RESEARCH ARTICLE
DOI: 10.26650/Tr-ENT.2022.1163309
The Turkish Journal of Ear Nose and Throat 2022;32(4):101-104

Virtual Reality Glasses (Cardboard VR): A New Tool for The Assessment of Nystagmus

Remzi Doğan[1], Nazan Değirmenci[1]

[1]Bezmialem Vakif University, Department of Otorhinolaryngology, Istanbul, Turkiye

ORCID ID: R.D. 0000-0003-0769-9734; N.D. 0000-0001-5627-1342

Citation: Dogan R, Degirmenci N. Virtual reality glasses (Cardboard VR): a new tool for the assessment of nystagmus. Tr-ENT 2022;32(4):101-104. https://doi.org/10.26650/Tr-ENT.2022.1163309

ABSTRACT

Objective: Virtual reality (VR) glasses are tools that provide a more realistic perception of the image viewed from mobile phones. The aim of this study was to assess nystagmus with Cardboard VR, the most widely used and simplest form of VR glasses, and to compare the findings with those obtained via conventional Frenzel goggles.

Materials and Methods: A total of 97 patients were included in the study. Balance tests were performed at one-hour intervals using Cardboard VR and Frenzel goggles. Direction, frequency, and duration of nystagmus were recorded during the examinations. Following the examinations, patients using both glasses were asked to rate the general comfort and holding quality of the glasses on a visual analogue scale (VAS).

Results: No significant difference was found between the two glasses in terms of the direction of nystagmus (p>.05). There was no significant difference between the two glasses (Cardboard VR vs Frenzel goggles) in terms of frequency (0.73±0.29 beats/sec and 0.86±0.39 beats/sec, respectively) (p>.05). There was no significant difference between the two glasses in terms of the duration of observation (18.58±5.54 sec and 20.54±6.40 sec, respectively)(p>.05). The VAS score of the Carton VR was found to be significantly higher than that of the Frenzel goggles (8.69±1.02 and 5.24±1.31, respectively) (p=0.001).

Conclusion: Cardboard VR is an easy-to-use, easily accessible, inexpensive, and effective tool that can be used to assess nystagmus under polyclinic and emergency conditions.

Keywords: Dizziness, positional vertigo, vertigo, peripheral, virtual reality

INTRODUCTION

Vertigo is a symptom that causes a person to feel as if they or their surroundings are moving even if they are not. There are two main pathologies in the etiology of vertigo: central or peripheral vestibular pathology. Assessment of nystagmus plays a major role in both peripheral (inner ear or vestibular nerve) and central (pons or cerebellum) vestibular pathologies (1). Nystagmus is involuntary, rhythmic, back and forth eye movements with slow and fast phases and corrective saccades. Assessment of nystagmus provides a significant distinction both in otolaryngology practices and in neurology and emergency departments. Today, there are many instruments used to assess nystagmus in patients presenting with dizziness. These can be listed as follows from simple to complex: Frenzel goggles (F glasses), Fresnel-based device (M glasses), ophthalmoscope, video Frenzel goggles, infrared CCD Camera (IR-CCD), and electronystagmography (ENG).

The development of computer technologies and their impact on daily life is increasing every day. Virtual reality glasses have been used for visual field examination since 1998. They are currently used to increase the reality of the image on mobile phones. For this purpose, many different types of VR glasses have been developed. There are studies investigating the use of these glasses in ophthalmology and microsurgery (2, 3).

The aim of this study is to compare the efficacy of Cardboard VR, an easily accessible, practical and inexpensive type of VR glasses, in the evaluation of nystagmus with classical Frenzel goggles.

Corresponding Author: Nazan Değirmenci **E-mail:** nzndegirmenci@hotmail.com

Submitted: 17.08.2022 • **Accepted:** 24.11.2022 • **Published Online:** 17.01.2023

MATERIAL AND METHOD

Study Design

Prior to the study, permission was obtained from the local research ethics committee of our university. A total of 97 patients, who were admitted to our otorhinolaryngology clinic with the complaint of dizziness and probably had a history of benign paroxysmal positional vertigo (BPPV), were included in the study. The reason for including only BPPV patients in the study was to optimize the study as much as possible. After the patients were informed about the study, verbal and written informed consents were obtained.

Patients who did not want to participate in the study, those who had non-BPPV peripheral and central pathology in their history, and patients whose eye movements were difficult to assess due to mental retardation, claustrophobia and so on, were excluded from the study.

The glasses were used at one-hour intervals. The order of application was changed for each patient. For instance, conventional Frenzel goggles were applied first for the first patient and Cardboard VR was applied first for the second patient. The reason for one-hour intervals without any corrective maneuver was to ensure the objective assessment of nystagmus. All examinations were performed in the same examination room under artificial light and without exposing the patients to daylight. The aim was to provide similar examination conditions. The Dix-Hallpike maneuver was performed for all patients.

Frenzel Goggles and Cardboard VR

The classic simple Frenzel goggles (DEHAG, Rosdorf, Germany) were used in the study. Frenzel goggles are an instrument with a weight of approximately 500 g and dimensions of approximately 20 × 13 × 7 cm. They have two lenses of +19 to +20 diopters and also a handle for the person who will apply the test to hold the instrument. The Cardboard VR (VR 3D Box Cardboard, Google Cardboard 3D Virtual Reality Glasses) used in the study were obtained via internet shopping. The cover on which the phone was placed was removed and the device was made ready for use (Figure 1). The Cardboard VR weigh 50 gr and have dimensions of 15 x 8 x 6 cm. They have two lenses of +19 to +20 diopters. The person who will perform the application does not need to hold the instrument; there is an elastic head band for fixing the device on the patient's head.

Evaluation Parameters

Visibility of nystagmus: The presence of nystagmus was evaluated using glasses in patients with a history of BPPV.

Direction of Nystagmus: The direction of nystagmus was determined.

Frequency and duration of nystagmus: The time from the occurrence of the nystagmus to the time it stopped and the number of beats during this time were evaluated using a stopwatch.

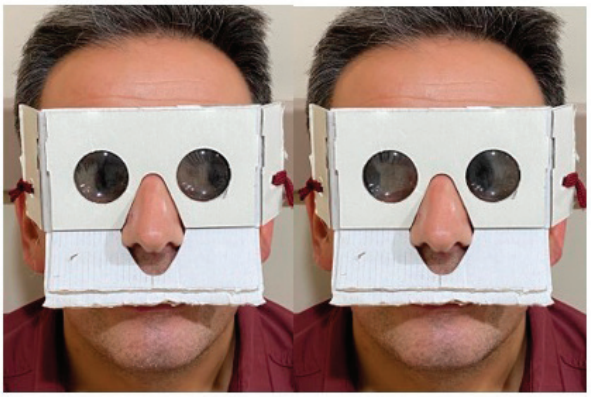

Figure 1: Cardboard VR

Ease-of-use of glasses: Patients were asked to score the ease of use of the instrument on a visual analogue scale (VAS) from 0 to 10 (0: very bad, 10: very good).

Statistical Analysis

Statistical analysis was performed using the Statistical Package for the Social Sciences version 24.0 software for Windows (SPSS Inc., Chicago, Illinois, USA). All quantitative variables were estimated using measurements of central location (i.e. mean and median) and measurements of dispersion (i.e. standard deviation [SD]). Data normality was assessed using the Kolmogorov-Smirnov test of normality. Student's t-test was used to compare the quantitative data of the groups, whereas, Chi-square test was used to compare the qualitative data. A p value of <0.05 was considered statistically significant.

RESULTS

A total of 97 patients were included in the study. Of the patients, 56 were female and 41 were male patients. The mean age was 45.36±9.75 years. Nystagmus was observed in 53 and 46 participants in the Frenzel goggles examination and Cardboard VR examination, respectively. There was no significant difference between the methods (p=0. 315).

Assessment of the nystagmus direction revealed horizontal rotatory nystagmus in all patients. Of the 53 patients who were found to have nystagmus in the Frenzel goggles examination, nystagmus was on the right side in 23 patients and on the left side in 30 patients. Of the 46 patients who were found to have nystagmus in the Carton VR examination, 20 patients had nystagmus on the right side, whereas, 26 had nystagmus on the left side. There was no significant difference between the two glasses in terms of nystagmus direction (p=0.993).

The duration of observation of nystagmus was 18.58±5.54 sec in the Cardboard VR examination and 20.54±6.40 sec in the Frenzel goggles examination. There was no significant difference in terms of the duration of observation (p=0.109) (Figure 2).

The frequency in the cardboard VR examination was 0.73±0.29 beats/sec, while it was 0.86±0.39 beats/sec in the Frenzel goggles examination. There was no significant difference

between the two glasses in terms of frequency (p=0.074) (Figure 3). Those who applied the test evaluated both goggles in terms of general comfort and holding quality with VAS. The mean VAS score was 5.24±1.31 and 8.69±1.02 in the Frenzel goggles examination and the Cardboard VR examination, respectively. There was a statistically significant difference between the two instruments in terms of general comfort and holding quality (p=0.001) (Figure 4).

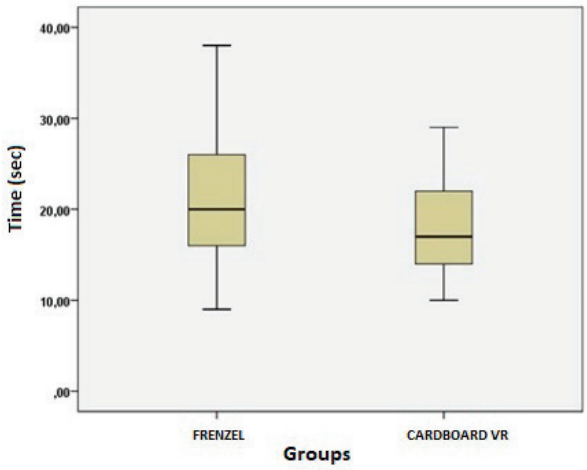

Figure 2: Nystagmus duration of the groups

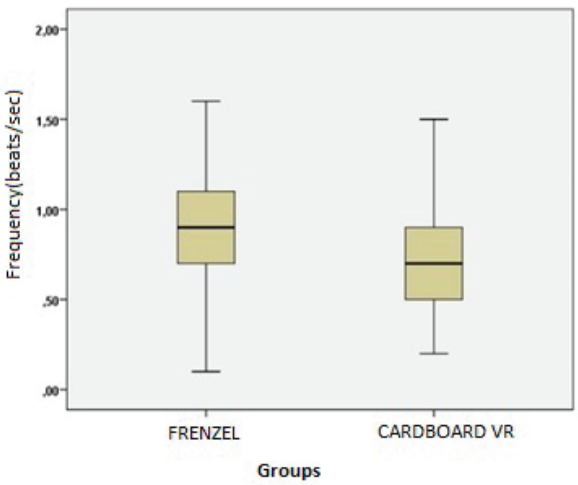

Figure 3: Nystagmus frequencies of the groups

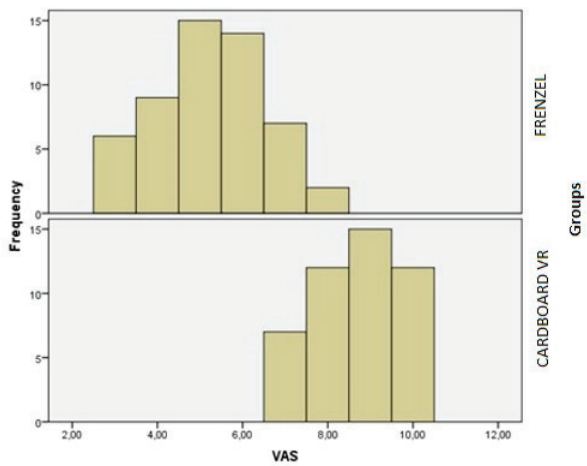

Figure 4: Visual analog scale values of the groups

DISCUSSION

Distinguishing the central and peripheral vertigo can significantly change the approach to the patient in both emergency and polyclinic settings. Assessing the nystagmus is the most important factor that changes this approach. Its assessment in emergency or polyclinic settings at first admission plays a decisive role in diagnosis. Changes that may occur in the medication or symptoms may mask the accurate diagnosis. Many advanced techniques (ENG, IR-CCD camera, video Frenzel) have been developed to assess nystagmus. However, such techniques take time and are not available in many emergency and polyclinic settings. Therefore, conventional Frenzel goggles are used most frequently in the assessment of nystagmus in clinical practice. However, they have some disadvantages: they are about 500 g in weight and 20x13x7 cm in size, they require electrical support, and a holder is needed to fix the instrument to the patient's eye, which limits the person who performs the examination (4). The present study found that Cardboard VR glasses are as effective as the Frenzel goggles to show the visibility of the nystagmus direction, and the speed and frequency of the nystagmus.

We frequently encounter VR glasses in our daily lives with the developing technology. They are available in many different formats, but the most accessible and least costly ones are cardboard VR glasses. They can be used as Frenzel goggles when the mobile phone holder part located on the frontside is removed from the instrument. In the evaluation of the two lenses via autorefractor, diopter degrees were found to be +19 to +20. The two instruments were compared after determining that these values were similar to the conventional Frenzel goggles and that these glasses could prevent fixation, the most important feature of these glasses.

Nystagmus was observed in 53 (54.63%) of 97 participants in the Frenzel goggles examination, whereas, nystagmus was observed in 46 patients (47.42%) in the Cardboard VR examination. There was no significant difference between the two glasses in terms of the visibility of the nystagmus direction. Different results have been reported in the studies comparing the visibility of nystagmus with Frenzel goggles and other methods. Ben-David et al. and Strauss and Meyer zum Gottesberge have reported that there was no significant difference between ENG and Frenzel goggles in terms of the visibility of nystagmus (5-6). West et al. have reported that the visibility rate of nystagmus via conventional Frenzel goggles is 10% and the light in the examination room significantly affects visibility (1). We believe that the low visibility rate in this study is due to the inclusion of patients who were admitted to the outpatient clinic with the complaint of general dizziness and had no significant history of dizziness. In a study by Baba et

al., 100 patients with vertigo were evaluated and nystagmus was detected in 33 patients via conventional Frenzel goggles (7). We believe that the reason for the high nystagmus rates in our study is due to the inclusion of patients in the acute phase and patients with a history of BPPV.

In the study by Baba et al., horizontal nystagmus was detected in 91% of patients whose nystagmus was detected via Frenzel goggles (7). In the present study, horizontal nystagmus was detected in all patients with nystagmus in both the Frenzel goggles examination and the Cardboard VR examination. There was no significant difference between the groups in terms of the direction of nystagmus. High rates of nystagmus in our study can be attributed to the fact that the participants had a possible BPPV diagnosis in their history.

Since it was aimed to assess the basic and practical nystagmus, the speed and duration of nystagmus in Cardboard VR and Frenzel goggles were evaluated with the naked eye by the person who applied the test. During the assessment, another person recorded the values using a stopwatch. No significant difference was observed between the duration and frequency of nystagmus in our study. This shows that the Cardboard VR glasses are as effective as the Frenzel goggles to show the speed and frequency of the nystagmus.

Strupp et al. developed M glasses, Fresnel-based glasses, to overcome the limitations of the conventional Frenzel goggles (4). As a result of the comparison of M glasses and Frenzel goggles, M glasses were found to be equivalent to Frenzel goggles in terms of the assessment of nystagmus. The M glasses consist of two lenses and a steel frame that connects them to each other. The advantages of M glasses compared to Frenzel goggles are being cheaper (M glasses = $ 100, Frenzel Goggles = $ 484), lighter and easier to use. The study on M glasses was published four years ago, but their use has not yet become widespread. Cardboard VR glasses have many common features with M glasses (easy to use, lightweight, and easily accessible). Therefore, these features are their advantages compared to Frenzel goggles. Furthermore, we compared the Cardboard VR with Frenzel goggles in terms of general comfort and holding quality and, as a result, the ease of use of the Cardboard VR was found to be significantly higher than the Frenzel goggles. Studies using VR glasses in different medical fields have been conducted in recent years. In a recent study by Choque-Velasquez et al., the authors reported that VR glasses can be used for educational purposes in the microsurgical area of neurosurgery (3). In a recent study by Tsapakis et al., VR glasses were shown to have a high correlation with Humphrey perimetry in visual field examination and to be suitable for clinical use (2). This is the first study in the literature showing that Cardboard VR have similar features to conventional Frenzel goggles in the assessment of nystagmus. The fact that eye movements can be evaluated with VR glasses suggests that this technology can be developed and used more effectively and widely in clinical use.

CONCLUSION

In conclusion, Cardboard VR have been found to be an easily accessible, light, inexpensive, and easy-to-use tool that can be used as an alternative to conventional Frenzel goggles in the assessment of nystagmus. We believe that their use may be useful in the examination of patients presenting with the complaint of vertigo.

Ethics Committee Approval: This study was approved by Bezmialem Vakif University Clinical Researches Ethics Committee (Date: 20.02.2019, No: 4/15).

Informed Consent: Written informed consent was obtained.

Peer Review: Externally peer-reviewed.

Author Contributions: Conception/Design of Study- R.D., N.D.; Data Acquisition- R.D., N.D.; Data Analysis/Interpretation- R.D., N.D.; Drafting Manuscript- R.D., N.D.; Critical Revision of Manuscript- R.D., N.D.; Final Approval and Accountability- R.D., N.D.

Conflict of Interest: The authors have no conflict of interest to declare.

Financial Disclosure: The authors declared that this study has received no financial support.

REFERENCES

1. West PD, Sheppard ZA, King EV. Comparison of techniques for identification of peripheral vestibular Nystagmus. J Laryngol Otol 2012;126(12):1209-15.
2. Tsapakis S, Papaconstantinou D, Diagourtas A, Droutsas K, Andreanos K, Moschos MM, et al. Visual field examination method using virtual reality glasses compared with the Humphrey perimeter. Clin Ophthalmol 2017;11:1431-43.
3. Choque-Velasquez J, Colasanti R, Collan J, Kinnunen R, Rezai Jahromi B, Hernesniemi J. Virtual Reality Glasses and «Eye-Hands Blind Technique» for Microsurgical Training in Neurosurgery. World Neurosurg 2018;112:126-30.
4. Strupp M, Fischer C, Hanß L, Bayer O. The takeaway Frenzel goggles: a Fresnel-based device. Neurology 2014;83(14):1241-5.
5. Ben-David Y, Hafner H, Fradis M, Krasnitz G, Podoshin L. Do Frenzel glasses have a place in the modern electronystagmography laboratory? Am J Otol 1996;17(1):89-92.
6. Strauss P, Meyer zum Gottesberge A. Caloric nystagmus: ENG in comparison with observation by Frenzel's glasses. Adv Otorhinolaryngol 1979;25:134-7.
7. Baba S, Fukumoto A, Aoyagi M, Koizumi Y, Ikezono T, Yagi T. A comparative study on the observation of spontaneous nystagmus with Frenzel glasses and an infrared CCD camera. J Nippon Med Sch 2004;71(1):25-9.