Original Article

A Study to Determine the Correlation between the Intercondylar and Interdental Widths in the Pakistani Asian Population

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ABSTRACT

Objective: To investigate the correlation between intercondylar distance (ICD) and occlusal vertical dimension (OVD) in a segment of the Pakistani Asian population, and assess whether ICD can serve as a reliable anatomical landmark for determining OVD in dentate individuals.

Study Design: Cross-sectional analytical study

Place and Duration of Study: This study was conducted at the Islamic International Dental Hospital, Islamabad, from January 2024 to December 2024.

Methods: A total of 160 dentate individuals (80 males, 80 females) aged 18–30 years with Class I occlusion were selected through randomized sampling. ICD was measured using the Denar reference point and a modified digital vernier caliper. OVD was assessed using a Willis Gauge. The Shapiro-Wilk test was applied to evaluate data normality. Gender-based differences were assessed using the Mann-Whitney U test, while the relationship between ICD and OVD was evaluated using Spearman's correlation.

Results: The mean ICD was 132.1 mm in males and 123.7 mm in females, revealing a statistically significant difference (p = 0.001). The mean OVD was 49.3 mm in males and 50.4 mm in females, with no significant gender difference (p = 0.29). Spearman's correlation showed a weak, non-significant association between ICD and OVD (ρ = 0.18, p = 0.25).

Conclusion: ICD significantly differs by gender, while OVD does not. No statistically significant correlation was found between ICD and OVD, indicating ICD alone may not be a reliable predictor for determining OVD.

Key Words: Intercondylar distance, occlusal vertical dimension, anatomical landmarks, complete denture

INTRODUCTION

Advancements in healthcare, medicine and technology have exponentially increased life expectancy; giving rise to an increasing geriatric population[1]. According to WHO, between 2015 and 2050, the proportion of the world's population over 60 years will nearly double.

Aging individuals have to deal with many age-related diseases and conditions, with edentulism being a common and major concern[2].

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Edentulism, or the complete loss of natural teeth, may arise from various factors including limited access to healthcare, low socioeconomic status, and general neglect of oral hygiene. Edentulism is a significant health concern as it is an irreversible condition affecting day to day activities[3]. It can affect the oral health, masticatory function, facial aesthetics and phonetics of the individual which may lead to malnutrition and a diminished quality of life[4].

Restoring lost dentition through prosthetic means should aim not only to recover masticatory efficiency but also to support oral tissues, improve appearance, and facilitate clear speech. The effectiveness of a prosthesis is largely dependent on its ability to meet these functional and aesthetic demands[5]. Researcher proposed that denture fabrication constitutes multiple steps and every step leading to the delivery of prosthesis should be done following proper guidelines and recommendations[6]. Lapses in judgement, mishandling of steps or reliance on assumptions can adversely affect the final quality of the denture.

A critical component of complete denture fabrication is determining the correct vertical dimension of occlusion (OVD). The loss of natural teeth makes it difficult to determine the appropriate OVD. There have been numerous reported methods to determine OVD with no universally accepted method[6]. As stated by Shen et al, almost every method has its own set of short comings[7]. Incorrect measurements can cause an increased or decreased OVD which can lead to a strained appearance, clicking, temporomandibular discomfort, or angular cheilitis, poor aesthetics, cheek biting respectively[8].

There are certain anatomical parameters that remain constant throughout an individual's life which are not prone to resorption or time related changes. Jassim et al reported that the inter condylar distance (ICD) is one such landmark, which is 'the distance between the rotational centres or two condyles or their analogues'[10]. Various parts of the human body are proportionate to each other, and theoretically the ICD may be used to estimate the OVD.

The purpose of pursuing this study is to determine whether the ICD can be utilised to serve as a reliable landmark for determining the OVD in a cross section of the Pakistani subpopulation. Although previous studies have reported positive results, there is a dearth of data of a study of this nature targeting a segment of Pakistani population. These results may help future clinicians in fabricating a more accurate prosthesis.

METHODS

The ethical review board of Islamic International Dental Hospital approved this study, Ref. No. IIDC/IRC/2023/11/056, without restrictions and an informed consent was taken from all participants. This was a cross-sectional study based on a randomized sampling technique on participants visiting Islamic International Dental Hospital from January 2024 to December 2024. A sample size of 160 was calculated according to a confidence level of 95%, margin of error 5% with a population proportion of 50% based on a population size of 258[5].

All participants were selected on the basis of the following criteria; male and female participants, who are completely dentate (excluding third molars), are within the age group of 18-30 years with a Class I occlusal relationship. Participants with any significant oral pathology, gross malocclusion, facial asymmetry, temporomandibular disorder, excessive parafunctional habits or fixed dental prostheses were excluded from the study. Uncooperative participants and/or patients with neurological disorders or under any sort of intoxication were excluded as well.

The intercondylar distance was measured using the Denar reference point[11] bilaterally to approximate the location of the condyles. This arbitrary point is located 12 mm anterior and 5 mm inferior to an imaginary line joining the superior border of the tragus and the outer canthus of the eye. To help in locating this point easily, a large plastic ruler was modified[5] with a 0.5 mm hole 12 mm anterior and 5 mm inferior starting from the zero reading on the ruler. Using this modified ruler, the Denar point was marked bilaterally with an indelible pencil with the participants sitting relaxed in the dental chair, in an upright position, whilst looking straight forward. (Figure 1).

A digital vernier caliper was modified to extend its arms in order to measure the marked points easily. With the extended arms contacting the marked points, the ICD of the participant was recorded in millimeters. (Figure 2).

Next, the occlusal vertical dimension of the participants was recorded with the help of a Willis Gauge, which uses the sub-nasale and Menton as reference points. Participants were asked to inter-cuspate their teeth and relax their lips beforehand. Readings were taken twice for each participant to reduce error, and values were recorded nearest to 0.1 mm. (Figure 3).

Data accumulated was tabulated and analyzed statistically by means of SPSS software (version 23). Descriptive statistics were calculated for qualitative and quantitative variables. Quantitative variables like ICD and OVD were calculated in terms of mean. Shapiro-Wilk test was applied to check the normality of data. As data was not normal, non-parametric tests and median were reported. Mann-Whitney U test was applied to compare OVD and ICD in male and female patients. A Spearman's correlation analysis was conducted to assess the relationship between ICD and OVD.

RESULTS

The Intercondylar Distance (ICD) and Occlusal Vertical Distance (OVD) of a total of 160 participants were recorded which comprised of 80 males and 80 females. The general mean of ICD was 127.9 mm and OVD was 49.8 mm. For males the mean ICD was 132.1 mm and the mean OVD was 49.3 mm. The mean ICD in female participants was 123.7 mm and the mean OVD was 50.4 mm. (Figure 4).

Table No.1: Shapiro-Wilk test

		Test Statistic (W)	p-value
Intercondylar Distance (ICD)	Male	0.949	0.003
	Female	0.957	0.008
Average		0.95	0.005
Occlusal Vertical Distance (OVD)	Male	0.899	0.001
	Female	0.909	0.001
Average		0.90	0.01

A Shapiro-Wilk test was conducted to assess the normality of ICD and OVD measurements. The results indicated that ICD was not normally distributed, W = 0.95, p = 0.005, and OVD was also not normally

distributed, W = 0.90, p = 0.001. Since p-values were less than 0.05, the assumption of normality was violated, and non-parametric tests were used for further analysis. (Table 1).
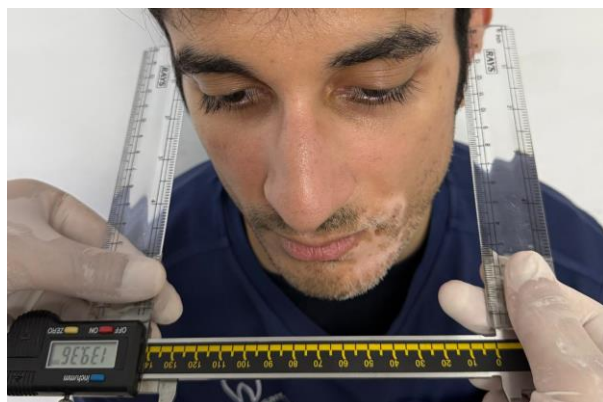

Figure No.1: whilst looking

Figure No.2: A digital vernier caliper to measure the marked points

Figure No.3: Occlusal vertical dimension

A Mann-Whitney U test was performed to examine the differences in ICD between male and female patients. The results showed a significant difference, U = 1899.5, p = 0.001. The median ICD for males was 134.0 mm, while for females, it was 123.9 mm. Since $p < 0.05$, we conclude that males have a significantly higher ICD as compared to females.

When comparing OVD between genders, the Mann-Whitney U test revealed no statistically significant difference, U = 2888, p = 0.29. The median OVD for males was 48 mm, while for females, it was 50 mm. Since $p > 0.05$, it was concluded that gender does not significantly affect OVD.

A Spearman's correlation analysis was conducted to assess the relationship between ICD and OVD. The results indicated a weak and non-significant correlation, $\rho = 0.18$, p = 0.25. Since $p > 0.05$, there was no statistically significant association between ICD and OVD.
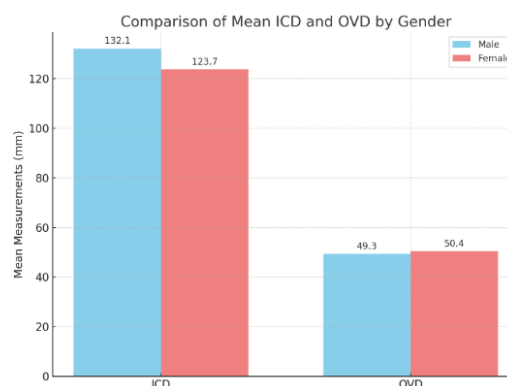

Figure No.4: ICD and OVD comparison

DISCUSSION

The OVD in edentulous patients is arguably one of the most important parameters that needs to be calculated precisely for an accurate prosthesis. As discussed earlier, various methods can be used, albeit their shortcomings[8]. In this study, we aimed to find the correlation between the OVD and ICD to assess if the ICD could be used as a landmark to predict the OVD accurately.

Correct determination of the condylar position is essential for determining the ICD. Different researchers employed different methods to determine the ICD. In this study, the Denar reference point was used to determine the location of condyles and a vernier caliper was used afterwards. In a similar fashion, Jassim utilized the Beyron point and then a caliper for measuring the intercondylar distance[10]. These methods have been proven to be very accurate in determining OVD as discussed by Baretto[12]. CBCT allows for accurate evaluation of craniofacial structures and was used to effectively measure ICD.

Oremosu et al stated that craniometric and facial measurements are usually greater in men than women[13]. A similar observation was made noting that the intercondylar distance is within the range of 101-119 mm for males and 91-100 mm for females. Patil et al. also noticed a significant difference of with a p-value of < 0.05 in males and females' condylar length amongst other factors[14]. A study done by Debnath et al in a South Indian population, measured the average ICD in males and females to be 112 mm and 108 mm respectively[15]. This is in line with our findings, with a mean ICD of male participants of 132.1 mm and 123.7 mm for females. Thus, deducing that males have a higher ICD in comparison to females.

Comparison of OVD between male and female patients revealed that the mean OVD was 49.3 mm for males and 50.4 mm for females. On the contrary, a study carried out in a Tunisian population revealed the mean OVD in male subjects to be higher, 67.60±4.49 mm, as compared to females, 60.72±3.84 mm[8]. This finding was also supported by Morata et al[16]. Based on our results, there is no significant evidence indicating the impact of gender on OVD in this population group, which is a stark contrast to previous studies[8,16] and to the findings of Bajracharya[17]. Although, a small difference between the median values of OVD between the two variables is noticeable yet this difference is not statistically significant owing to the lack of a significant p value. This makes the probability of natural variation much higher in comparison to a difference that could be attributed to gender. This outcome indicates that clinicians do not necessarily need to take into account gender while determining OVD in comparison to other factors that might impact OVD significantly more like age, ethnicity or anatomical variations.

Spearman's rank correlation analysis was conducted to evaluate the relationship between ICD and OVD. A p-value of 0.18 suggested a weak positive correlation between ICD and OVD. Thus, theoretically, as the intercondylar distance will increase, the occlusal vertical dimension will also tend to increase, but this relationship is very weak. Since this p-value is greater than 0.05, it indicates that the correlation is not statistically significant, providing no strong evidence to suggest that ICD and OVD are meaningfully related. This contradicts previous studies carried out by Bhat[5], Debnath[15] and Awotile[18].

Bhat et al reported a statistically significant positive correlation between ICD and OVD, with a Pearson correlation coefficient of $R = 0.619$ ($P < 0.001$). He emphasized the potential to predict OVD using ICD through regression analysis, reducing dependency on subjective methods of measuring OVD[5].

Meanwhile, Debnath et al. analysed the relationship between inter-condylar distance and occlusal vertical dimension in 120 dentate South Indian individuals, divided into two groups and further subdivided into four subgroups based on their facial form. These results were less definitive due to variability in the OVD/ICD ratio across face forms, suggesting that ICD may not consistently predict OVD as its relation with OVD is less consistent and influenced by other factors such as facial morphology[15].

In Awotile's study, Spearman's correlation coefficient analysis revealed a positive correlation of intercondylar distance with occlusal vertical dimension (R^2 =0.911) among other factors. Thus, the value of inter condylar distance can be calculated from known or measured OVD, and with the help of regression equations but he further argued that the mathematical method be used in combination of other techniques[18].

This has important implication as this suggests clinicians should not rely only on one to predict the other parameter and changes or measurements in one of these variables (such as ICD) may not reliably predict or be associated with changes in the other (OVD), contrary to the correlation exhibited in previously done studies. Thus, a multifaceted approach should be taken into consideration.

Several limitations should be noted. The study's sample size, although adequate for preliminary analysis, was limited to a specific age group and geographic population. These constraints may restrict the generalizability of the findings. Furthermore, being a single-center study, variability due to ethnic diversity and broader anatomical differences was not captured. Differences in study protocols, measurement tools, and patient characteristics across published literature may also explain the conflicting results. Additionally, potential uncontrolled confounding variables could have impacted the observed associations.

To strengthen future conclusions, studies with larger and more diverse samples across multiple regions are recommended. Incorporating imaging-based techniques such as CBCT may also enhance accuracy in identifying anatomical landmarks.

CONCLUSION

Based on the results of this study, the following conclusions can be drawn:

- A statistically significant difference was observed in the intercondylar distance (ICD) between male and female participants, with males exhibiting greater values.
- No significant difference was found in occlusal vertical dimension (OVD) between genders, indicating that gender does not play a notable role in determining OVD.
- The correlation between ICD and OVD was weak and statistically non-significant, suggesting that ICD cannot be reliably used as a sole predictor of OVD.

These findings highlight the importance of using a comprehensive and individualized approach when determining OVD, rather than relying on a single anatomical reference.

Author's Contribution:

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Final Approval of version:	All the above authors
Agreement to accountable for all aspects of work:	All the above authors

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