Re-evaluation of Interarch Space Determination in Fully Dentate Adults with Different Facial Forms: A Clinical Study

Abstract

Aim: The aim is to determine the average inter-arch space of fully dentate subjects at rest and at occlusion with different facial forms. Materials and Methods: Fifty subjects each of three groups of facial form, square, taper, and oval facial with a complete set of maxillary and mandibular arch teeth with average age from 25 to 40 years were included in this study. An equal number of male and females were included in all the groups. Vertical height at rest and at occlusion was recorded in each subject of the all the three groups using a prescribed procedure, and freeway space (FWS) was measured. Results: The collected data were statistically evaluated, and it showed the mean and median for each facial form subjects, square facial form (3.2 ± 2), taper facial form (2.6 ± 2), and oval facial form (2.6 ± 2), respectively. No significant difference between any of the readings (P < 0.05). However, 9% of the individuals showed the FWS range of 5–6 mm. The lowest and highest FWS measurements were 1 and 7 mm, respectively. One more significant factor is that majority (56%) of the square facial form subjects showed FWS range of 3–4 mm. Conclusion: The conclusions were drawn, to understand the average inter-arch space in various facial forms, which was more than 3–4 mm.

Keywords: Dentulous, facial form, freeway space, jaw relation, vertical dimension

Introduction

Individuals with natural dentition, demonstrate a space between the occlusal surfaces of the teeth, with that of the opposing jaw, when both the jaws are in the rest position.[1] This freeway space (FWS), or interocclusal distance, is determined by the balance between the elevator and depressor muscles attached to the mandible, and the “elastic” nature of the surrounding soft tissue in a natural dentition.[1] FWS is measured by noting the difference between the resting vertical dimension (RVD) of the face and the vertical dimension of occlusion (OVD) with the teeth in occlusion.[1] Exact measurement of FWS is most essential in the successful practice of many phases of dentistry. It has been found that duplication of normal vertical height is difficult and incorrect determination of OVD and centric relation position is a major cause for failures in complete denture treatment.[3]

The literature mentions an average FWS of 2–4 mm.[3,6] Tyson et al., stated that FWS could be increased above the range of 2–4 mm for elderly patients, and patients with atrophic mucosa overlying the residual ridge.[7] It is also recommended that, an increase in FWS by a further 2–3 mm acceptable, in cases where a reduction in loading of the underlying tissues is needed. Incorrect registration of the FWS may result in loss of facial proportions, insufficient mastication, dysphagia, trauma, resulting in loss of alveolar ridges, tightness of facial muscles, clicking of dentures during the speech, cheek biting soreness of corners of the mouth (angular cheilitis) and pain in the temporomandibular joint (TMJ).[8,10]

Few common methods of recording the FWS in edentulous patients are by using dividers (or millimeter rule or tongue depressor),[4,6,11,12] Willis gauge,[4,11,12] speech tests,[12–15] general appearance,[16] patient opinion,[15] and swallowing.[13]

Using caliper for measuring OVD was shown to be significantly more accurate than the Willis method.[7] Accurate assessment of FWS is essential to ensure success in complete denture fabrication.[7] Lower one-third of the face can have far-reaching effects on facial aesthetics, not only on the peri-oral areas but also on the entire face. Mandibular posture greatly depends

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on head posture. Thus, it is compulsory to state if the subject is in RVD or in OVD with the teeth in contact. Seated or supine position may also influence the posture, as the habitual mandibular position is determined by the stiffness that results from the postural muscle tone acting on the mandible. Thus, a facial form of individuals has to be taken into consideration while measuring FWS.\(^9\) This study was aimed to evaluate the FWS of dentate subjects with different facial forms and to compare with the recommended range for edentulous patients.

**Materials and Methods**

Based on the three facial form, square, taper and oval, fifty subjects in each group were selected with an equal number of males and females, in a total of 150 subjects. The subjects included in this study were based on criteria of fully dentate in the maxillary and mandibular arch, without any history of orthodontic treatment, no extensive restoration of the dentition, no history of TMJ problem, no head and neck injury.\(^{17}\) The criteria for selection of facial form was based on the lines joining the imaginary horizontal lines such as interpupillary line, inter zygomatic line and a line passing through the base of the chin together with lines passing through the side of the face of individual were taken to differentiate the facial forms of individuals [Figure 1].\(^{10}\) To avoid the influence of muscle fatiguability on the FWS, all the recordings were made in the morning.\(^{19}\) Using Niswonger and Thompson’s method, vertical height at rest and occlusion were recorded in every subject of all the three groups. Physiologic rest position can be achieved using Niswongers method.\(^{20}\)

Digital caliper was used to avoid any errors while measuring the FWS [Figure 2].\(^{21}\) Two skin markings were made on the subjects face. The first marking was made by sticking a triangular shaped adhesive tape on the most prominent point of the nose. The second mark was made by sticking same shaped adhesive tape on the most prominent point on the chin.\(^{22}\) Then two pointers of the caliper were held on these points. Readings were obtained. For the more consecutive readings, digital caliper again brought to the “0” reading and again opened to make the next reading. The rest and occlusal face heights were then measured between these two dots using digital caliper. The FWS was obtained, by calculating the difference between vertical height and rest and at occlusal. The operator repeated each procedure 10 times for measuring to assess the reproducibility of the results. The vertical dimension (VD) at rest and at occlusion was confirmed with the TMJ view radiograph [Figure 3]. The obtained data were analyzed using Wilcoxon signed ranks test.

**Results**

Statistical analysis was performed using the SPSS statistical software, version 17.0 (SPSS Inc.,233 South Wacker Drive, 11 th Floor, Chicago, IL). Table 1 shows the mean and median for each facial form subjects, square facial form (3, 2.32), taper facial form (2.62, 2), and ovoid facial form (2.68, 2). No significant difference between any of the readings was obtained. No statistical significance differences were seen between each facial forms. However, 9% of the individuals showed the FWS range of 5–6 mm. The lowest and highest FWS measurements were 1 and 7 mm, respectively. Fifty-six percent of square facial form subjects showed an increase freeway space of 3–4 mm, when compared to other facial forms.

**Discussion**

Patients with natural dentition have been found to have an interocclusal distance varying from 1 to 10 mm. As a
general rule, a greater amount of interocclusal distance is provided as the age of complete denture patients increases.\(^{[23,24]}\) One of the important, yet elusive steps in complete denture fabrication is the correct establishment of VD remains empirical and arbitrary because there is no scientific or absolutely reliable technique available for the determination of VD. Boucher\(^{[9]}\) noted that if the VD is too great the patient may complain of soreness of residual ridges, tightness of facial muscles, and clicking of the dentures during speech and if it is too small, the patient will look older as the lower half of the face is compressed, the cheeks and lips are slack, and the chin protrudes.\(^{[9]}\)

When selecting the best method to determine VD, criteria to be considered are accuracy, repeatability, consistency of the measurement, adaptability of the technique type, complexity of the technique needed, and the length of the time required to secure the measurements.\(^{[25,26]}\) Despite several methods to determine the VD, the use of facial reference points is still a popular method in clinical practice. Hence, digital caliper method have been studied.\(^{[26,27]}\) Many investigators have suggested various methods for estimation of vertical dimensions of occlusion (VDO). Niswonger suggested interocclusal or FWS as a guide to determine the VDO, but short- and long-term variations have been reported.\(^{[25,27]}\) The mean measurements of FWS of dentate subjects with different facial forms were within the recommended range (2–4 mm) for edentulous patients. A 2–4 mm recommend FWS for edentulous patients would seem to be the mean range required with only 9% of the subjects in the study having overall mean measurements higher than this recommended range. Similar to a study, which shows 16% of the subjects with these values.\(^{[22]}\)

This 16% is not ignorable. Lamb stated that dentate patients showed a vertical range of 2–9 mm in the anterior teeth region, but stated that dentures would function satisfactorily with an FWS range of 2–5 mm.\(^{[6]}\) Johnson et al. suggesting a range of 2–6 mm,\(^{[17]}\) similarly Johnson et al. also suggested in a range of 2–7 mm of FWS in their study.\(^{[22]}\)

The result of the study recommend that the range for FWS measurement could more realistically be 2–7 mm and that a less rigid, narrow range be recommended, the important feature being that there should be an FWS, sufficient to provide comfort during function and speech. There was no significant difference between each facial form, although the square facial form group, showed the FWS range of 3–4 mm. This could be explained by the potential for considering the facial form while keeping the FWS in edentulous patients. This 56% of the square facial form individuals who had showed the FWS of 3–4 mm is not ignorable.

Studies have shown that the individuals with square facial form showed the increased masticatory function.\(^{[28]}\) Sheppard suggested that the average rest space would be 6.15 mm, provided the patient is one whose mandibular rest position is increased with the insertion of dentures. While this unplanned addition to the rest space may be a safety factor, it is apparently possible to obtain over the closure of the OVD, when the increase in mandibular opening upon insertion of the dentures (downshifting) is greater than the average of 3.15 mm. FWS of 7–13.8 mm would tend to indicate this possibility.\(^{[29]}\) The subjects used in this study were aged 25–40. It is suggested that, as we age our FWS increases (because of tooth wear and loss of muscle tone, etc.), therefore it is reasonable to suggest that FWS be at the higher end of the recommended range for the older complete denture patient. This study strongly recommends correlating dentate subjects with edentulous subjects, 2–3 mm FWS is a misnomer as we are following now.

VD at rest and at occlusion position was confirmed with the radiograph as we all know once growth is complete, maintenance of the OVD is determined by the adaptive capacity of the biologic system to insult or injury. Adaptive responses can occur within the TMJ, the periodontium, and the dental occlusion.\(^{[10]}\)

**Declaration of patient consent**

The authors certify that they have obtained all appropriate patient consent forms. In the form the patient(s) has/have given his/her/their consent for his/her/their images and other clinical information to be reported in the journal. The patients understand that their names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

**Conclusion**

Facial forms influences the FWS of individuals, and needs to be taken into consideration. It should be emphasized that measurements are merely guidelines and good judgment should prevail. Future prospective of this study is that evaluating the FWS in edentulous patients with increased number of subjects would definitely increase the clarity.

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Nil.
Conflicts of interest

There are no conflicts of interest.

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