Correlation Between the Tragus-Incisal Distance and Interocclusal Rest Distance

Yoav Pietrokovski, DMD
Michael Goldberg, DMD
Yael Houri-Haddad, DMD, PhD
Gilad Ben-Gal, DMD, MSc

Department of Prosthodontics, The Hebrew University, Hadassah Faculty of Dental Medicine, Jerusalem, Israel.

Purpose: To evaluate correlations of arch size and sex with the interocclusal rest distance (IORD), as well as to estimate proportional variance.

Materials and Methods: A total of 106 participants were examined. The participants, 38 men and 68 women, were aged 22 to 30 years, were fully dentate, had no signs of abnormal abrasion, and had intact posterior occlusal contacts. Measurements of interocclusal rest distance and tragus-incisal distance were recorded, and the rest angle created between the tragus-incisal distance in maximum intercuspation and in resting vertical dimension were calculated according to the cosine formula. Correlation between the size of the mandible (tragus-incisal distance, mean of left and right sides) and the IORD were calculated using Pearson correlation coefficient. Correlations for sex (calculated separately for male and female) and rest angle were also assessed.

Results: The mean (SD) tragus-incisal distance values were 123.38 (6.77) mm for all participants, 120.01 (4.64) mm for women, and 130.72 (5.24) mm for men. The mean (SD) IORD values were 2.76 (1.3) mm for all participants, 2.13 (0.9) mm for women, and 3.87 (1.17) mm for men. The mean (SD) rest angle values were 1.26 (0.55) degrees for all participants, 1.02 (0.41) degrees for women, and 1.7 (0.49) degrees for men. Pearson correlation coefficient between IORD and tragus-incisal distance was significant \( (P < .05) \). According to \( t \) test, there was a significant difference between men and women for IORD, tragus-incisal distance, and rest angle \( (P < .01) \).

Conclusion: A correlation exists between IORD and arch size. A statistically significant difference was found between men and women for IORD and arch size values. Int J Prosthodont 2022;35:724–729. doi: 10.11607/ijp.7825

The occlusal vertical dimension (OVD) is defined as the distance measured between two points when the occluding members are in contact. A decrease in OVD may be caused by excessive wear, parafunctional occlusal habits, abrasion, erosion, loss of posterior support, or a combination of these factors.

When oral rehabilitation treatment is considered, the practitioner must decide in what OVD the patient will be restored. This parameter should be determined after accounting for several factors, such as function, phonetics, and esthetics. The methods for determining OVD can be mechanical (eg, pre-extraction records and measurements, ridge parallelism) or physiologic (eg, physiologic rest position, swallowing, phonetics).

The interocclusal rest distance (IORD), also known also as interocclusal space or freeway space, is defined as the difference between the resting vertical dimension and the OVD. IORD is regarded as a factor that must be addressed when the vertical
dimension is established in rehabilitation cases where a new OVD is being determined, such as edentulous and/or nonphysiologic occlusion, worn dentition, single edentulous arch, or full-mouth oral rehabilitation. Correct registration of IORD gives an indication of the appropriate OVD.4

Different methods have been developed in an attempt to establish a clinically reproducible rest position, such as phonation, swallowing, and tooth closure.5 One of the most popular methods are phonetics procedures, such as pronouncing the letter "M" while sitting upright6,7 or saying “Mississippi” and holding the position,8 which provide the clinicians with a reproducible position that is useful as a guide in denture construction.9

In the literature there is inconsistency regarding the accepted IORD. Different studies have found varying ranges between 1 and 4 mm,9 while textbooks state that normal IORD ranges from 1 to 3 mm and 2 to 4 mm.10 A possible reason for this inconsistency is the fact that IORD depends on posture, muscle tonus and fatigue, and the patient’s cooperation.

Several studies have tried to estimate the IORD9,11–15 in dentate patients using these methods, but some have compared patients with distinctive anatomical differences (eg, low vs high mandibular plane angle,13,15 long face14).

The purpose of this study was to examine whether there is a correlation between the size of the arch and the IORD, measured as the distance between the tragus and the mesioincisal edge of the mandibular central incisor. In addition, the authors introduce an original term, “rest angle,” which is defined as the angle of an isosceles triangle composed of the distances of the tragus-incisal (TI) angle at closure and at rest.

MATERIALS AND METHODS

Patient Screening and Selection

This in vivo study was performed during a period of 3 years and included 106 participants aged 22 to 30 years who were students of the Dentistry Faculty of Hebrew University, Hadassah School of Dental Medicine, Jerusalem, Israel. All patients were given an explanation about the trial and signed a consent form that was approved by the Helsinki Committee (0587-16-HMO).

Of the participants, 38 were men and 68 were women. All were fully dentate, had no signs of abnormal abrasion, and had intact posterior occlusal contacts. Exclusion criteria included signs of bruxism and missing teeth due to a congenital or dental disease.

Clinical Procedures

To reduce variability, all measurements were carried out by the same operator, an experienced dentist (M.G), at the same hour of the day (15:00 to 18:00 pm) and in identical dental chairs, with the patient sitting in the same position under the conditions of the student dental clinic of the Hadassah School of Dental Medicine.

IORD Measurement

The measurements were carried out with the patient sitting upright in a dental chair, eyes focused on the horizon. Two arbitrary points were marked on the nose and chin. Participants were asked to relax and pronounce the letter “M” and the word “Mississippi” repeatedly,7 followed by measurement of the distance between the two points at rest with a digital caliper (CD-8”, Mitutoyo). Next, the participants were asked to close the mouth to maximum intercuspsation (MIP), and the distance was measured between the same two points. (Fig 1).

The difference between these two distances was calculated and taken as the IORD.

T-I Distance

The distance between the most prominent distal point of the tragus and the mesioincisal point of the central mandibular incisor was measured (Fig 2) in the resting and MIP positions using a digital caliper. Both the left and right sides were measured, and the T-I distance was taken as the mean of the two sides. The measurements were carried out twice by one researcher (M.G.) under the supervision of two other researchers (Y.P. and G.B.).

Calculation of Rest Angle

The rest (α) angle was defined as the angle at the vertex of an isosceles triangle, where the T-I distances in the MIP and resting positions were the two equal sides and the IORD was the base of the triangle (Fig 3). The angle was calculated according to the cosine equation \( \cos \alpha = (2a^2 - b^2) / 2a^2 \), where “a” is the size of the isosceles triangle, “b” is the base of the isosceles triangle, and “\( \alpha \)” is the angle at the vertex of this triangle.

Statistical Analysis

Descriptive statistics were used to present the data and evaluate data distribution. Correlation between the size of the mandible (T-I distance, mean of left and right sides) and the IORD was calculated using Pearson correlation coefficient. Correlations for sex, calculated separately, and rest angle were also assessed using \( t \) test. The sexes were compared for all factors using \( t \) test.

RESULTS

Results are shown in Figs 4 and 5 and in Table 1. Mean (SD) values of the T-I distance, IORD, and rest angle (\( \alpha \)) were calculated. For all participants (106), the
The mean (SD) T-I distance was 123.38 (6.77) mm, the IORD was 2.76 (1.3) mm, and the rest angle was 1.26 (0.55) degrees (Table 1).

The differences between men and women in IORD, T-I distance, and rest angle were evaluated using t test. The differences were found to be statistically significant for all three factors ($P < .01$) (Table 1).

Pearson correlation coefficient between IORD and T-I distance was significant ($r = 0.69; P < .05$), establishing a correlation between these two measures (Fig 4).

**DISCUSSION**

The initial stage of mouth opening is composed of a movement around the transverse horizontal axis, also known as the terminal hinge axis, during which the...
condyle turns in a rotational movement while the point of the mandibular incisor moves along a circle centered on the center of the condyle.

The IORD is measured as the difference between the resting vertical dimension and the OVD. Due to the diversity of anatomical traits in the population, the assumption that the IORD for all patients should be determined arbitrarily between 2 and 4 mm seems unlikely. Inaccurate registration of the IORD in a patient may diminish the esthetics of facial soft tissues, induce speech difficulties, and cause muscle discomfort.\(^1\)

The importance of accurate determination of the IORD in a full-mouth rehabilitation that demands setting of a new therapeutic occlusal scheme emphasizes the need for a more accurate and personalized method. A predictable, quick, and easy-to-use system may support this important and crucial step in treatment and contribute to the accuracy of the rehabilitation.

The OVD must also be determined in full-mouth oral rehabilitation cases. In general, this is the situation when dealing with a edentulous patient treated with complete dentures or an edentulous patient treated with interocclusal implant-supported prostheses. Setting the OVD is also demanded when restoring a case with severely worn teeth or a single edentulous arch against a dentate one, with or without implant support.

The tragus landmark is a well-known and accepted reference point used in oral rehabilitation. The most distal part of the tragus presents the most stable and predictable point\(^1\) and was thus chosen as the posterior vertex of the triangle. The mesioincisal point of the central mandibular incisor was chosen as the anterior vertex of the triangle (Fig 3).

By creating an imaginary isosceles triangle where the base is the IORD and the sides are the tragus-incisal distances (Fig 3), it is possible to calculate the angle between the two equal sides according to the cosine law. Vice versa, knowing the angle between the sides (T-I distances) and the distances of the two sides enables the clinician to find the value of the base (IORD). This was called the “rest angle” (\(\alpha\)) in the present study.

### Table 1
Tragus-Incisal Distance, IORD, and Rest Angle Values for All Participants

<table>
<thead>
<tr>
<th></th>
<th>All participants (N = 106)</th>
<th>Female (n = 68)</th>
<th>Male (n = 38)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tragus-incisal distance (mm)</td>
<td>IORD (mm)</td>
<td>Rest angle (degrees)</td>
<td>IORD (mm)</td>
</tr>
<tr>
<td>Mean</td>
<td>123.38</td>
<td>2.76</td>
<td>1.26</td>
</tr>
<tr>
<td>SD</td>
<td>6.77</td>
<td>1.3</td>
<td>0.55</td>
</tr>
</tbody>
</table>

\(^a\) Statistically significant difference between men and women.
Initially, the goal of this study was to prove the hypothesis that there is a correlation between the T-I distance and the IORD and to establish a predictable system using two anatomical indices: the T-I distance and the rest angle. The results showed a significant correlation between the T-I distance and IORD, in the general population (Fig 4) and in both male and female patients. A simple and predictable measuring method to establish IORD in the clinic was established based on these results: when needing to decide the size of a future IORD in a patient in need of full dentures or a full-mouth rehabilitation, the clinician can measure the T-I distance using a digital caliper and determine the expected IORD by using a simple table (Fig 5 and Table 2). In cases of edentulism or major discrepancies between the mandibular midpoint and the position of the two central incisors, the measurement should be directed to the mid-arch point.

The classic method of IORD measurement by using two arbitrary points on the face and measuring them in the resting and MIP positions is still one of the most popular ways to establish IORD for a full-mouth future rehabilitation. This method is quick, simple, and does not involve complicated equipment. Other methods, such as electromyographic recording, require expensive equipment and are used mainly for research.

As more factors influence the IORD in addition to anatomical traits such as age, muscle tonus, and posture, the present study chose certain exclusion criteria and measurement methods to account for them—ie, only young but fully matured patients were included, and the measurements were identical, as they were conducted at the same time with patients in the same posture.

One of the most surprising findings of this study is that the T-I distance was not fully correlated with the rest angle in all individuals. Different individuals with an equal T-I distance showed different rest angle and IORD values. This finding led the authors to the assumption that the T-I distance is not the only factor affecting IORD value.

The rest angle found for men was on average larger than for women, which seems to be an additional factor affecting higher values of IORD. It can be assumed that the reason for a larger angle in men is a higher mandibular weight and larger metric parameters of the mandible compared to women. This topic remains to be investigated more thoroughly in future studies.

CONCLUSIONS

Based on the findings of this clinical trial, the following conclusions were drawn:

• The IORD of an individual is correlated with arch size and sex.
• A simple and predictable method is suggested for the clinician in need of determining a therapeutic IORD.

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The authors report no conflicts of interest.

REFERENCES

Literature Abstract

Efficacy and Risks of Removable Partial Prosthesis in Periodontitis Patients: A Systematic Review

The aim of this systematic review was to answer the following focus question: In partially edentulous patients with periodontitis, are removable dental prostheses (RDPs) more efficacious than no prosthetic treatment, treatment with a shortened dental arch (SDA), or tooth-supported fixed dental prostheses (FPDs)? A systematic literature search was performed electronically for literature from the period 1966 to 2020. Two authors independently assessed the studies for eligibility according to the PRISMA guidelines. Risk assessment was performed using RoB 2.0 and the Newcastle-Ottawa Scale. Two retrospective studies indicated that RDPs increased the risk of tooth loss compared to FPDs in patients with a history of periodontitis. Prospective studies found that RDPs could be maintained without any significant periodontal destruction on a long-term basis. Owing to the heterogeneity of the data, no meta-analysis could be performed. Several studies indicated that RDP increased plaque accumulation. RDPs had only a limited effect on masticatory efficiency and nutritional status. RDPs may improve oral-health–related quality of life (OHRQoL), but to a lesser extent compared to patients treated with an SDA approach. There is no strong evidence that RDPs will cause periodontal destruction, including tooth loss. RDPs do not inevitably improve masticatory efficiency but do improve OHRQoL, although less than FPDs, including resin-bonded prostheses.


Literature Abstract

Anterior Implant Restorations with a Convex Emergence Profile Increase the Frequency of Recession: 12-month Results of a Randomized Controlled Clinical Trial

The objective of this study was to test whether the emergence profile (convex or concave) of implant-supported crowns influences the mucosal margin stability up to 12 months postplacement of the final restoration. A total of 47 patients with a single implant in the anterior region were randomly allocated to one of three groups: (1) convex (n = 15): implant provisional restoration and an implant-supported crown both with a convex profile; (2) concave (n = 16): implant provisional and an implant-supported crown both with a concave profile; (3) control (n = 16): no provisional (healing abutment only) and an implant-supported crown. All patients were recalled at baseline and at 6 and 12 months. The stability of the mucosal margin along with clinical, esthetic, and profilometric outcomes were evaluated, as well as time and costs. To predict the presence of recession, multivariable logistic regression and linear models using generalized estimation equations (GEE) were performed for the different outcomes. A total of 44 patients were available at 12 months postloading. The frequency of mucosal recession amounted to 64.3% in the convex group, 14.3% in the concave group, and 31.4% in the control group. Regression models revealed that a convex profile was significantly associated with the presence of recession (OR: 12.6, 95% CI: 1.82 to 88.48, P = .01) compared to the concave profile. Pink esthetic scores amounted to 5.9 in the convex group, 6.2 in the concave group, and 5.4 in the control group, with no significant differences between the groups (P = .756). The convex and concave groups had more appointments and higher costs compared to the control group. The use of implant-supported provisional with a concave emergence profile resulted in greater stability of the mucosal margin compared to a convex profile up to 12 months of loading. This was accompanied, however, by increased time and costs compared to the absence of a provisional and may not necessarily enhance the esthetic outcomes.


References: