



Journal Homepage: -www.journalijar.com

INTERNATIONAL JOURNAL OF ADVANCED RESEARCH (IJAR)

Article DOI:10.21474/IJAR01/15263
DOI URL: <http://dx.doi.org/10.21474/IJAR01/15263>



RESEARCH ARTICLE

RELATIONSHIP BETWEEN INTERPUPILARY DISTANCE AND VERTICAL DIMENSIONS OF OCCLUSION

Zhanina Pavlova

Associate Professor, Department of Prosthetic Dental Medicine, Faculty of Dental Medicine, Medical University, Sofia, Bulgaria.

Manuscript Info

Manuscript History

Received: 26 June 2022

Final Accepted: 28 July 2022

Published: August 2022

Key words:-

Complete Dentures, Interpupillary Distance, Vertical Dimensions of Occlusion

Abstract

Background: The determination of the vertical occlusion dimensions is one of the most important aspects in the treatment of edentulous patients. A widely discussed biometric indicator that is suggested for determination of the vertical occlusion dimensions is the interpupillary distance. The aim of this research was to study the relationship between the interpupillary distance and the vertical dimension of occlusion among individuals with natural dentition.

Material and methods: Subjects of observation in the study were 100 representatives of Bulgarian population, aged 20 to 25. Three reference points were marked: Pronasale, Subnasale and Gnathion. Every person was photographed enface with professional digital camera in strict standardized conditions. With help of the computer program were marked the pupil centres, connected the clinically marked points and then the distances between them were measured. Data were subjected to statistical analysis.

Results: Stronger correlation was established between interpupillary distance and the distance Subnasale - Gnathion (for men: $r = 0.6858$; for women: $r = 0.6584$), compared to the correlation with distance Pronasale - Gnathion (for men: $r = 0.5714$; for women: $r = 0.5805$).

Conclusions: Clearly expressed correlation was established between the interpupillary distance and the vertical dimensions of occlusion. The interpupillary distance could be applied as an additional landmark during determination of the vertical dimensions of occlusion. For achievement of optimal results, this method could be used along with other clinical methods.

Copy Right, IJAR, 2022., All rights reserved.

Introduction:-

The determination of the vertical occlusion dimensions directly impacts the functional fitness of the complete dentures, as well as the recovery of patient's aesthetical appearance (Dervis, 2004; Gross et al., 2002). Patient's rapid adaptation to the complete dentures and his or her comfort during their daily use also greatly depend on defining the adequate occlusal ratios (Fenlon et al., 1999).

What is essential to the success of prosthetic treatment with complete dentures is the reproduction of vertical occlusion dimensions that are optimal for each and every patient, and when choosing the manner of their definition

Corresponding Author:- Zhanina Pavlova

Address:- Associate Professor, Department of Prosthetic Dental Medicine, Faculty of Dental Medicine, Medical University of Sofia, Bulgaria.

we should take into account numerous objective and subjective conditions (Misch, 2000). The changes that have occurred in many structures of the facial-mandibular area after full tooth loss differ in view of their severity and in numerous cases they complicate the recovery of the exact dimensions and ratios in the facial-mandibular area.

Numerous methods are based on data that were established through measurements between skull's reference points (Edler et al., 2006). A widely discussed biometric indicator that was suggested for determination of the vertical occlusion dimensions is the interpupillary distance (IPD). It is defined in the horizontal plane as distance between the geometric centres of both eyes' pupils. It is believed that in adult individuals the interpupillary distance remains constant throughout life (Filipovic, 2003). Direk et al. (2016) establish in large-scale comparative research among participants of different age groups that the average value of IPD varies insignificantly within 1-2 mm.

The dental literature contains numerous research works whose objective is to establish the average values of the interpupillary distance and correlative dependencies between it and other facial parameters (Evereklioglu et al., 2002; Gomes, et al., 2002). The average values of the interpupillary distance in representatives of the Caucasian race are between 60-65 mm (Pointer, 1999; Swan and Stephan, 2005). Other research works show higher dimensions. Gomes et al. (2002) report average value of IPD of 69.97 mm for men and 66.68 mm for women. Similar results were communicated by Oladipo et al. (2010). In the prevailing research works are established statistically significant difference in IPD between men and women.

The opinions concerning the opportunity of using IPD as an orientation for defining the vertical occlusion dimensions are not unambiguous. According to some authors (Živković et al., 2019) there is distinct correlation between the two distances in both sexes, and according to others positive correlation is present only in men (Ladda et al., 2014). Most authors share the opinion that the established dependencies should be applied while taking into consideration the fact there are statistically significant differences between the data of representatives of various populations predetermined by ethnical features (Mishra et al., 2016). The indexes for determination of the vertical occlusion dimensions that include the IPD value, suggested in various research works, could be applied in the prosthetic treatment of particular population's representatives in view of which these were outlined (Majeed et al, 2018).

Material And Methods:-

The **aim** of this research was to study the relationship between the interpupillary distance and the vertical dimension of occlusion in individuals with natural dentition. One hundred (48 men and 52 women) participants, aged 20 to 25, were included in the study.

Including criteria:

Participants with natural permanent dentition and Angle class I jaw relations; without missing teeth; without previous orthodontic or prosthetic treatment; without vision defects; without temporomandibular disorders.

Excluding criteria:

Individuals with: prosthodontic treatment or missing teeth; jaw relations different from neutro-occlusion; vision defects (strabismus) or eye surgery; temporomandibular disorders.

Informed consent was obtained from all participants.

Every person was photographed enface with professional digital camera (OLYMPUS - CAMEDIA C-470 ZOOM) in the following strict standardized conditions:

1. The camera was fixed onto tripod at a distance of 120 cm off the floor and at 50 cm off the shot object.
2. Each and every person was placed to sit on a chair so that the masticatory plane is parallel to the horizontal plane and at a height of 120 cm off the floor.
3. The participant was invited to close his teeth in central occlusion. This was performed with help of the bilateral manual technique of Ramfiord.
4. With dermatographic pencil was marked the following benchmark points: point: Pronasale (Pn – tip of the nose), point Subnasale (Sn) and point Gnathion (Gn).
5. In front of the head of each and every researched person a transparent millimetre plaque was placed and fixed onto a special tripod at 1 cm from object's face and oriented so that its horizontal lines would coincide with the

horizontal plane, and the marked middle line – with the facial middle line. The millimetre plaque was used for defining the photo scale and calibration, thus ensuring measurement precision and reliability of results.

- Each and every participant was invited to look straight ahead and focus on the objective of the camera during the shooting.

Each and every photograph was processed via the program “Corel DRAW Graphic Suite 16”. With help of the computer program the clinically marked points – Pronasale, Subnasale and Gnathion was connected and the pupil centres was marked. Then the distances between the marked points were measured.

Statistical Methods:-

Data were subjected to statistical analysis that includes descriptive and correlative analysis. In order to establish the presence of differences in the average values, which result from the data about men and women, was used Student's t-Test. In order to analyse the differences between the average values of the studied distances we implemented paired t-test. The statistics was performed through Microsoft Office Excel 2016.

Results:-

For all researched persons we established average value of the interpupillary distance of 59.72 ± 2.87 mm (Table 1). The established average value for the central occlusion height when performing measurement between the points Subnasale and Gnathion is 62.10 ± 3.05 mm, and in the case of performing measurement between the points Pronasale and Gnathion – 64.38 ± 3.27 mm. Based on the data we could see that in the case of men the established average distance between eye pupils is 61.85 ± 2.16 mm. In the case of women, the average value of interpupillary distance is 57.75 ± 1.87 mm. The difference between the resulting data for men and women in view of all researched distances is statistically significant ($p < 0.05$).

Table 1:- Results of the descriptive statistics concerning the values of the measured distances.

Participants	Men N=48				Women N=52				Total N=100			
	Mean	St.dev.	Min	Max	Mean	St.dev.	Min	Max	Mean	St.dev.	Min	Max
IPD	61.85	2.16	55	65	57.75	1.87	53	61	59.72	2.87	53	65
Sn-Gn	64.46	2.27	57	68	59.92	1.80	56	65	62.10	3.05	56	68
Pn-Gn	66.38	2.45	58	72	62.08	2.01	58	68	64.38	3.27	58	72

The data analysis shows that there is clearly expressed correlation between the interpupillary distance and the central occlusion height (Table 2).

Table 2:-Correlative data analysis about the researched distances.

Participants	Relation between distances:	R	R Square	Adjusted R Square	Std. Error
Men N= 48	IPD:Sn-Gn	0.6858	0.4703	0.4588	1.67
	IPD :Pn-Gn	0.5714	0.3265	0.3118	2.03
Women N= 52	IPD :Sn-Gn	0.6584	0.4336	0.4222	1.37
	IPD :Pn-Gn	0.5805	0.3370	0.3237	1.65

Stronger is the correlation between IPD and the distance Sn-Gn, whereas the correlation coefficient of Pearson is 0.6858 for men and 0.6584, for women, correspondingly. When analysing the distances IPD and Pn-Gn we established correlation coefficient is 0.5714 for men and 0.5805, for women.

Discussion:-

There is no single precise scientific method for the successful determination of optimal vertical occlusion dimensions and most authors recommend a combination of techniques for the achievement of adequate results (Johnson et al., 2002). What is essential is the individual approach when choosing the method and interpretation of biometric indicators, according to the features of the particular patient. In some cases, thanks to the development of parafunctional habits after the full tooth lose, the voluntary or even managed achievement of physiological rest position could be complicated (Zarb, 1982). That limits the use of anatomic-physiological methods based on this indicator. This type of problem was observed in patients with diseases of the temporomandibular joints, with some

neurological diseases that make inapplicable some anatomic-physiological, or phonetic methods. In the case there are no pre-extraction records, in view of such patients it is more purposeful to use facial biometric indicators as additional landmarks for determination of vertical occlusion dimensions.

The average values of IPD established during this research in representatives of the Bulgarian population – 61.85 ± 2.16 mm for men and 57.75 ± 1.87 mm for women are similar to the ones found by Pointer (1999), who established that in representatives of the Caucasian race the average value of IPD is 60.14 mm for men and 57.33 mm for women. Similar data were reported by Swan and Stephan (2005) - 63.6 mm for men and 59.6 mm for women. Research works of other populations at the Balkan Peninsula also show close average values for IPD. In the case of researching the Serbian population Živković et al. (2019) established IPD of 61.4 ± 0.52 mm for men and 54.7 ± 0.65 mm for women. The data found by us also coincide with the ones reported by Ladda et al. (2014).

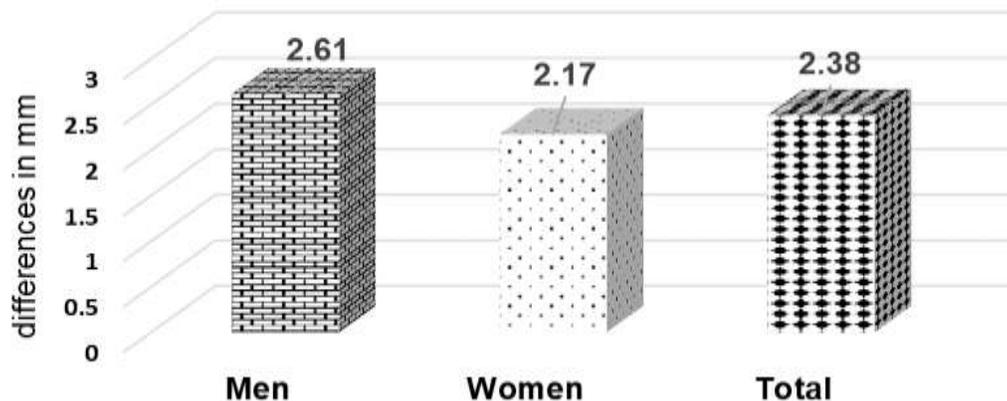
Comparative research works establish significant differences in view of IPD in representatives of various populations. For example, among the Indo-European population IPD is on the average 61.92 ± 5.85 mm, and in the case of Mongoloids correspondingly: 57.50 ± 7.23 mm (Mishra et al. 2016). When researching the Iran population, it was established that the average values of IPD in the case of adult individuals aged above 19 are correspondingly: 64.18 ± 4.6 in men and 61.13 ± 3.5 in women (Fesharaki et al., 2012). This data shows that the ethnic belonging could impacts values of IPD.

The average values for all the measured distances in men and women established during this research show statistically significant difference – $p < 0.05$. Our data confirm the opinion expressed by most authors that is necessary to be taken into consideration the difference in values for men and women, as an expression of the sex dimorphism typical to facial parameters (Oladipo et al. 2010), (Majeed et al, 2018).

In the present research work was established outstanding correlation between IPD and the vertical occlusion dimensions, defined via the measurement of the distance Sn-Gn and little bit weaker correlation between IPD and the distance Pn-Gn. The vertical occlusion dimensions established via the measurement of distance Pn-Gn, show greater variability among the individual values probably due to the different position of point Pronasale in the frontal plane (along the vertical), depending on the nose length and configuration of different individuals. This is the possible reason for the difference in correlation ratios.

Within limitation on this research we can confirm the opinion expressed by numerous (Živković et al., 2019) authors that the interpupillary distance is in correlation with the vertical occlusion dimensions and could be a starting point for defining them in view of both sexes. On the other side, full coincidence of the vertical occlusion dimensions and the IPD was established in neither researched person. The data show that the difference between the distance Sn-Gn and IPD is on the average 2.60 ± 1.36 mm for men and 2.17 ± 1.52 mm for women (Fig.1). In 81.25% of the researched men and in 90.38% of the researched women this difference is within the interval of 1-4 mm, which is in range of mandibular rest position.

Fig. 1. Differences between the established average values of vertical dimension of occlusion (Sn-Gn) and IPD



The interval analysis of differences shows that the empirical application of the IPD value as orientation for vertical occlusion dimensions could produce error in some cases. This possibility should be taken into consideration in the practice.

Irrespective of the fact that the established correlations are based on data from measurements performed onto young individuals with natural dentition, these are applicable with significant degree of reliability and in the case of toothless patients at more advanced age. This opinion is grounded on the data available in literature according to which IPD does not change with age or changes are of insignificant value from clinical point of view. For example, according to Direk et al. (2016) the average value of IPD in young individuals is 64.94 mm, whereas in middle-aged people it is 64.33 mm, and in people of advanced age it is 63.30 mm, whereas the differences are not statistically significant. According to Yildirim, et al. (2015), IPD increases with age but not more than 1 to 2 mm. In the case of individuals aged 50, IPD is about 1 mm larger compared to the group of 30-50 year-olds.

We wouldn't recommend using of the interpupillary distance as single method for determination of vertical occlusion dimensions, but it could be applied as additional anatomical landmark collaboratively with other clinical methods.

The limitation of the study was that only the representatives of Bulgarian population were included and the results may be applicable only on them; only the participants with Angles class I occlusion were included in the study. Further studies should be conducted in order to clarify the reliability of this method in the clinical practice.

Conclusions:-

Within the limitations of this study, significant correlation was established between the interpupillary distance and the vertical dimensions of occlusion. The interpupillary distance could be applied as an additional anatomical landmark during determination of the vertical dimensions of occlusion. For achievement of optimal results, this method could be used along with other clinical methods.

Conflict of interest:

The author declares no potential conflicts of interest with respect to the research, authorship and publication of this article.

References:-

1. Dervis, E. (2004): The influence of the accuracy of the intermaxillary relations on the use of complete dentures: a clinical evaluation. *J of Oral. Rehabil.*, 31(1) :35-41.
2. Direk, F.K., Deniz, M., Uslu, A.I. and Dogru, S. (2016): Anthropometric analysis of orbital region and age-related changes in adult women. *J of Craniofac. Surg.*, 27(6): 1579-1582.
3. Edler, R., Agarwal, P., Wertheim, D. and Greenhill, D. (2006): The use of anthropometric proportion indices in the measurement of facial attractiveness. *Eur. J Orthod.*, 28(3): 274-281.
4. Evereklioglu, C., Doganay, S., Er, H., Gunduz, A., Tercan, M. and Balat, A. (2002): Craniofacial anthropometry in a Turkish population. *Cleft Palate-Craniofac. J*, 39(2) :208-218.
5. Fenlon, M.R., Sherriff, M. and Walter, J.D. (1999): Association between the accuracy of intermaxillary relations and complete denture usage. *J Prosthet. Dent.*, 81(5): 520-525.
6. Fesharaki, H., Rezaei, L., Farrahi, F., Banihashem, T. and Jahanbakhshi, A. (2012): Normal interpupillary distance values in an Iranian population. *J Ophthalmic. Vis. Res.*, 7(3): 231-234.
7. Filipovic, T. (2003): Changes in the interpupillary distance (IPD) with ages and its effect on the near convergence/distance (NC/D) ratio. *Coll. Antropol.*, 27(2) :723-727.
8. Gomes, V.L., Goncalves, L.C., do Prado C.J., Junior, I.L. and de Lima Lucas, B. (2006): Correlation between facial measurements and the mesiodistal width of the maxillary anterior teeth. *J Esthet. Restor. Dent.*, 18(4) :196-205.
9. Gross, M., Nissan, J., Ormianer, Z., Dvori, S. and Shifman, A. (2002): The effect of increasing occlusal vertical dimension on face height. *Int. J Prosthodont.*, 15(4) :353-357.
10. Johnson, A., Wildgoose, D.G. and Wood, D.J. (2002): The determination of freeway space using two different methods. *J Oral. Rehabil.*, 29(10): 1010-1013.
11. Ladda, R., Kasat, V.O. and Bhandari, A.J. (2014): A new technique to determine vertical dimension of occlusion from anthropometric measurement of interpupillary distance. *J Clin. Exp. Dent.*; 6(4) :395-399.

12. Majeed, M.I., Haralur, S.B., Khan, M.F., Al Ahmari, M.A., Al Shahrani, N.F. and Shaik, S. (2018): An anthropometric study of cranio-facial measurements and their correlation with vertical dimension of occlusion among Saudi Arabian subpopulations. *Maced. J Med. Sci.*, 6(4) :680-686.
13. Misch, C.E. (2000): Clinical indications for altering vertical dimension of occlusion. Objective vs subjective methods for determining vertical dimension of occlusion. *Quintessence Int.*,31(4): 280-282.
14. Mishra, M.K., Singh, R.K., Suwal, P., Parajuli, P.K., Shrestha, P. and Baral, D. (2016): A comparative study to find out the relationship between the inner inter-canthal distance, interpupillary distance, inter-commissural width, inter-alar width, and the width of maxillary anterior teeth in Aryans and Mongoloids. *Clin. Cosmet. Investig. Dent.*, 8:29-34.
15. Oladipo, G.S., Okoh, P.D. and Hart, J.S. (2010): Anthropometric study of ocular dimensions in adult Ijaws of Nigeria. *Res. J Medicine & Med. Sci.*; 5(2) :121-124.
16. Pointer, J. (1999): The far interpupillary distance. A gender specific variation with advancing age. *Ophthal. Physiol. Opt.*, 19(4) :317-326.
17. Swan, L. and Stephan, C. (2005): Estimating eyeball protrusion from body height, interpupillary distance, and inter-orbital distance in adults. *J Forensic. Sci.*, 50(4) :1-3.
18. Tavano, K.A., Seraidarian, P.I., de Oliveira, D.D. and Jansen, W.C. (2012): Determination of vertical dimension of occlusion in dentate patients by cephalometric analysis – pilot study. *Gerodontology*, 29(2) :297-305.
19. Yildirim, Y., Sahbaz, I., Kar, T., Kağan, G., Taner, M., Armağan, I. and Cakici, B. (2015): Evaluation of interpupillary distance in the Turkish population. *Clin. Ophthalmol.*, 9:1413-1416.
20. Zarb, G. A. (1982) Oral motor patterns and their relation to oral prostheses. *J Prosthet. Dent.*, 47(5) :472-478.
21. Živković, N., Nikolić, P., Kuzmanović-Pfíćer, J., Perić, M. and Milić-Lemić, A. (2019): An anthropometric study of craniofacial measurements and their correlation with vertical dimension of occlusion among fully dentate population in Serbia. *Serbian Dental Journal*, 66(4) :182-188.