ORIGINAL RESEARCH PAPER | Medical Science | Volume : 6 | Issue : 10 | October 2016 | ISSN - 2249-555X | IF : 3.919 | IC Value : 74.50

A Cross Sectional Study To Evaluate The Efficacy of Subjective Visual Vertical By Bucket Method

KEYWORDS: Subjective visual vertical, ocular tilt reaction, bucket method

*** DR.LOKESH KUMAR**
Assistant Professor, Otorhinolaryngology & head neck surgery, Narayana Medical College Hospital, Andhra Pradesh,India * CORRESPONDING AUTHOR

MR.BHASKAR THAKUR
PHD Scholar, Dept of Biostatistics, AIIMS,New Delhi,India

ABSTRACT *Introduction: Subjective visual vertical is a function of otolith organs. There were many publications over the measurement of subjective visual vertical in laboratory set up. In this article , subjective visual vertical was measured by a simple, easily made bucket method.*
Materials and methods:Thirty normal subjects with no previous complaints of vertigo were compared with fifteen patients with acute vertigo with this bucket method.
Results and conclusion:*Subjective Visual Vertical test (SVV) at a cutoff value of 1.30 demonstrating 100% sensitivity and 100 % specificity . We recommend the use of bucket method for measurement of SVV in patients with vertigo in routine neurotological examination.*

Introduction:
Isolated loss of utricular nerve activity elicits a stereotypical set of static responses called the ocular tilt reaction[1] which comprises (1) a head tilt toward the lesioned side, (2) a disconjugate deviation of the eyes such that the pupil on the intact side is elevated and the pupil on the lesioned side is depressed (a so-called skew deviation), and (3) a static conjugate counter-roll of the eyes rolling the superior pole of each eye away from the intact utricle. The ocular tilt reaction can also occur from interruption of central otolithic pathways as, for example, in multiple sclerosis.[2] The full ocular tilt reaction is not often observed with peripheral vestibular lesions because the brainstem compensates for some aspects very rapidly.

Subjective visual vertical is based on ocular tilt reaction. In patients with unilateral vestibular weakness due to damage to the utricle there will be ocular tilt reaction.[9] Head tilt is a component of this phenomenon. So, this can be used for assessment of the vestibular weakness, side of the lesion,[11] site of the lesion,[50] for prognostication after injury to vestibular system. Our study is to elicit subjective visual vertical by a simple bucket method and to know the sensitivity and specificity of this test when done in normal individuals and in patients with acute vestibular neuritis.

MATERIALS AND METHODS:
STUDY DESIGN: cross sectional study

CONTROL GROUP: 30 adults between the ages of 20-45yrs with no previous history of vestibular or balance disorder.

Case group: 15 patients who were diagnosed with acute vestibular neuropathy.

INCLUSION & EXCLUSION CRITERIA
CONTROL GROUP:
Inclusion criteria:-
- Healthy young adults (20-45years old)

Exclusion criteria:
- Any history of previous Vestibular Otologic or Neurologic disease.
- History of significant systemic illness.
- Any long term medication currently being taken by the subject or a history of previous ototoxic medication.
- Any abnormality on the ear examination or the pure tone audiogram.

CASE GROUP:
Patients who presented to ENT dept with complaint of acute onset of vertigo with normal hearing on both sides.

Exclusion criteria:
- Patients with documented hearing loss on pure tone audiometry.
- Tinnitus
- Other neurological deficits
- Patients with diabetes , hypertension and other systemic disorders.

TEST METHODS:
Equipment: A medium sized light-weight opaque plastic bucket (40 cm length and 25 cm width) was used. A diametric straight line was drawn along the inner surface of the bucket bottom and reinforced with fluorescent tape to aid visualization. A similar exactly superimposed line was drawn on the outer surface of the bucket bottom.

A large cardboard protractor was attached to the outer surface with the 0^0 line of the protractor superimposed on the outer line. A pinhole was made at the centre of the bucket base and a thread with a weight passed through it (Figure 1), so as to create a system wherein the weighted thread acts as a plumb line when the bucket is held up horizontally. Since the weighted thread plumb line is always aligned vertically this system allows that the degree of deviation of the fluorescent inner line /outer line from the vertical can be read off as the angle between the plumb line and the outer line.

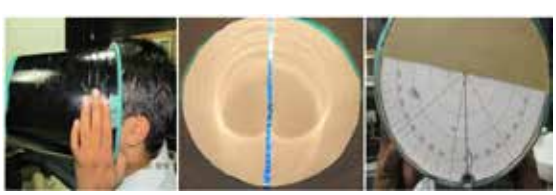


Figure 1: Subjective Visual Vertical- Opaque bucket with

Volume : 6 | Issue : 10 | October 2016 | ISSN - 2249-555X | IF : 3.919 | IC Value : 74.50

a fluorescent inner line and a corresponding superimposed outer line with a plumb line for reading the extent of rotation from the vertical axis.

Test procedure: The subject was asked to hold the bucket horizontally and insert his/her face in the bucket so that visual cues from the environment are blocked off (Figure 1). The subject keeps the eyes open and aligns the fluorescent line at the bucket bottom as per his/her perceived vertical orientation. The final alignment can be assessed by the complimentary line on the outer bottom surface and its angulation from verticality read off as the measure from the plumb line. The test was repeated thrice and the average deviation from verticality noted.

STATISTICAL ANALYSIS:
Quantitative variables were summarized as Range, Mean ± Standard Deviation, and Median. Since the distribution of variables was not confirmed as Normal, the Wilcoxon rank sum test was preferred to the Student's t test. Statistical analysis was carried out using STATA version 12.1 and included Receiver Operating Characteristic (ROC) curves, sensitivity and specificity calculations.

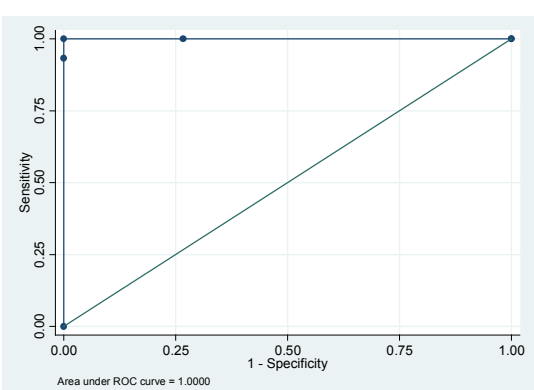
RESULTS:
Subjective visual vertical could be elicited in all controls and cases. A clear demarcation between the control group and case group was noted in the measurements of Visual Vertical (SVV) *(p< 0.001)*. Mean tilt from vertical obtained in control group is 0.08^0 and in case group is 3.5^0. Median tilt (interquartile range) obtained in control group is $0^0(0^0$-$3^0)$ and in case group is $3.3^0(3^0$-$4.3^0)$.

TABLE 1:comparison between control and case groups

SVV test	Range	Median	Mean*± SD (In degree)	95% CI	P-Value
Controls(30)	0^0 – 0.3^0	0^0	0.08 ± 0.13	0.03-0.12	0.001
Cases (15)	1.3^0– 6^0 *	3.3^0	3.5 ± 1.15	2.86-4.13	

***towards pathological side.**

Application of ROC curve (Receiver Operating Characteristic Curve) to the data indicated optimal cutoff values which would separate the two groups at 1.3^0 ipsilateral tilt for the SVV (100% sensitivity; 100% specificity).



Graph 1: ROC curve for SVV (subjective visual vertical test)

DISCUSSION:
The subjective visual vertical test is also based on the ocular tilt reaction. There were various methods for assessment of SVV. In our study, simple bedside assessment of the SVV was undertaken by means of bucket method. Seo J et al[3] measured ocular torsion by means of fundus photographs. The same method was used by many others as reliable method for assessing ocular torsion[4]. Martha Funabashi et al,[5] used a 45-cm-tall seat with a 30-cm-long dark tube was used to isolate the volunteer from external visual references. This is comparable to methodology in our study. In our study also we used a opaque bucket around 30 cm in length to isolate the volunteer from the external visual references. Tabak et al,[6] used vertical luminous bar with remote control held in patient hand for aligning the luminous bar in vertical axis as a testing protocol for SVV. Halmagyi[7] used fundus photography for documentation of the ocular torsion in the unilateral vestibular deficit patients.

In our study, a simple bed side method for assessing SVV was adopted which was done by bucket method. Helen et al,[8] used similar bucket method for assessing SVV in normal subjects and in patients with unilateral vestibular weakness. Zwergal A[9] also used bucket method for assessing SVV in peripheral and central vestibular lesions.

The mean tilt in SVV obtained by bucket method in our study was 0.08^0 in control group and 3.5^0 in case group. In the study done by Tabak et al[6] using luminous bar and remote control, he noticed that the normal subjects could accurately align a vertical luminous bar to the gravitational vertical in an otherwise completely dark room with a mean setting of $0.14^0 \pm 1.11^0$. Patients with left sided and right sided vestibular loss made mean settings at $2.55^0 \pm 1.57^0$ and $2.22^0 \pm 1.96^0$ respectively. Their mean settings are comparable to our mean tilt settings in both control and case groups.

Anna Hafstorm et al,[10] using laser light bar and remote control for aligning light bar in vertical line showed mean SVV deviation of $4.7^0 \pm /2.5^0$, and the median 4.3^0 (range 0.4^0 to 9.6^0) in unilateral vestibular deafferentiation patients. The mean deviation obtained in their study is again comparable with the results obtained in our study.

Bohmer A et al[11] in his study showed that SVV deviation did not deviate more than 2 degrees from true vertical. Patients after vestibular neurectomy, the SVV deviations were consistently tilted by some 12 degrees toward the affected ear. The greater degree of deviation in this patients might be because of the acute conditions after vestibular neurectomy without compensation.

Results from studies using bucket method:
The mean tilt in SVV obtained by bucket method in our study was 0.08^0 in control group and 3.5^0 in case group. Helen et al,[8] in his study using similar bucket method showed 0.75^0 tilt for control group and 2.3^0 tilt for case group. The mean tilt obtained by the bucket method, in the study by Zwergal A[9] in healthy subjects was 1.1 ± 0.7 degrees for monocular and 0.9 ± 0.7 degrees for binocular measurements which is comparable to our results.

The study done by Helen S. Cohen et al[8] showed that some, but not all, patients' responses differed from normal but responses also differed by age and sex. ROC values were all weak, i.e., < 0.8. No good cut-points differentiated controls from patients. Thus he concluded although the bucket test is useful for describing spatial deficits in patients. This test is not useful for screening people for

Volume : 6 | Issue : 10 | October 2016 | ISSN - 2249-555X | IF : 3.919 | IC Value : 74.50

possible vestibular impairments. In his study he compared normal controls, patients with u/l BPPV and patients with u/l vestibular weakness. In his methodology even though he used bucket similarly used in our study, patients has not given option of self aligning the vertical line. In their study examiner aligns the vertical line from the exterior of the bucket by listening to the patients' verbal command. The ROC values for SVV test and Head tilt test in our study are 100% and 98.7% respectively which differed from his study.

CONCLUSION:

Subjective visual vertical is a function of otolith organs mainly utricle. Its measurement can be done in various ways. Measurement of SVV by bucket method is a cheap and easily performed method. Subjective Visual Vertical test (SVV) at a cutoff value of 1.3^0 demonstrating 100% sensitivity and 100 % specificity . When done with precision it has yielded sensitive results in discriminating population with acute vestibular neuropathy.

REFERENCES:

1. Halmagyi GM, Gresty MA, Gibson WPR: Ocular tilt reaction with peripheral vestibular lesion. Ann Neurol 1979; 6:80.
2. Glasauer S, Dieterich M, Brandt T: Simulation of pathological ocular counter-roll and skew-torsion by a 3-D mathematical model. NeuroReport 1999; 10:1843.
3. Seo J, Kim K, Kim J, Park K, Chung H. Measurement of ocular torsion using digital fundus image. Conf Proc IEEE Eng Med Biol Soc. 2004;3:1711-3.
4. Jitendra J, G Seethapathy,Jayaprakash P and Deepak Shah. Measuring normal ocular torsion and its variation by fundus photography in children between 5-15 years of age.. Indian J Ophthalmol. 2010 Sep-Oct; 58(5): 417–419.
5. M Funabashi, TE Grespan, Santos-Pontelli, J Fernando ,C Mina, T Z Pavan, A Adilton, O Carneiro. A new method to analyze the subjective visual vertical in patients with bilateral vestibular dysfunction clinics 2012;67(10):1127-1131.
6. S Tabak, H Collewij and L Boumans.Deviation of the subjective vertical in long-standing unilateral Vestibular loss. Acta otolaryngol (stockh) 1997; 117: 1-16.
7. Curthoys IS, Dai MJ, Halmagyi GM: Human ocular torsional position before and after unilateral vestibular neurectomy. Exp Brain Res 1991; 85:218.
8. Helen S. Cohen & Haleh Sangi-Haghpeykar. Subjective visual vertical in vestibular disorders measured with the bucket test. Acta Oto-Laryngologica, 2012; 132: 850–854.
9. Zwergal A, Rettinger N, Frenzel C. A bucket of static vestibular function. Neurology. 2009 May 12;72(19):1689-92.
10. Anna Hafstrom, Per-Anders Fransson, Mikael Karlberg, & Mans Magnusson. Subjective visual tilt and lateral instability after vestibular deafferentation. Acta Oto-laryngologica, 2006; 126: 1176_1181.
11. Böhmer A Evaluating otolith function with subjective visual vertical discrimination. HNO. 1997 Jul;45(7):533-7.