VEMP is an electro-myogenic short latency evoked response recorded at high intensities from the electrodes placed on the contracted SCM muscle or the inferior oblique muscle. Two types of VEMP, namely cVEMP and oVEMP, assess the functionality of the otolithic organs i.e., the saccule and the utricle of the vestibular system. The amplitude of cVEMP responses is found to be contingent upon the magnitude of SCM muscle contraction. Thus the response amplitudes show variations when the electromyographic level of SCM muscle differs as a result of the presence or absence of feedback methods. The major parameters used in the interpretation of VEMP responses for the diagnosis of otologic and neurologic diseases are latency and amplitude. There is little information available on latencies and amplitude difference between the left and right ears for oVEMP. A dispute on cVEMP and oVEMP findings related to latencies, amplitudes, and response rate in old adults does exist in literature. Studies till date have mainly focused on cVEMP testing either with the use of visual feedback system to control electromyography or without any visual feedback, with controversial results. oVEMP on the other hand is a recently developed vestibular test that can be used conjoint with cVEMP while testing individuals with vestibular pathology. The test retest reliability of oVEMP has not been precisely established as yet.

Hence the present research was aimed at observing VEMPs in healthy adults across different ages. The objectives were to investigate the occurrence of cVEMP (with & without integrated visual feedback system) and oVEMP response between left and right ears across different age groups; to see age related changes in cVEMP (with & without integrated visual feedback system) and oVEMP response; to determine the test retest reliability of cVEMP (with & without integrated visual
A cross sectional study design was adopted for the research using convenient sampling method to select the participants for the study. The participants included in this study were divided into three groups based on their age, such as, early adult (20-40 years), middle adult (41-60 years), and old adult (60 years and above). To see the age related changes in each age group, a total of 42 (84 ears) participants were considered. To check the test retest reliability in each age group, 20 participants were considered. The cVEMP and oVEMP recordings were done using IHS Smart EP. A 500Hz tone burst with 8ms duration was presented monaurally at an intensity level of 100dBHL to elicit cVEMP and oVEMP responses. cVEMPs were recorded with and without integrated visual feedback system, and oVEMP were recorded without integrated visual feedback system. To record the cVEMP response with integrated visual feedback, the tonic muscle contraction were monitored from 50µV to 150µV. cVEMPs and oVEMP recording were performed 3 times to check for test retest reliability. The data were analysed in terms of latencies (P13, N23, P13-N23 interval for cVEMP & n10, p15 n10-p15 interval for oVEMP), peak to peak amplitude and, amplitude ratio. Smith’s statistical package was used to perform two sample test of probabilities. SPSS software (version 17) were used to performed mixed design ANOVA, one way ANOVA, post hoc Bonferroni test, McNemar’s test, Intra class correlation test, and Wilcoxon signed rank test.

There was no difference in latencies and peak to peak amplitude between the left and right ears for cVEMP with and without integrated visual feedback system as well as for oVEMP across different age groups. Hence, for further analysis, the data of left and right ears was pooled together. There was a significant reduction in the
response rate in the old adult group for cVEMP with integrated visual feedback system and oVEMP response. A significant decrease in the response rate was observed in the middle and old adult group as compared to the young adult group for cVEMP without integrated visual feedback system. A prolongation of the latencies and a reduction in the peak to peak amplitude was observed with increasing age with a considerable difference noted at 60 years and above for cVEMPs (with & without integrated visual feedback system) and oVEMP. There was no effect on amplitude ratio for cVEMPs (with & without integrated visual feedback system) and oVEMP with ageing. There was no significant difference observed for latencies and amplitude ratio with and without integrated visual feedback system for cVEMP. However, peak to peak amplitude showed significant differences with and without integrated visual feedback system across the age groups. These findings indicate that age should be taken into consideration when interpreting VEMPs results. cVEMP recording with integrated visual feedback system shows better amplitude and less variation in amplitude. Hence it is also recommended that while interpreting peak to peak amplitude it is important to consider tonic muscle contraction during cVEMP testing.

cVEMP results also indicated a fair to good reliability for P13 latency, P13-N23 interval and amplitude ratio and an excellent reliability for N23 latency across the age groups. For peak to peak amplitude of cVEMP, an excellent reliability was obtained with integrated visual feedback system, and a fair to good reliability without integrated visual feedback system. These findings suggest that the reliability of peak to peak amplitude measures was relatively higher when the tonic muscle contraction was monitored using integrated visual feedback, which ensures a constant amount of contraction. With respect to oVEMP responses, a fair to good reliability was obtained for n10 latency, n10-p15 interval and amplitude ratio. Peak to peak amplitude and p1
latency showed an excellent reliability for oVEMP response. Reliability of peak to peak amplitude in the old adult group showed a slightly lower reliability as compared to the young and middle adult groups for cVEMP (with & without integrated visual feedback system) and oVEMP. In general, reliability was acceptable for both cVEMP and oVEMP response parameters. Thus it can be concluded from the current research that cVEMP and oVEMP testing procedures are reliable in the young, middle and old adult groups during and between test recordings. The 5 point self rating scale of comfort showed no significant difference in scores for cVEMP and oVEMP procedures.

Clinical Implications

The findings of this research help in understanding the ageing effect on cVEMP and oVEMP responses. While interpreting the results of cVEMP (with & without integrated visual feedback system) and oVEMP in older adults, it is recommended that, caution be taken, owing to drastic reduction in response rate, prolongation of absolute latencies, and reduction of peak to peak amplitude in old adults. Further, the mean and standard deviation across different age groups obtained in the present research will serve as a normative data for comparison against the clinical population. The present research also showed higher mean peak to peak amplitude, and less variation of cVEMP with integrated visual feedback system across the age groups, suggesting that cVEMP has to be ideally recorded with tonic muscle contraction monitoring system. The present results showed higher reliability of peak to peak amplitude with integrated visual feedback system than without, which suggest that information on tonic muscle contraction is very important while interpreting the
results. In general cVEMP and oVEMP can be recorded reliably across the various age groups, without compromising on the procedure comfort.

Limitations and Future Directions

In the present research, a wide range of age groups were studied. Hence in future studies, the focus on the aging effect of cVEMP and oVEMP may be done by considering a smaller age range. The present research had monitored tonic muscle contraction of cVEMP response between 50 to 150µv, it would be interesting to use a smaller range of electromyography to monitor tonic muscle contraction.