showed no statistical difference between the two groups in terms of treatment efficacy.

A home based exercise devised by Carol Foster is the Half Somersault exercise. A randomized controlled trial which was single blinded was conducted to compare the home based treatment with standard Epley treatment(84). The subjects in both arms were given the exercise twice and retested with Dix Hallpike test. A six month follow up was done. The reductions in nystagmus, tolerability of reduced nystagmus, tolerability of induced dizziness were the outcome measures looked for in their study. It was found in the study that both exercises showed significant reduction in nystagmus with Epley performing significantly better. But there was significantly more dizziness after Epley maneuver than the Half somersault maneuver. There was more treatment failures in Epley than Half Somersault group at six months follow up. It was concluded that half somersault was better tolerated and had fewer side effects as a home based exercise

In our study, there were 30 patients. There were more females than males. In group 1, the male: female ratio was 4:11 and in group 2 male: female ratio was 3:12. Both the groups had similar base line characteristics on statistical comparison.

The duration of vertigo at the time of presentation was compared between the groups and not found to be significant. The frequency of vertigo between the groups at the time of presentation was also compared and this was also not statistically significant. Our study showed a general trend of increase in frequency of vertigo with the age. Normal day to day head movements may be limited in older population, hence decreasing natural resolution of vertigo frequency in BPPV.

Duration of nystagmus during Dix Hallpike was one of the main outcome measures which was studied. In group 2, the duration of nystagmus was in a range of 4 seconds to 15 seconds and in group 1, the nystagmus was in the range of 6 seconds to 15 seconds and this difference was not statistically significant. There was no statistically significant difference in the reduction of nystagmus when both treatment modalities were compared.

Vertigo scale reduction was another outcome measure compared. Reduction in vertigo scale was also similar in both the groups. Except one patient in group 2, all the patients were almost asymptomatic and vertigo scale was 1 or less by the third visit. The reduction in vertigo scale in both the groups was statistically compared in each visit. The reduction in vertigo scale in second visit from the first visit was compared between the groups and this was similar. Similarly reduction in vertigo scale in third visit from the second visit was compared between the groups and found to be similar.

The percentage of reduction in vertigo frequency was also an outcome measure calculated in the study. The mean percentage of reduction in vertigo frequency in group 1 was 51.6% in second visit and group 2 was 38.8%. The mean percentage of reduction in vertigo frequency in group 1 was 81.1% and group 2 was 73.7% in third visit . The reduction in vertigo was compared between the groups and found to be insignificant.

Reduction in grade of symptoms was calculated. At the time of presentation, group 1 had 14 patients with severe symptoms and 1 patient with moderate symptom. Group 2 had 11 patients with severe symptoms and 4 patients with moderate symptoms. There was no significant difference of symptoms between the two groups at the time of presentation.

Grade of symptoms in second visit in both groups were compared and there was no significant difference. Grade of symptoms in third visit in both groups were compared and there was no statistically significant difference in grade of symptoms between the groups.

All the outcome measures which indicate efficacy of the tests shows that there was no statistically significant difference in outcomes between the two groups. HBPRP as a home based exercise is as effective as Epley in the treatment of posterior canal BPPV. The study showed that HBPRP is safe and effective in reducing the signs and symptoms of posterior canal BPPV.

- Complications - There was no complication after the treatment in the form of any severe nausea, neck pain or sprain, vomiting, worsening of vertigo in both the arms

There was one patient who was not improving with the HBPRP. On second visit she was further counseled regarding regular performance of the HBPRP. On third visit since her symptoms persisted, she was given Epley following which she improved.

LIMITATIONS

In our study a home based exercise was compared with a hospital based treatment. Epley was not taught to patients whereas HBPRP was taught to patients and expected be done at home.

There was no way of monitoring the way exercises that were being done in the patients' homes. The patients' word and that of the accompanying relative had to be taken into account regarding compliance. However knowledge of the home based procedure was re-checked by asking the patient to demonstrate the exercise during follow-ups.

The study was not blinded, the patients and the investigator knew which treatment was being given to the patient.

There was no long term follow up of the patients to understand and study whether any group had long term effects or treatment failures.

A much bigger sample size would have been better for comparison.

CONCLUSION

- Both Epley and HBPRP had similar outcomes in terms of reduction in vertigo scale and nystagmus at 1 week and 4 weeks
- Epley group had a higher reduction in frequency of vertigo but this was not statistically significant
- HBPRP is as effective as Epley in reducing the signs and symptoms of posterior canal BPPV
- HBPRP can be taught safely to patients who find it difficult to come to hospital multiple times and in cases of recurrent BPPV.

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INFORMATION SHEET

BPPV is a disease affecting the balance due to displacement of certain particles inside the ear. It is characterized by giddiness and nystagmus. The treatment of this disease is exercise. There are different types of exercises each with its own advantages and disadvantages. The most commonly used one is called Epley's maneuver. There are some disadvantages for Epley's maneuver also. There is a new method we are trying which abolishes some of the disadvantages of Epley. This study is a comparison between Epley and the new method. In this study the patients will be given either of the one exercise as treatment according to a randomization table. The patients will have to come for follow up at 1 week and at 4 weeks. If there is any discomfort for the patient, they can withdraw from the study at any time.

For any doubts, kindly contact Dr.Ranju (Phone number-04162286089, email-ranjurl86@gmail.com)

CONSENT FOR STUDY

EFFICACY OF HOME BASED PARTICLE REPOSITIONING MANEUVER IN TREATMENT OF POSTERIOR CANAL BENIGN PAROXYSMAL POSITIONAL VERTIGO

Study number:

Subject's initials:

Subject's name:

Age:

Phone number:

I confirm that I have read and understood the information sheet dated ..... for the above study & had the opportunity to ask questions

I understand that my participation in study is voluntary & that I am free to withdraw at any time, without any reason, without any medical care or legal rights being affected

I understand that the people working on the project, Ethical committe and regulatory authorities will not need any permission to look at my health records both in respect to current study and any further research related to it in future, even if I withdraw from this trial. I agree to this. I understand that my identity will not be revealed in any information released to third parties or published.

I agree not to restrict the use of any data or results that arise from the study provided such a use is only for scientific purpose

I agree to take part in the above study

I am aware of audiovisual recording of the informed consent form

Signature

Date

Name

Representative

Date

Name

Investigator

Date

Name

Witness

Date

Name & address

PROFORMA

Serial No: Treatment: 1/ 2

Name: Hospital no:

Age: Gender

Duration of present vertigo: .....days/.....wks/.....months/.....yrs

Duration of each attack: .....sec/.....min/.....hrs

Frequency of episodes: .....per day/.....per week/.....per month/..... per year

No of previous clusters (if any): .....per year/.....per 5 years

History of head trauma: yes / no

Medications used earlier:

Dix Hallpike Test: right..... left.....

Post Rx instruction: given/ not given

GRADES OF BPPV

At 0 week:

Rx given: 1 /2

Vertigo scale: 0 1 2 3 4 5

Nystagmus duration (during hallpike): --------sec --------min

Frequency of vertigo:--------/day,----------/week, ----------/month

Duration of each episode:------sec,----------min,----------hours

Mild symptoms (vertigo not interfering with daily activities)

Moderate symptoms (vertigo interfering with daily activities but not preventing)

Severe symptoms (vertigo preventing daily activities)

Complications : yes/no

If yes describe:

At 1 week:

Rx given: 1 /2

Vertigo scale: 0 1 2 3 4 5

Nystagmus duration (during hallpike): --------sec --------min

Frequency of vertigo: --------/day, ----------/week, ----------/month

Duration of each episode: ------sec, ----------min, ----------hours

Mild symptoms (vertigo not interfering with daily activities)

Moderate symptoms (vertigo interfering with daily activities but not preventing)

Severe symptoms (vertigo preventing daily activities)

Complications : yes/no

If yes describe:

At 4 weeks:

Rx given: 1 /2

Vertigo scale: 0 1 2 3 4 5

Nystagmus duration (during hallpike): --------sec --------min

Frequency of vertigo:--------/day,----------/week, ----------/month

Duration of each episode:------sec,----------min,----------hours

Mild symptoms (vertigo not interfering with daily activities)

Moderate symptoms (vertigo interfering with daily activities but not preventing)

Severe symptoms (vertigo preventing daily activities)

Complications : yes/no

If yes describe:

Co-morbid illness:

Any other ear diseases:

Vitamin D deficiency: yes/no

Osteoporosis/osteopenia: yes/no

DATA SHEET

slno	age	gender	vertigo	durvert	vertdays	attack	duratt	attacksec
1	75	2	8	1	8	30	1	30
2	64	2	20	1	20	10	1	10
3	61	2	4	1	4	1	2	60
4	20	2	1	3	30	30	1	30
5	59	2	3	3	90	1	2	60
6	66	2	3	3	90	10	1	10
7	34	2	1	2	7	10	2	600
8	65	1	2	2	14	45	1	45
9	64	1	1	2	7	1	2	60
10	41	2	1	2	7	10	2	600
11	49	2	10	1	10	20	1	20
12	48	2	1	2	7	2	2	120
13	47	2	2	2	14	1	2	60
14	67	2	10	1	10	20	1	20
15	63	1	1	2	7	1	2	60
16	35	2	3	1	3	10	1	10
17	43	2	2	2	14	10	1	10
18	48	2	201	1	201	1	2	60
19	40	2	1	2	7	30	1	30
20	72	2	10	1	10	10	1	10
21	76	2	1	2	7	10	1	10
22	60	1	1	2	7	20	1	20
23	48	2	15	1	15	45	1	45
24	53	2	8	1	8	1	2	60
25	52	2	1	2	7	2	2	120
26	47	1	9	1	9	15	1	15
27	51	2	5	1	5	1	2	60
28	38	1	4	2	28	30	1	30
29	54	1	10	1	10	10	1	10
30	47	2	1	3	30	2	2	120

episod	freqepi	freqepiday	cluster	prevclus	trauma	medicat	hallpike	postrx
20	1	20	0	1	0	1	1	1
6	1	6	1	1	0	1	1	1
4	1	4	3	1	0	1	2	1
6	1	6	0	1	0	4	1	1
9	1	9	2	2	0	1	1	1
5	1	5	0	1	0	4	2	1
10	1	10	0	1	0	4	1	1
15	1	15	0	1	0	4	1	1
10	1	10	1	2	1	1	1	1
25	1	25	1	2	0	1	1	1
5	1	5	0	1	0	4	2	1
5	1	5	0	1	0	4	2	1
6	1	6	0	1	0	4	1	1
10	1	10	0	1	0	4	1	1
7	1	7	0	1	0	4	2	1
15	1	15	0	1	0	4	2	1
20	1	20	0	1	0	4	2	1
8	1	8	0	1	0	4	2	1
20	1	20	0	1	0	4	1	1
8	1	8	0	1	0	4	1	1
7	1	7	0	1	0	4	1	1
8	1	8	0	1	0	4	2	1
6	1	6	0	1	0	4	1	1
8	1	8	0	1	0	4	1	1
12	1	12	1	2	0	4	2	1
4	2	28	4	2	1	1	2	1
6	1	6	1	1	0	1	2	1
20	1	20	0	1	1	4	1	1
15	1	15	0	1	1	4	2	1
5	1	5	0	1	0	4	2	1

owrx	owvert	owhall	owfreqvert	owfreqver1	owfreqver2	owepi	owepi1	owepi2
2	4	6	20	1	20	30	1	30
2	5	10	6	1	6	10	1	10
2	4	10	4	1	4	1	2	60
2	5	10	6	1	6	30	1	30
2	4	10	9	1	9	1	2	60
2	5	8	5	1	5	10	1	10
2	5	12	10	1	10	10	2	600
2	5	10	15	1	15	45	1	45
2	5	6	10	1	10	1	2	60
2	5	15	25	1	25	10	2	600
2	5	10	5	1	5	20	1	20
2	5	6	5	1	5	2	2	120
2	5	10	6	1	6	1	2	60
2	5	8	10	1	10	20	1	20
2	5	10	7	1	7	1	2	60
1	5	12	15	1	15	10	1	10
1	5	8	20	1	20	10	1	10
1	5	10	8	1	8	1	2	60
1	5	8	20	1	20	30	1	30
1	5	12	8	1	8	10	1	10
1	5	8	7	1	7	10	1	10
1	5	6	8	1	8	20	1	20
1	5	8	6	1	6	45	1	45
1	5	8	8	1	8	1	2	60
1	5	10	12	1	12	2	2	120
1	4	15	4	2	28	15	1	15
1	5	4	6	1	6	1	2	60
1	5	8	20	1	20	30	1	30
1	5	4	15	1	15	10	1	10
1	5	10	5	1	5	2	2	120

owsymptom	owcomp	owcompyes	w1rx	w1vert	w1hall	w1freqvert	w1freqver1	w1freqver2
3	0	nil	2	3	0	10	1	10
3	0	nil	2	3	0	2	1	2
3	0	nil	2	2	6	3	1	3
3	0	nil	2	2	0	5	1	5
3	0	nil	2	3	0	5	1	5
2	0	nil	2	3	0	5	1	5
3	0	nil	2	2	0	5	1	5
3	0	nil	2	3	0	10	1	10
3	0	nil	2	3	0	3	1	3
3	0	nil	2	4	0	13	1	13
3	0	nil	2	3	0	3	1	3
3	0	nil	2	3	0	4	1	4
3	0	nil	2	3	0	3	1	3
3	0	nil	2	4	0	8	1	8
3	0	nil	2	3	0	4	1	4
3	0	nil	1	4	0	8	1	8
3	0	nil	1	3	0	10	1	10
3	0	nil	1	4	0	4	1	4
3	0	nil	1	3	0	10	1	10
2	0	nil	1	2	0	2	1	2
3	0	nil	1	4	0	5	1	5
3	0	nil	1	3	0	6	1	6
3	0	nil	1	2	0	4	1	4
3	0	nil	1	4	0	4	1	4
3	0	nil	1	2	0	9	1	9
2	0	nil	1	1	0	2	2	14
2	0	nil	1	3	0	2	1	2
3	0	nil	1	3	0	10	1	10
2	0	nil	1	2	0	3	1	3
3	0	nil	1	3	2	2	2	14

w1epi	w1epi1	w1epi2	w1symptom	w1comp	w1compyes	w4rx	w4vert	w4hall
10	1	10	2	0	nil	2	1	0
10	1	10	2	0	nil	2	1	0
15	1	15	2	1	nil	2	1	0
15	1	15	2	0	nil	2	2	0
30	1	30	2	0	nil	2	1	0
3	1	3	1	0	nil	2	1	0
5	2	300	2	0	nil	2	0	0

30	1	30	2	0	nil	2	0	0
30	1	30	1	0	nil	2	0	0
5	2	300	2	0	nil	1	4	0
10	1	10	2	0	nil	2	1	0
1	2	60	2	0	nil	2	1	0
30	1	30	2	0	nil	2	1	0
20	1	20	2	0	nil	2	1	0
30	1	30	2	0	nil	2	1	0
10	1	10	2	0	nil	1	1	0
5	1	5	2	0	nil	1	0	0
30	1	30	2	0	nil	1	0	0
20	1	20	2	0	nil	1	1	0
5	1	5	1	0	nil	1	1	0
10	1	10	2	0	nil	1	1	0
10	1	10	2	0	nil	1	1	0
30	1	30	2	0	nil	1	1	0
45	1	45	2	0	nil	1	1	0
45	1	45	2	0	nil	1	1	0
5	1	5	1	0	nil	1	0	0
30	1	30	2	0	nil	1	1	0
20	1	20	2	0	nil	1	0	0
3	1	3	2	0	nil	1	1	0
1	2	60	2	0	nil	1	1	0

w4freqvert	w4freqver1	w4freqver2	w4epi	w4epi1	w4epi2	w4symptom	w4comp	w4compyes
5	1	5	5	1	5	1	0	Nil
1	1	1	4	1	4	1	0	Nil
5	2	35	10	1	10	1	0	Nil
4	2	28	10	1	10	1	0	Nil
1	1	1	20	1	20	1	0	Nil
5	2	35	2	1	2	1	0	Nil
0	1	0	0	1	0	4	0	Nil
2	2	14	5	1	5	1	0	Nil
0	1	0	0	1	0	4	0	Nil
6	1	6	1	2	60	2	1	changed to epley
0	1	0	0	1	0	4	0	Nil
2	1	2	30	1	30	1	0	Nil
2	1	2	10	1	10	1	0	Nil
2	1	2	5	1	5	1	0	Nil
2	1	2	3	1	3	1	0	Nil
1	1	1	5	1	5	1	0	Nil
0	1	0	0	1	0	4	0	Nil
0	1	0	0	1	0	4	0	Nil
2	1	2	5	1	5	1	0	Nil
1	2	7	2	1	2	1	0	Nil
2	1	2	2	1	2	1	0	Nil
2	1	2	3	1	3	1	0	Nil
5	2	35	3	1	3	1	0	Nil
4	2	28	3	1	3	1	0	Nil
2	1	2	15	1	15	1	0	Nil
0	1	0	0	1	0	4	0	Nil
3	2	21	10	1	10	1	0	Nil
0	1	0	0	1	0	4	0	Nil
1	2	7	2	1	2	1	0	Nil
1	2	7	2	1	2	1	0	Nil

dm	htn	dlp	hypothy	osteo	vitdeff	vitaminues	eardise	chgetreat
1	1	1	0	1	1	1	5	0
1	0	1	1	1	1	1	5	0
0	0	1	1	1	1	1	5	0
0	0	0	0	0	0	5	0	
0	1	1	1	1	1	1	5	0
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0	0	0	0	0	0	5	0	
0	0	0	0	0	0	5	0	
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0	0	1	0	0	0	5	0	
0	1	0	0	0	1	1	5	0
0	0	1	0	0	0	0	4	0
1	1	1	0	1	1	1	5	0
1	1	0	0	0	0	0	5	0
0	0	0	0	0	1	1	5	0
0	0	0	0	0	0	0	5	0

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1	0	1	0	1	1	1	5	0
0	1	1	0	0	0	1	0
1	0	0	0	1	1	1	5	0
0	1	1	0	1	1	1	5	0
1	1	1	0	1	1	1	5	0
0	1	0	0	1	1	1	5	0
1	1	1	0	1	1	1	5	0
0	0	0	0	0	0	5	0
1	0	0	1	1	1	1	5	0
0	0	0	0	0	0	5	0
1	1	0	0	0	0	5	0
0	0	0	0	0	0	5	0

treatyes	weektreat
nil	3
nil	3
nil	3
nil	3
nil	3
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nil	3
nil	3
to epley	2
nil	3
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nil	3

REFERENCE NUMBER

Not secure | ctri.nic.in/Clinicaltrials/main1.php?EncHid=50086.62904

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Total Trials	**1**
Under Entry Stage	0
Under Review Stage	1
Registered Trials	0
Terminated/Suspended Trials	0

Click here to Add New Trial

Trials Under Entry/ Review

S.No.	REF Number	CTRI No	Scientific Title	Trial Acronym	Secondary ID	View Details	Select
1	**REF/2018/07/020896**	**Pending**	Effect of home based particle repositioning maneuver in the treatment of posterior canal BPPV		NIL[NIL]	Full Details	Submitted to CTRI on 25/07/2018 Last Submitted On: 12/10/2018