ANALYSIS INTO FREEWAY SPACE ACHIEVED DURING COMPLETE DENTURE CONSTRUCTION

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Abstract: Introduction: Rest position, also called as inter occlusal rest position or freeway space (FWS), has been defined as the neutral position attained by the mandible as it is involuntarily suspended by the reciprocal coordination of the elevator and depressor masticatory muscles with the maxillary and mandibular teeth separated. The amount of freeway space (FWS) in any individual is mainly an expression of muscle function, its equilibrium and gravity. **Materials and method:** A total of 422 patients were involved in this study based on the inclusion and exclusion criteria. The study was conducted among complete denture patients reported to Saveetha dental college and hospital,Chennai. All the data were entered in the excel sheet and data analysis was done using SPSS software. Chi square test was used to find an association between the study variables. **Results:** Mean measurements of freeway space of edentulous subjects in this study were within the recommended range (2–4 mm) for edentulous patients. Among 422 study subjects, the mean age group was found to be 53.29 and 55 to 70 years age groups were reported higher in number(54.5%). The gender distribution of the patients were reported as 259 were males and 163 were females. The most common freeway space achieved during the construction of complete denture was 3 mm. **Conclusion:** The study results conclude that the most commonly achieved freeway space during the complete denture construction was 3 mm (42.65% of cases). The most common age group with 3 mm of freeway space was seen in 55 to 70 years older adults. It was identified that 1 mm (3.55%) of freeway space was commonly seen in 30 to 45 years indicating inadequate inter arch space during the rest phase.

Keywords: Freeway space, complete denture, Rest position, edentulous,innovation

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INTRODUCTION

Freeway space (FWS) also called as rest position or interocclusal rest position, has been defined as the neutral position attained by the mandible as it is involuntarily suspended by the reciprocal coordination of the elevator and depressor masticatory muscles with the maxillary and mandibular teeth separated (Potgieter, Monteith and Kemp, 1983). Freeway space is a primary prerequisite for comfort and optimum function of partial or complete dentures, as it is expressed as a gap that occurs in the vertical dimension separating the position which the mandible assumes in space when it is at rest, and its spatial position when the teeth are brought into contact (Mack, 1989). Although FWS seems easily accessible, it is one of the controversial topics in prosthetic dentistry. It is the basic introductory step in jaw relations on which further complicated ones, such as vertical dimension and centric relation, are contingent upon Hence, the knowledge about the precise level at which this lost dimension previously occurred is very important as the correct horizontal relation depended on the correct vertical relations, and any alteration in these dimensions can affect the stomatognathic system (Pyott and Schaeffer, 1954; Özkan, 2018)

The establishment of the rest dimension is of first consideration in all types of restorative dentistry. Vertical dimension means the anatomic balance of the mandible. The mandible must not be in the most retruded position because this is a strained position. The proper positioning of the condyle heads cannot be accomplished by forcing the mandible to its most retruded position or by forcing it to any other point. The intermaxillary distance proved the same when examined at long intervals (Monteith, 1984). There is no trouble in getting the exact, true relation of the jaws at rest in any individual case. Although the patient may have lost his former jaw movement, he always has his natural rest position. Muscles fatigued by chewing cause the mandible to return to centric occlusion. The patient is instructed to close until he feels natural and comfortable (Jain *et al.*, 2013b)

The physiologic rest position of the mandible is widely used in clinical practice as a functional method for the determination of occlusal vertical dimension. However, the mandibular position is considered to be affected by various factors such as head and body postures and mental state as well as masticatory and facial muscles and temporomandibular joints (Gillis, 1941). As the head is bent forward, the closing path approached the maximum intercuspal position from the anterior region, and as the head is bent backward, the closing path approached the maximum intercuspal position from the posterior region.(Morrison, 1959) There is an effect of gravity on a forward head posture, which causes an increase in forward tension, which induces fatigue

and presents a compressive force on the soft tissue. The freeway space is now generally recognized as a normal and necessary feature of normal occlusal function.(Eriksson, 1982)When selecting the best method to use, criteria to be considered are accuracy and repeatability of the measurement, adaptability of the technique, type and complexity of the equipment needed, and the length of time required to secure the measurement (Jain, 2013; Jain *et al.*, 2013a). The incorrect measurement and resultant provision of insufficient freeway space have been reported to lead to teeth clashing, with difficulties approximating the lips, with discomfort brought about by constant stimulation of the muscles, poor appearance, cheek biting, angular cheilitis, temporomandibular joint pain (Frost, 1988)(Moreno-Hay and Okeson, 2015).

Most studies recommended a freeway space range of 2 to 4 mm(Fayz and Eslami, 1988; Abduo and Lyons, 2012; Alhajj *et al.*, 2017). However they also stated that freeway space could be increased above this range for elderly patients and patients with atrophic mucosa overlying the residual ridge (Nanda *et al.*, 2014; Yashendra *et al.*, 2015). Our team has extensive knowledge and research experience that has translated into high quality publications (Choudhari and Thenmozhi, 2016; Govindaraju, Jeevanandan and Subramanian, 2017; Ravi *et al.*, 2017; Vikram *et al.*, 2017; Gupta, Ariga and Deogade, 2018; Hannah *et al.*, 2018; Kavarthapu and Thamaraiselvan, 2018; Pandian, Krishnan and Kumar, 2018; Ramamurthy and Mg, 2018; Ashok and Ganapathy, 2019; Ramesh *et al.*, 2019; Sharma *et al.*, 2019; Venu, Raju and Subramani, 2019; Wu *et al.*, 2019; Samuel, Acharya and Rao, 2020)

They recommended an increase in freeway space by further 2-3 mm in such cases where a reduction in leading of the underlying tissues was needed.

Hence, this present study was conducted to analyze the freeway space achieved during the construction of complete denture.

MATERIALS AND METHOD

The study was designed as a retrospective cross clinical study analyzing all the patients with complete denture.The data of 86000 patient records were reviewed and analyzed between June 2020 and March 2021 from which 422 complete denture patients were identified. The records with Incomplete medical documentation, replication of results, improper clinical photographs or diagnosis were excluded from the study.

Data collection: Patient details like age, gender, complete denture site, freeway space were recorded. The collected Data was described as frequency distribution and percentile. Statistical analysis was performed using Statistical Package for the Social Sciences ,version 22(SPSS).Descriptive analysis was based on quantitative variables and frequencies for categorical variables.A Chi square test was applied to determine the significance between groups. p value< 0.05 was considered to be statistically significant with a confidence interval of 95%.

RESULTS AND DISCUSSION

Among 422 study subjects, the mean age group was found to be 53.29. The frequency distribution of age as illustrated in Figure 1 infers that around 54.5% of the patients were between 55 to 70 years age groups which was reported higher in number. The gender distribution of the patients were reported as 259 were males and 163 were females. It was inferred that among completely edentulous patients, the males (61.4%) reported higher numbers than females (38.6%) (figure 2). Completely edentulous (both arch) patients were reported higher in number (72.04%) than single arch edentulous patients. The frequency distribution of upper arch edentulous patients was 18.72% followed by lower arch edentulous was 9.24% (figure 3).

The most common freeway space achieved during the construction of complete denture was 3 mm (42.65%) followed by 2 mm (31.52%) and 4 mm (15.40%)(figure 4). Freeway space had an average of 3.6 mm. Pearson correlation showed that there is a strong positive correlation between age groups and freeway space (figure 5), p value = 0.001 which was statistically significant.

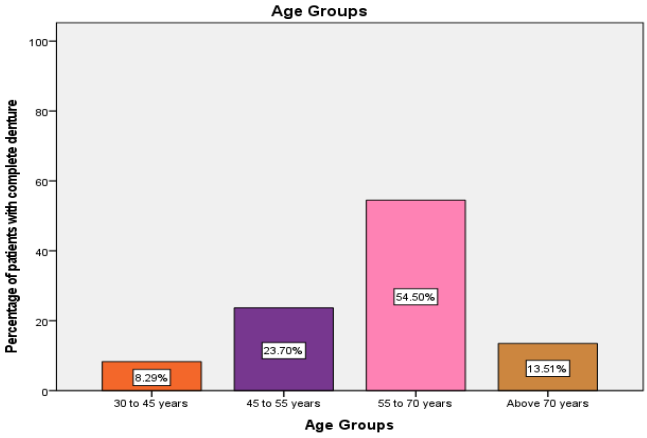

Figure 1. Shows the distribution of the population based on age . The X axis depicts the age group-30 to 45 years(orange), 45 to 55 years(purple), 55 to 70 years(pink), > 70 years(brown) and Y axis is the percentage of patients with complete denture. There were higher patients with complete denture among the 55 to 70 years yr age group with 54.5%.

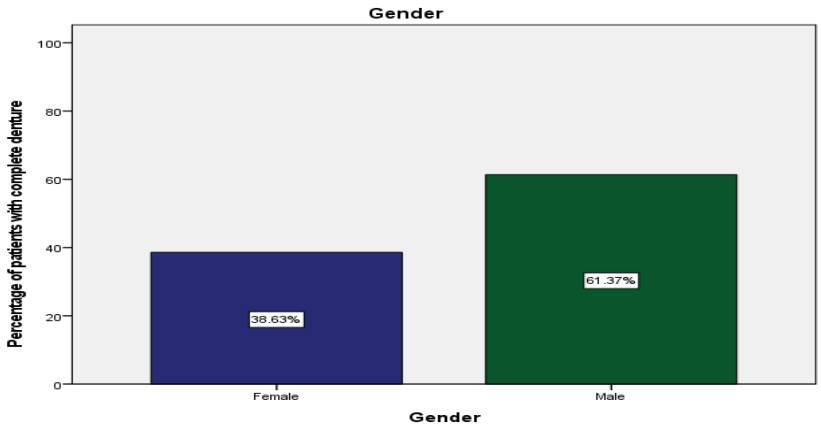

Figure 2. Shows the distribution of the population based on gender . The X axis depicts the gender -Male (green) and Female (blue) and Y axis is the percentage of patients with dental implants. Male patients were predominant with 61.37%.

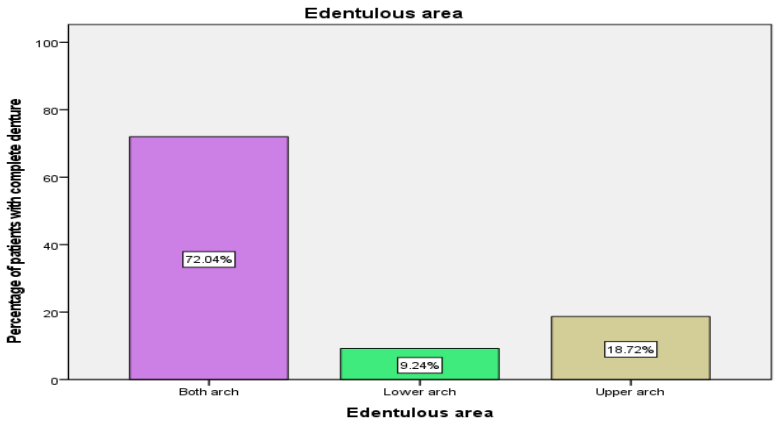

Figure 3. Bar graph represents the frequency of the edentulous area of the prosthesis . X axis represents the edentulous area such as both arch (lavender),lower arch (light green), upper arch (teal) and Y axis represents the percentage of patients with complete denture. Completely edentulous (both arch) patients were reported higher in number (72.04%).

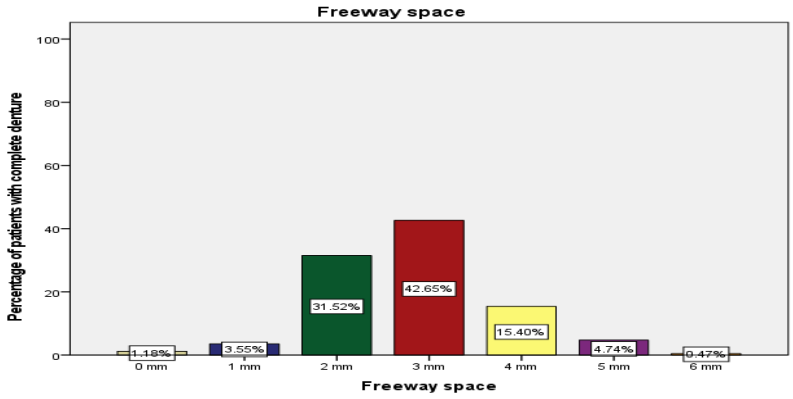

Figure 4: Bar graph represents the frequency of the freeway space achieved during the construction of complete denture . X axis represents the freeway space such as 0 mm, 1 mm, 2mm, 3mm, 4mm, 5mm, 6mm and Y axis represents the percentage of patients with complete denture. The most common freeway space achieved during the construction of complete denture was 3 mm (42.65%)

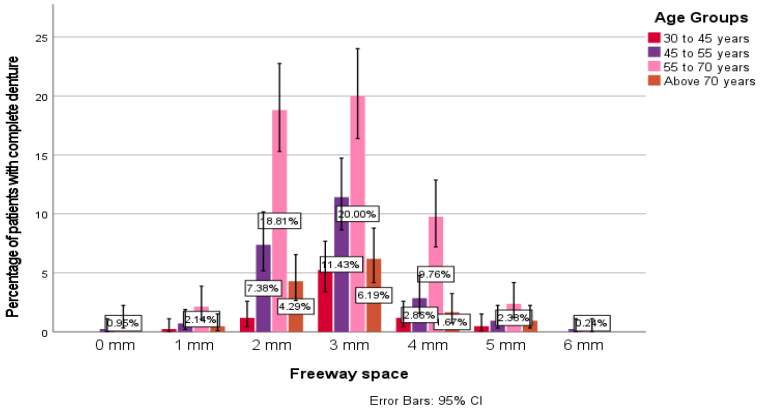

Figure 5. Bar graph showing the association between age and freeway space achieved during the construction of complete denture. The X axis represents the freeway space and the Y axis the percentage of patients with complete denture .Orange represents 30 to 45 years, purple represents 45 to 55 years, pink represents 55 to 70 years and brown represents > 70 years. 3 mm freeway space was the most common among 55 to 70 yrs with 40.3% .This was found to be statistically significant. Pearson Chi square,p= 0.00 (P<0.05,statistically significant).

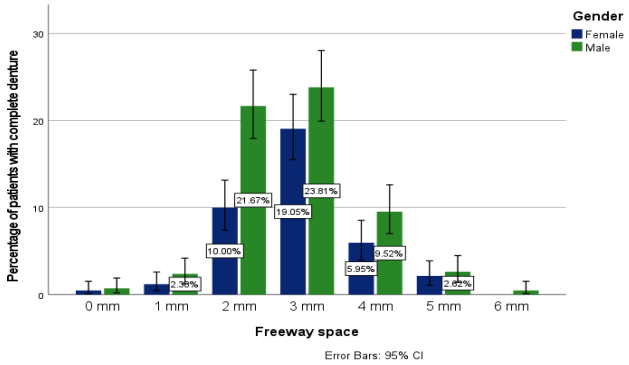

Figure 6. Bar graph showing the association between gender and freeway space . X axis represents the freeway space achieved and the Y axis the percentage of patients with complete denture. Blue represents females and green represents males. 3 mm was the most common freeway space associated with males and females. This was found to be statistically not significant. Pearson Chi square,p= 1.2(P>0.05,statistically not significant).

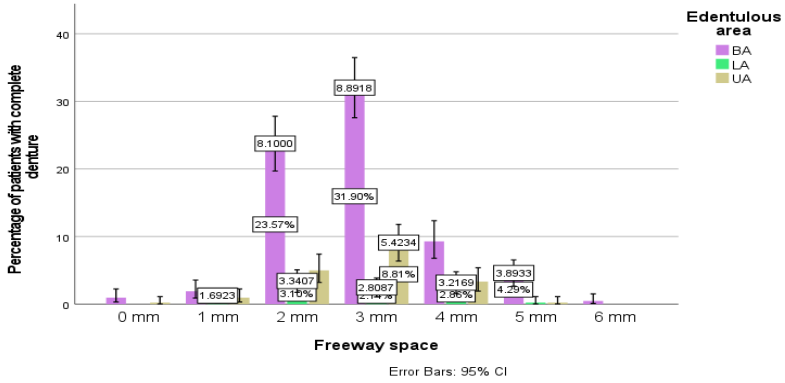

Figure 7. Bar graph showing the association between edentulous area and freeway space . X axis represents the freeway space achieved and the Y axis the percentage of patients with complete denture. Lavender Represents both arches, light green represents lower arch and teal represents upper arch. 3 mm was the most common freeway space associated with both arch edentulous patients. This was found to be statistically, Pearson Chi square,p= 0.02 (P <0.05,statistically significant).

There are various methods to record vertical dimensions in patients such as using the pre-extraction records, functionally acquired jaw position associated with phonetics, cephalometric radiographs, evaluation of radio opaque paste in the vestibular foramina(Rugh and Drago, 1981; Babu *et al.*, 1987). Changes in occlusal vertical dimension (OVD) certainly affect aesthetics and functional activities such as chewing and speech due to their intrinsic relationship with the freeway space and the speaking space. Johnson et al (Johnson, Wildgoose and Wood, 2002) found a wide range for the freeway space (2–7 mm), which could lead to inaccurate determination of the OVD when standardized values are used (2–4 mm) which correlates with the finding in this study. Variety of techniques used earlier was most directed towards the correct determination of vertical dimension at occlusion and having little concern in determining the FWS. Correct determination of FWS can be ascertained by trial and error with cooperation between the operator and patients(Mishra *et al.*, 2019).

A 2–4 mm recommended freeway space for edentulous patients would seem to be the mean range of the subjects in the study having overall mean measurements similar to the recommended range. Sumitra et al (Sumita and Otani, 1952)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 a freeway space range of 2–5 mm.Jain et al (Jain, 2013) suggesting a range of 2–6 mm. This study would suggest that the range could be widened to 1–7 mm and that a less rigid,narrow range be recommended, the important feature being that there should be a freeway space, sufficient to provide comfort during function and speech

The most common age group with 3 mm of freeway space was seen in 55 to 70 years older adults, which correlates with the study findings of pleasure et al where 2 to 5mm freeway space was seen in the 65 years age group (Pleasure, 1951). It was identified that 1 mm (3.55%) of freeway space was commonly seen in 30 to 45 years indicating inadequate inter arch space during the rest phase which in corroboration its Zarb et al who stated 1 mm freeway space in above 40 years age group (10.4%) are reported as inadequate inter arch space (Zarb *et al.*, 2013). The subjects used in this study were aged from above 30 year. It is observed that as age advances the degree of freeway space achieved may vary because of bone loss and lost residual ridge height. Therefore it is reasonable to suggest that freeway space can be at the higher end of the recommended range for the older complete denture patient.

Limitations: The limits of the study include a short sample size and doesn't involve all ethnic groups.

Future scope: The future scope of the study focuses on a study for a larger population and to extend the benefits to patients and dental practitioners, further studies should be undertaken to assess existing complete denture patients using jaw tracking devices.

CONCLUSION

This study indicated that the most commonly achieved freeway space during the complete denture construction was 3 mm. The most common age group with 3 mm of freeway space was seen in 55 to 70 years older adults. It was identified that 1 mm (3.55%) of freeway space was commonly seen in 30 to 45 years indicating inadequate inter arch space during the rest phase. Therefore, this study would suggest that the range for freeway space measurement could be less in young aged individuals and can be on the higher end for older patients. The FWS of 3mm was common among both arch complete dentures and upper single arch complete dentures and 2 mm was most common FWS achieved among lower single arch complete denture patients.

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