HEB

# Comparative Evaluation of Maximum Bite Force in Patients with Natural Dentition and Conventional Complete Denture

JOPD

*[1]Dr. Kajal Balana, [2]Dr. Sandeep Kumar, [3]Dr. Rajnish Aggarwal, [4]Dr. Sunita Choudhary, [5]Dr. Japjee Uppal, [6]Dr. Avei Puro*

[1]PG Student, Department of Prosthodontics, Surendera Dental College & Research Institute, Sri-ganganagar (Raj), India
[2]Professor & Head, Department of Prosthodontics, Surendera Dental College & Research Institute, Sriganganagar (Raj), India
[3]Professor, Department of Prosthodontics, Surendera Dental College & Research Institute, Sriganganagar (Raj), India
[4]Reader, Department of Prosthodontics, Surendera Dental College & Research Institute, Sriganganagar (Raj), India
[5]Post Graduate, Department of Prosthodontics, Surendera Dental College & Research Institute, Sriganganagar (Raj), India
[6]Post Graduate, Department of Prosthodontics, Surendera Dental College & Research Institute, Sriganganagar (Raj), India

***E-mail:*** ***mdssandy07@gmail.com***

**ABSTRACT:**

**Aim:** The aim of the study is to compare the maximum bite force between conventional complete denture and natural dentition.

**Materials and method:** A strain guage device was used to compare the maximum bite force. A total of 140 subjects were selected which were further categorized into GROUP A as 70 subjects with natural dentition and GROUP B as 70 subjects wearing conventional complete dentures. The device was positioned between the most distal maxillary and mandibular molars (for dentulous subject) and between the second premolars and first molar (for edentulous subject). Bite force was recorded for both right and the left side. The maximum value on the display was recorded. The mean of right and left side maximum bite force value was accepted for the statistical analysis.

**Results:** The differences in bite forces values among conventional denture subjects and natural dentition are statistically significant ($p < 0.01$), while there is no such correlation between the left and right side of the jaw. Bite forces are statistically insignificant ($p > 0.01$) in right and left side for edentulous and dentulous subjects.

**Conclusion:** Dentulous subjects with natural dentition have greater bite force than edentulous subjects with conventional complete denture, while there is no difference in bite force of right and left side in both dentulous and edentulous subjects with conventional complete denture.

**KEY WORDS:** Bite force, Gnathodynamometer, Strain gauge

| Access this Article Online | Quick Response Code: |
|---|---|
| Website:**http://heb-nic.in/jopd** | |
| Received on 13/03/2020 | |
| Accepted on 19/03/2020 © HEB All rights reserved | |

**INTRODUCTION:**

To control masticatory movements and forces the brain needs information from a variety of sense organs in and around the mouth. This is generally called sensorimotor regulation. By virtue of their location in the ligaments anchoring the tooth to the alveolar bone, the periodontal mechanoreceptors play a central role in encoding relevant aspects of the patterns of forces acting on the dentition. They are therefore likely to contribute to the regulation of masticatory forces and forces generated when we use the mouth in various manipulative tasks.[1] The number of teeth in the oral cavity and the lack of dental contact are important factors that affect the action of the masticatory system.[2]

Bite force is one indicator of the functional state of the masticatory system that results from the action of jaw elevator muscles modified by the craniomandibular biomechanics.[3] Determination of individual bite force level has been widely used in dentistry, mainly to understand the mechanics of mastication for evaluation of the therapeutic effects of prosthetic devices and to provide reference values for studies on the biomechanics of prosthetic devices.[4] In addition, bite force has been considered important in the diagnosis of the disturbances of the stomatognathic system.[5]

The bite force measurements can be made directly by using a suitable transducer that has been placed between a pair of teeth. This direct method of force assessment appears to be a convenient way of assessing the submaximal force. An alternative method is indirect evaluation of the bite force by employing the other physiologic variables known to be functionally related to the force production.[6]

Electromyographic activity of the surface elevator muscles of the mandible can be picked up from the cutaneous projection of the muscular belly.[7] In this way, obtained data give an idea for the bite force. The results of some investigations showed a linear relationship between electromyographic activity potentials and direct bite force measurements; especially at a submaximal level.[6] Several factors influence the direct measurements of the bite force. Thus, different investigators have found a wide range of maximum bite force values. The great variation in bite force values depends on many factors related to the anatomical and physiologic characteristics of the subjects. Apart from these factors, accuracy and precision of the bite force levels are affected by the mechanical characteristics of the bite force recording system.[8]

Maximum voluntary bite force is an indicator of the functional state of the masticatory system and it results from the combined action of the jaw elevator muscles modified by jaw biomechanics and reflex mechanisms. The measurement of maximum bite force can provide useful data for the evaluation of jaw muscle function and activity. It is also an adjunctive value in assessing the performance of dentures.[9]

**MATERIALS AND METHODS:**

**Materials Used In the Study:**

**A)** For Examination of the Patient

1) Mouth mirror
2) Probe
3) Curved explorer
4) Dental tweezer

**B)** Impression material (polyvinyl siloxane material)

**C)** Strain Guage instrument for measuring maximum bite force

**SOURCE OF DATA:**

140 subjects were evaluated. The subjects were divided into 2 groups with 70 subjects in each group.

- **Group 1:** 70 subjects aged between 18 to 30 years with natural dentition.
- **Group 2:** 70 subjects aged between 50 to 75 years those wearing conventional complete dentures.

**Inclusion criteria:**

**For Dentulous subject**

1. Presence of complete permanent dentition.
2. Full compliment of natural teeth without any restoration.

**For Edentulous subject**

1. All the patients having class I ridge relationship, who received their complete denture.
2. Absence of any temporomandibular joint dysfunction or any documented systemic disease.

**Exclusion criteria:**

1. Patients with systemic disease.
2. Patients with facial asymmetry.
3. Patients on drug therapy.
4. Any form of tobacco user.
5. Pregnant/lactating mothers.

The nature and design of the clinical study was explained to all 140 subjects (both dentulous and edentulous). Once the subjects fulfilled the inclusion criteria, their bite force measurements were recorded. The device was positioned between the most distal maxillary and mandibular molars (for dentulous subject) (Figure 3) and between the second premolars and first molar (for edentulous subject) (Figure 2). After the patient got adapted to the denture bite force were recorded for both right and the left side. The maximum value on the display was recorded. This was repeated for 2-3 times till the subjects get familiar to the device. Then the value was finally documented and the mean of right and left side maximum bite force value was accepted for the statistical analysis.

In this maximum bite force was measured with a specially designed instrument known as strain gauge (Figure 1). The device consisted of a slot for the power supply and two bite tongs which were attached with sensor of digital weighing machine. To measure the maximum bite force, two bite tongs was unilaterally placed in the molar region, one tong was in contact with the upper teeth and the other tong was in contact with the lower teeth while at the same time, the occlusion was stabilized contra laterally with a rubber block of polyvinyl siloxane material. Patients were asked to close their mouth with maximum force. The force with which the patient closed their mouth transmitted to a digital recorder via an amplifier. This procedure was done 3 times on each side with 1- minute interval and the mean was recorded as maximum bite force for each side.

**OBSERVATIONS AND RESULTS:**

The data obtained was statistically analysed using SPSS software version 22. p value was set at <0.05.

Intergroup comparison was done using un-paired 't' test

**TABLE I** shows mean bite force and SD on right side 3.88 ±1.03 and left side 3.96 ±1.05 among edentulous patients with conventional complete denture. When the mean bite force compared among right and left side of conventional complete dentures it was found to be statistically insignificant.

**TABLE 2** shows mean bite force and SD on right side 12.87 ±1.35 and left side12.98 ±1.05 among dentulous patients with natural dentition. When the mean bite force compared among right and left side of natural dentition it is found to be statistically insignificant.

**TABLE 3** shows comparison of bite forces on right side among conventional and natural dentition

- The mean bite force and SD on right side of subjects with conventional complete denture was 3.88 ±1.03.
- The mean bite force and SD on right side of subjects with natural dentition was 12.87±1.35.

When the mean bite force compared among right sides of conventional complete denture and natural dentition it is found to be statistically significant.

**TABLE 4** shows comparison of bite forces on left side among conventional and natural dentition.

- The mean bite force and SD among left side of subjects with conventional complete denture was 3.96 ±1.05 respectively.
- The mean bite force and SD among right side of subjects with natural dentition was 12.98 ±1.21 respectively.

When the mean bite force compared among left sides of conventional complete denture and natural dentition it is found to be statistically significant.

**TABLE 5** shows comparison of total bite forces among conventional and natural dentition.

- The total mean bite force and SD of subjects with conventional complete denture was 3.92 ±1.04.
- The mean bite force and SD of subjects with natural dentition was 12.92 ±1.28.

When the total mean bite force compared among conventional complete denture and natural dentition it is found to be statistically significant.

**DISCUSSION**

Success of any dental treatment primarily depends upon thorough knowledge of masticatory system. Masticatory performance is influenced by several factors like loss and/or restoration of posterior teeth, bite force, malocclusion, body size, facial form, occlusal contact area, and other motor activities.

Interest for measuring bite forces lasts almost two centuries, starting from Black and his construction of a mechanic gnathodynamometer. In 1923 Wustrow claimed that measurement of practically possible values of bite forces is a precondition for loading of oral tissues within the limits of physiological tolerance.

Hundred-odd measuring devices have been constructed up to now, applying various measuring principles, with the aim of examining various factors with a proven influence on the values of bite forces.

Duygu Koc[9] stated that bite force is one of the important indicator of the functional state of stomatognathic

system. Determination of bite force of the patient before planning the prosthetic treatment can enhance the clinical outcome of the treatment.

With the advancement in age the bite force gradually decreases, because of gradual loss of dental component. Edentulous individuals are orally handicapped when compared to dentulous individual; even with the well fabricated complete denture they have reduced capacity to perform various masticatory functions.

Masticatory function of the complete denture wearers was quite poor in comparison with that of healthy dentate persons. Complete denture wearers needed from four to even eight times more chewing strokes than dentate persons to achieve the same degree of pulverisation of the food. The poor chewing performance of denture wearers was compensated by chewing longer and swallowing coarser food particles. One of the factors leading to the decrease in chewing performance is the reduced bite force that denture wearers can develop owing to a lack of retention and stability of the denture. Consequences of edentulousness include lack of ability to perform daily tasks such as speaking and eating and reduction of social contact due to embarrassment associated with wearing complete dentures.

Most studies concluded that denture wearers have only about one fifth to one fourth the bite strength and masticatory force in comparison to the natural dentition subjects. In edentulous patient, there are many factors that influence the magnitude of the biting force of an individual such as the anteroposterior inclination of the occlusal plane on biting force[10], effect of altering the vertical dimension of occlusion on biting force[11-12], type of teeth used and occlusion pattern[13].

The present study aimed to evaluate the variations of bite force in dentulous and edentulous subjects.

In this study, the maximum bite force was evaluated for 140 subjects (70 dentulous, 70 edentulous) using bite force measuring device. The largest number of subjects were aged between 18 to 30 years with natural dentition and 50 to 75 years for edentulous ones wearing conventional complete dentures. The method used for this particular study to measure the bite force was the direct method where in bite force process indicator is placed between the predesignated areas

The electronic strain guage used in our investigation is highly sensitive instrument for measuring bite forces. Earlier studies have proved that the direct method of measuring bite force is more convenient and accurate when compared to indirect evaluation of the bite force measurement by employing electromyography test for Masseter and Temporalis muscle which are be functionally related to the force production.[9,13,14,15]

After the analysis of the bite force of all the subjects, mean values and standard deviation values obtained were evaluated and comparisons were made.

Comparison of maximum bite force between dentulous (Mean=12.92, SD=1.28) and edentulous (Mean=3.92, SD=1.04) groups using unpaired t-Test, revealed significant results which reveals bite force is more in dentulous subjects than edentulous ones, due to the loss of dental component and ageing which markedly reduces the biting force by 1/5th to 1/10th of the bite force seen in younger individuals with the natural teeth. Due to loss in dental component there is loss in periodontal support. It is been documented earlier that biting force induced by elevator muscles are mainly influenced by the mechanoreceptors in periodontal ligament. Slagter[16] have stated earlier that people with loss of attachment have shown impaired sensory function resulting in reduced control of biting force.

It was interesting to find that bite force variation among left and right side of edentulous subjects with

conventional complete denture and dentulous subjects with natural dentition, when compared was found to be statistically insignificant.

Clinical significance of the study is to understand the mechanics of mastication for evaluation of the therapeutic effects of prosthetic devices and to provide reference values for studies on the biomechanics of prosthetic devices. In addition, bite force has been considered important in the diagnosis of the disturbances of the stomatognathic system.

Limitations of the study were:

- The study consist of only two types of samples namely edentulous and dentulous subjects which was a very narrow criteria for comparison.
- The study comprised bite forces only in conventional complete denture, over denture (tooth supported or implant supported) were not included.
- Certain factors such as age, gender, facial forms and arch forms etc were not considered for comparison.
- Frequency distribution of particle size chewed and chewing strokes by subjects with and without teeth were not considered.
- High correlation between values on left and right posterior teeth were established, while correlation between the forces for posterior and anterior teeth was not considered.

## CONCLUSION

Dentulous subjects with natural dentition have greater bite force than edentulous subjects with conventional complete denture, while there is no difference in bite force of right and left side in both dentulous and edentulous subjects with conventional complete denture.

## REFERENCES

1. Trulsson M, Bilt AV, Carlsson GE, Gotfredsen K et al**.** From brain to bridge: masticatory function and dental implants. J Oral Rehabil 2012;39:858-77.
2. Rosa L, Bataglion C, Siéssere S, Palinkas M**.** Bite force and masticatory efficiency in individuals with different oral rehabilitations. Open J Stomatol 2012;2:21-26.
3. Bakke M. Bite force and occlusion. Semin Orthod 2006;12:120-126.
4. Fernandes CP, Glantz PJ, Svensson SA, Bergmark A. A novel sensor for bite force determinations. Dent Mater 2003;19:118-126.
5. Calderon Pdos S, Kogawa EM, Lauris JR, Conti PC. The influence of gender and bruxism on the human maximum bite force. J Appl Oral Sci 2006;14:448-453.
6. Ferrario VF, Sforza C, Zanotti G, Tartagilia GM. Maximal bite force in healthy young adults as predicted by surface electromyography. J Dent 2004;32:451-457.
7. Castroflorio T, Bracco P, Farina D. Surface electromyography in the assessment of jaw elevator muscles. J Oral Rehabil 2008;35:638-645.

8. Van Der Bilt A, Tekamp FA, Van Der Glas HW, Abbink JH. Bite force and electromyograpy during maximum unilateral and bilateral clenching. Eur J Oral Sci 2008;116:217-222.
9. Koc D, Dogan A, Bek B. Bite force and influential factors on bite force measurements: a literature review. Eur J Dent 2010;4:223-32.
10. Hideaki Okane, Toru Yamashina, Tooru Nagasawa, Hiromichi Tsuru. The effect of anteroposterior inclination of the occlusal plane on biting force. J Prosthet Dent 1979;42(5):497-501.
11. Prombonas DV, P Molyvdas. The effect of altering the vertical dimension of occlusion on biting force. J Prosthet Dent 1994;71(2):139-43.
12. Ralph WJ. The effect of dental treatment on biting force. J Prosthet Dent 1979;41:143–45.
13. Rosenstiel SF, Land MF, Fujimoto J. Contemporary Fixed Prosthodontics. 4th edition page no.110-144.
14. Herbert T.Shillingburg, Sumiya Hobo. Fundamentals of fixed prosthodontics. 3rd edition page no.11-24.
15. Proffit WR, Fields HW, Nixon WL. Occlusal forces in normal and long face adults. J Dent Res 1983;62:566–71.
16. Fontijn-Tekamp FA, Slagter AP, van der Bilt A, van T Hof MA, Witter DJ, Kalk W, et al. Biting and chewing in overdentures, full dentures and natural dentitions. J Dent Res 2000;79:1519–24.

**Figure Legends:**

**Figure 1:** Strain gauge for recording maximum bite force.

**Figure 2:** a) Maximum bite force recording on right side for edentulous subjects with complete dentures. B) Maximum bite force recording on left side for edentulous subjects with complete dentures.

**Figure 3:** a) Maximum bite force recording on right side with natural dentition. b) Maximum bite force recording on left side with natural dentition.


**Figure: 1**


**Figure: 2**

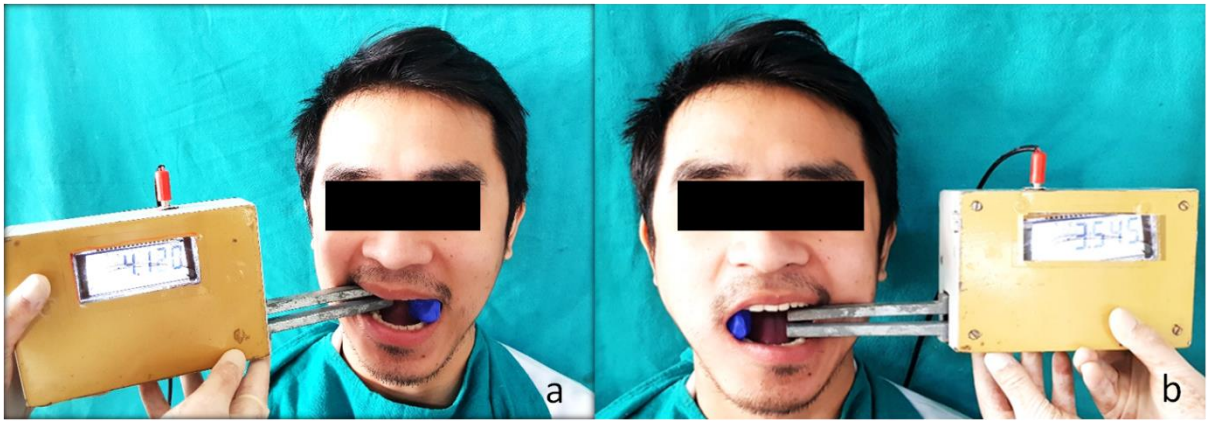


**Figure: 3**

**TABLE 1**

**DESCRIPTIVE STATISTICAL ANALYSIS OF BITE FORCES OF EDENTULOUS SUBJECTS WITH COMPLETE DENTURE**

| Complete Denture | N | Minimum | Maximum | Mean | SD |
|---|---|---|---|---|---|
| Right | 70 | 2.17 | 6.07 | 3.88 | 1.03 |
| Left | 70 | 2.17 | 6.37 | 3.96 | 1.05 |
| t test | | | | 0.45 | |
| p value | | | | 0.65 | |

**TABLE 2**

**DESCRIPTIVE STATISTICAL ANALYSIS OF BITE FORCES OF SUBJECTS WITH NATURAL DENTITION**

| Natural Dentition | N | Minimum | Maximum | Mean | SD |
|---|---|---|---|---|---|
| Right | 70 | 8.87 | 15.33 | 12.87 | 1.35 |
| Left | 70 | 9.33 | 15.83 | 12.98 | 1.21 |
| t test | | | | 0.51 | |
| p value | | | | 0.61 | |

**TABLE 3**

**COMPARISON OF RIGHT SIDE BITE FORCE AMONG EDENTULOUS SUBJECTS WITH COMPLETE DENTURES AND SUBJECTS WITH NATURAL DENTITION**

| Right | Mean | SD |
|---|---|---|
| Complete Denture | 3.88 | 1.03 |
| Natural dentition | 12.87 | 1.35 |
| t test | 44.29 | |
| p value | <0.01* | |

*: statistically significant

**TABLE 4**

**COMPARISON OF LEFT SIDE BITE FORCE AMONG EDENTULOUS SUBJECTS WITH COMPLETE DENTURES AND SUBJECTS WITH NATURAL DENTITION**

| Left | Mean | SD |
|---|---|---|
| Complete Denture | 3.96 | 1.05 |
| Natural dentition | 12.98 | 1.21 |
| t test | 44.11 | |
| p value | <0.01* | |

*: statistically significant

**TABLE 5**

**COMPARISON OF TOTAL BITE FORCES AMONG EDENTULOUS SUBJECTS WITH COMPLETE DENTURES AND SUBJECTS WITH NATURAL DENTITION**

| Total | Mean | SD |
|---|---|---|
| Complete Denture | 3.92 | 1.04 |
| Natural dentition | 12.92 | 1.28 |
| t test | 45.66 | |
| p value | <0.01* | |

*: statistically significant