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Title- Intrarater test-retest reliability of video -graph observation method to check diversion time in Fukuda Step test among collage going student.

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Abstract:

Background: Fukuda step test is valuable test to identify Vestibular dysfunction among human population. This study evaluated the Intra-rater and test-retest reliability of video-graph observation to find the diversion time while performing Fukuda test. Study aimed to find the usage of video-graph observation as beneficial tool to record real-time assessment procedures in clinical settings.

Methods: Fifty collegiate students selected on the basis of inclusion criteria performed 3 consecutive sessions of Fukuda step test. Intra-rater and test-retest reliability of video-graph observation was identified using Intraclass correlation coefficient.

Results: Good Intra-rater (ICC= 0.78) and moderate to good test-retest reliability (ICC= 0.69) of video-graph observation were observed.

Conclusion: Video-graph observation can be used in clinical settings and to identify diversion time while performing Fukuda step test.

Keywords: Fukuda step test, Vestibular, Video-graph, ICC

Introduction:

The vestibular organs, which are tiny, exquisitely shaped, and confined inside the skull, constantly barrage the brain with signals. The messages are really distinctive from others. They describe accelerations, the head's rotation, translation, and spatial orientation. For crucial functions like balance, posture control, gait, spatial orientation, and self-motion perception, accurate and precise detection of our head and body displacement in space is essential. The vestibular pathway, which begins with two simple, but elegant organs embedded in our inner ears, can facilitate this process; the semicircular canals and the otolith which, respectively, detect linear and angular acceleration of our head. The encoded inertial motion signals from the peripheral system are sent to the central nervous system for processing. Although it is well known that neural circuits mediate automatic processes like the vestibulo-ocular reflex (VOR) for maintaining visual stability and body balance, less is known about how the brain codes vestibular signals for self-motion perception and spatial orientation especially in darkness. In particular, a growing number of cortical regions, many of which are also sensitive to visual motion stimuli, show vestibular activity in response to translation or rotation of the head or body in darkness.[1] For the purpose of diagnosing unilateral vestibular dysfunction, Unterberger proposed a stepping test with the eyes closed in 1938. Fukuda improved the test and made it popular, naming it the Fukuda stepping test (FST) in 1959. In the FST, patients are asked to stand up, extend both arms, and walk in place with their eyes closed for 50–100 steps. Asymptomatic person will lead to walk straight ahead without turning to either side. Patients with vestibular dysfunction typically divert more than 45 degrees to the side of the lesion.[2]

There are numerous evidences showcasing usage of FST to diagnose vestibular dysfunction. A study was administered to identify the functionality of FST to diagnose recurrent benign paroxysmal postural vertigo (BPPV) concluded FST to be invaluable in the diagnosis of BPPV since the ratio

of FST positivity and negativity were similar in patients with BPPV.[3] To identify the factors affecting spatial parameters in population, a study was conducted identifying the impact of step height and concurrent cognitive task and found influence of these two factors.[4] Significant test-retest reliability of FST was found in study conducted to assess the vestibular system integrations.[5] As far as our knowledge reaches, there is scarcity of research showing positive evidence of video-based observation method to find the time of diversion during performing FST. Hence we aimed to estimate the intra-rater and test-retest reliability of video-based observation to find the values of FST among collegiate students. This study hypothesized e video-graph observation method as reliable method to assess vestibular function.

Methods:

Study settings: A methodological research: Intra-rater and test-retest reliability study was performed on collegiate students.[6] Study sample was recruited from the recognized middle collegiate students' age group between 18 and 30 years . Simple random sampling method was used for the collection of sample. Written informed consent was taken prior to the study. Before proceeding, permission was taken from the college authorities for conducting the research. Study was conducted in accordance with National ethical guidelines for biomedical and health research involving human participants (Indian council of medical research, 2017) and Declaration of Helsinki (Revised, 2013).

Participants: Inclusion criteria consisted of asymptomatic collegiate adults, males and females, age group between 18 and 30 years, no symptoms of dizziness, nausea and vomiting prior to the study. Students were excluded if they have presented with any symptomatic condition related to cardio-respiratory, musculoskeletal, neurological and positive history of lower limb surgery in past one year.

Sample size estimation: To find the sample size for current study, unpublished pilot study was done including 12 samples. On the basis of pilot study results analyzed in SPSS, Estimating Mean Formula $\{(1.96)^2 (\alpha)^2 \div (E)^2\}$ was used to calculate the actual sample size for the current study.[7]

Minimum required sample for the study was calculated using estimating mean formulae $(Z\ \alpha\ \sigma/d)^2$. By substituting, $Z\ \alpha = 1.96$; σ (SD) = 12.1 and d (Standard Error of mean) = 3.5, the minimal required sample size was found to be, n=47. After rounding off, we have used n=50 in the present study.

Procedures:

All measurements were collected in three sessions conducted at the physiotherapy laboratory by the two raters. Both the raters were physical therapist with 3 years of experience and Master's Degree in Cardio-respiratory and Pediatric-neurology. Before proceeding with the data collection, examiner made a 2x2 box block with the help of the microporous paper tape inside the examination area. The room selected for the data collection was calm, quiet and having white tiles. The reason behind choosing room with white tiles was proper identification of linear and angular acceleration with the coloured footprints of the participant. Participants were selected on the basis of simple random sampling. Complete procedure to the participants was thoroughly explained by the examiner. After explanation, one examiner took all the anthropometric measurements (Height, weight, and BMI) and demographic details (Name, age, and gender). Before proceeding with the main procedure of FST, pulse rate was measured from radial artery pulsation. One examiner was already being there in examination area with the placement of mobile phone used for the video-graph observation. Mobile Phone [APPLE iOS IPhone 12th Generation Rear camera 16-megapixel (f/1.8)] was used to capture the video. Examiner was stood in front to the participant's initial position and mid of the examination area to capture the time taken for diversion. Markers were marked using microporous tape for the identification of starting point and linear or angular acceleration. After all these arrangements, participant was asked to stand at starting point after dipping his/her feet in water with water colours. Different water colours were used to identification of each participant correctively. After all these arrangements, FST was performed. Before FST, instructions given to participant and for examiner were as follows[8]:

Instructions to the participant:

- Close the eyes before the start of the test.
- Shoulder should be flexed in vertical direction at 90 degrees.
- Start marching as soon as we start the timer.

Instructions to the examiner:

- Stand by the participants to prevent any sort of falls.
- Instruct the patient in layman language in order to avoid any miscommunications
- Now start the timer and ask the subject to march in the same place.
- Mark and note when there are any deviations till the end of the test.
- After the completion of 1 minute, ask the patient to stop, mark and measure the area using measuring tape.
- Measure the linear distance and angular distance with help of measuring tape and measure the angular deviation with the help of protractor.

Intra-rater reliability:

The consistency of data collected by one examiner over two trials is referred to as intra-rater reliability. Pre and post FST, pulse rate (PR) was measured to standardize the rest period. The examiner must wait until the post FST pulse rate drops to the pre FST pulse rate (±3 pulse beats). After assessing the participant's PR, the procedure for determining intra-rater reliability was restarted. Two trials of FST were used to find intra-rater reliability.

Test-retest reliability:

The procedure of FST was repeated after 24 hours to check Test-retest reliability because a minimum 24 hours' time period should be required for obtaining values of FST. One consecutive reading of FST was taken on next day of first reading.[9]

Statistical analysis:

Analytical software was used to analyze the data; SPSS (IBM SPSS V-20 for Windows 10 Armonk, NY: (IBM Group). Kolmogorov-Smirnov test was used to verify normality due to the estimated 50 participants in this study. As the information was not following typical dissemination, the clear measurements were expressed in median with IQR. Mann-Whitney U test was utilized to consider the segment aspects among males and females selected for the study. Using the intra-class correlation coefficient (ICC), test-retest and intra-rater reliability were determined. Shrout and Fleiss utilized an ICC (3, 1-two-way mixed effect model) for intrarater and test-retest reliability. If ICC values are <0.25; low, if low to fair ($0.25 \leq rs \leq 0.5$), moderate to good ($rs = 0.50–0.75$), or strong ($rs > 0.75$).[10]

Results: Demographic details and FST components of males (n=24) and females (n=26) recruited for the study were shown in Table 1 and Table 2 respectively. There was no significant difference found among males and females demographic details and FST components ($P > 0.05$). We considered as single group for further ICC analysis. ICC values (Intra-rater and Test-retest) of diversion time were shown in Table 3.

Insert Table 1 almost here

Insert Table 2 almost here

Insert Table 3 almost here

Discussion: The primary reason for this study was to find the Intra-rater and Test-retest dependability of the video-graph method among collegiate students while performing FST. 50 college students ranging in age from 18 to 30 participated in this study. It is clear from the analysis that the video-graph method has moderate to good intra-rater and test-retest reliability (ICC between 0.5 and 0.75). As both intra-rater and test-retest

reliability was acceptable as far as possible, video-graph perception can be used to carve out the opportunity of checking diversion time while performing FST.

Previous studies have shown good to moderate test-retest reliability of 50-step FST but no discussion of time taken for the diversion was mentioned in any study.[11] In our study, we have found the time taken for diversion while angular displacement was ranging from 18 to 30 seconds. We found the intra-rater and test-retest reliability of video-graph method while recording FST for 3 successive session. Intra-rater and test-retest reliabilities were found in moderate to good range.

The participants which are selected on the based on predefined inclusion criteria and volunteered to participate at their own will. To make the procedure interesting and motivating, standard instructions were given to the participants regarding cerebellum function and importance of FST. The time chosen for the study is 9 am to 12 noon to minimize the diurnal variation. There is blood pressure variability at day and night which can be affected by body circadian effect. Normal circardian effect is seen in morning time which decreases the chances of fatigability. It helps in minimum fluctuation of the result because of proper concentration in morning.[12]

This study has some limitations. These are unavoidable human error while measuring the linear and angular displacement using measuring tape, unequal gender distribution and small sample size. Strength of this study includes minimal time and space, cost effective, easy to understand and implement. In future, this study can be done on pediatric and geriatric population for more exploration towards screening of vestibular dysfunctions in any age group. Correlative studies can be done between demographic details and FST components. Regardless of the limitations, conclusion of our study enlightens the identification of FST components specifically diversion time using video-graph observation.

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