“A COMPARATIVE EVALUATION OF MASSETER AND TEMPORALIS MUSCLE ACTIVITY IN GERIATRIC PATIENTS WITH AND WITHOUT COMPLETE DENTURE PROSTHESIS – AN ELECTROMYOGRAPHIC STUDY”

Dissertation

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In the partial fulfilment of the requirements for the degree

Of

MASTER OF DENTAL SURGERY

In

PROSTHODONTICS

By

Dr. Aisha Mirza

Under the guidance of

Dr. Manoj Upadhyay
Reader
Department of Prosthodontics

BABU BANARASI DAS COLLEGE OF DENTAL SCIENCES, LUCKNOW

(Faculty of Babu Banarasi Das University)

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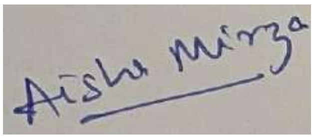

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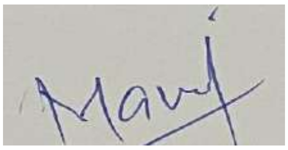

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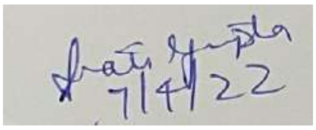

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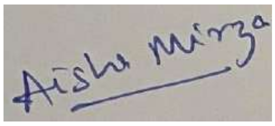

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Dr. AISHA MIRZA

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Background: Mastication is a highly coordinated neuromuscular function involving fast effective movements of the jaw and continuous modulation of force. In older subjects these mechanisms act with marked differences. They have a reduced capacity in various functions of stomatognathic system. The loss of natural teeth not only results in aesthetics issues to individuals, but can also seriously risk masticatory functions. Long- term edentulism result in bone resorption, temporomandibular disorders or muscle hypotonicity which leads to direct damage to the masticatory process.

Aim: To evaluate the masticatory muscle activity in geriatric patients with and without complete denture prosthesis through Electromyographic study of masseter and temporalis muscles.

Methodology: A total of 20 edentulous subjects of both sexes, between the age group of 65 to 80 years having no evident signs and symptoms or history of stomatognathic system and neuro muscular disorders were selected in the study. A complete denture was fabricated, followed by thorough clinical examination of the denture for proper extension, adequate retention and stability, and occlusion in maximum intercuspation was done. EMG recordings were made when patient became comfortable with denture approximately after one month.

Result: It was observed that for both the sides (right and left), muscle activity was found to be significantly more among Denture wearer subjects as compared to without denture prosthesis.

Conclusion: Within the limitations of study it was concluded that muscle activity of both the masticatory muscles showed higher activity in subjects wearing the denture prosthesis when compared to those without denture prosthesis.

Keywords: Maximum intercuspation, Electromyography, Masseter, Temporalis.

The loss of natural teeth not only results in aesthetics issues to individuals but can also seriously risk masticatory functions. Long- term edentulism result in bone resorption, temporomandibular disorders or muscle hypotonicity which leads to direct damage to the masticatory process[1].

The masticatory system is the functional unit of the body, responsible for chewing, speaking, and swallowing. Mastication is generated by rhythmic contraction of the masticatory system. In relation to the stomatognathic system, addition to tooth loss, there is reduced masticatory force, alveolar bone decomposition, changes in oral mucosa, and reduction in the number of functional motor units, leading to decreased muscular activity[2].

Movements of the mandible are governed by a generator in the brain stem influenced by proprioceptors in muscles, joints, and mucosa. Advancing age may delay the central processing of nerve impulses, impede the activity of striated muscle fibers, and inhibit decisions. It can also reduce the number of functional motor units and fast muscle fibers and decrease the cross-sectional area of the masseter and medial pterygoid muscles (Newton et al., 1987). Consequently, older people tend to have poor motor coordination and weak muscles[3].

Bite force and chewing efficiency are considerably reduced when natural teeth have been replaced by complete dentures (e.g. Kapur and Soman, 1964; Helkimo, Carlsson and Helkimo, 1977, 1978; Lucas et *al.,* 1986; Slagter *et al.*, 1992a). This also applies to the activity of the jaw elevator muscles. Miralles *et al.* (1989) for example, observed lower EMG activities during maximal clenching in denture wearers than in dentate subjects; Shi, Ouyang and Guo (1991) found similarly lower activities during mastication.

Several studies suggest that elevator muscle activity is peripherally influenced by food resistance (Plesh, Bishop and McCall, 1986; Morimoto *et al.*, 1989; Ottenhoff *et al.*, 1992).

In most studies of the EMG patterns of jaw elevator muscles the measures of activity have been averaged over an entire sequence of chewing strokes (Møller, 1966; Steiner, Michman and Litman, 1974; Hannam *et al.*, 1977; Horio and Kawamura, 1989).

However, Diaz-Tay *et al.* (1991) studied, in dentate subjects, the trends in elevator muscle activity over the masticatory sequence. Muscle activities varied around initial values or tended to decline.

We recently studied the influence of food texture on particle-size reduction during mastication in dentate individuals and complete-denture wearers. The subjects chewed a firm and a soft standardized artificial test food in equal portions and of equal initial particle size (Slagter *et al.*, 1992b, c)[4].

Electromyography, a sensitive tool, overcomes the difficulty encountered to analyze and quantify the behavior of the masticatory muscles. It has been widely used for measuring muscle function since first introduced by RE Moyers in 1949[5].

A number of studies comparing various types of complete denture teeth have been conducted for years and have explored outcomes such as masticatory efficiency, occlusal force and patient preference (Brewer 1987, Thompson M.J 1937, Hickey et all 1963)[6,7,8]. However there are few studies that correlate the effect of occlusal form on the masticatory muscles such as temporalis and masseter which are primarily affected owing to edentulism.

Many different methods of evaluating masticatory efficiency have been reported, including the sieve method, which is used to measure the degree of comminution of different kinds of test foods after a specified number of masticatory strokes, the mixing ability index of 2- colored paraffin wax cubes, color changeable chewing gum, electromyography etc.

Serious attempts have been made to explain how the stomatognathic system reacts to a functional stimulation such as chewing training or chewing exercises.

Electromyography evaluation helps in understanding the impact as well as the underlying physiology. It is an objective method as it records the muscle activity in terms of evoked potential and is done through highly sensitive equipment, thus giving an opportunity to study the impact of intervention without much delay. EMG is a non-invasive technique by which electrical activity of muscles can be studied. Sum total of electrical events produced by contraction of motor unit can be recorded by the use of electromyography and interpreted for muscular activity or efficiency[9].

The authors mostly investigated the activity of elevator muscles (anterior temporal and masseter muscle), while the depressor muscle activity during chewing has not been completely studied. The objective of the study is to show that elevator muscle activity during mastication is altered by the presence of complete denture prosthesis.

Aim:

To evaluate the masticatory muscle activity in geriatric patients with and without complete denture prosthesis through Electromyographic study of masseter and temporalis muscles.

Objective:

- To assess the activity of Masseter and Temporalis muscles in geriatric patients with complete denture prosthesis by Electromyography.
- To assess the activity of Masseter and Temporalis muscles in geriatric patients without complete denture prosthesis by Electromyography.
- To compare the activity of Masseter and Temporalis muscles in geriatric patients with and without complete denture prosthesis by Electromyography.

1. **Hickey et al. (1957)[10]** measured the muscular activity for various jaw movements and the total electrical activity of the different muscles was compared on the time basis. He concluded that external pterygoid and suprahyoid muscles were responsible for opening movement. Masseter and temporalis were responsible for closing movement. Left external pterygoid muscles were responsible for movement of mandible to right and right external pterygoid muscles for the opposite side. External pterygoid muscles on both sides were responsible for the protrusion of mandible.
2. **Luis Angelone, Joseph a. Clayton (1960)[11]** A study conducted to evaluate the Quantitative Electromyography of the Masseter Muscle and the usefulness of electromyography depends upon the ability to characterize quantitatively the "normal" population. Moreover, it concluded that, the data now do not permit such a characterization, because of the lack of standardization in recording techniques and the obvious difficulty in expressing the resultant electromyogram in simple quantitative terms.
3. **Peter Schaerer et al. (1967)[12]** evaluated the interrelationship between the occurrence of tooth contacts and the electromyographic (EMG) activity during mastication in habitual occlusion, and after the insert ion of a balancing side cuspal interference. They concluded that the EMG response during mastication was the same for the different types of tooth contacts. Tooth contacts were a part of the reflex mechanisms controlling movements of the mandible and muscle contract ions. These masticatory mechanisms were influenced by pressure- and touch-sensitive receptors when tooth contact occurs, regardless of where and in what maxillomandibular relationship they take place.

4. **Arturo Manns et al (1979)**[13] studied the relations between EMG, force, and muscular elongations during submaximal isometric contract ions of the masseter muscle measuring from 7mm to almost maximal jaw opening. EMG was recorded with superficial electrodes and bite force recorded with the gnathodynamometer. Results showed that there was for each experimental subject a physiologically optimum muscular elongation of major efficiency where the masseter muscle developed highest muscular force with least EMG activity.
5. **John D. Rugh et al (1981)**[14] Revaluated the relationship of jaw muscle activity, rest vertical dimension, and clinical rest position. The investigation was done in 10 subjects using EMG. The vertical dimension of minimal muscle activity ranged from 4.5 – 12.6mm with an average of 8.6mm. Minimum muscle activity levels ranged from 1.1 – 1.8 μvolt. The mandibular position of 1-3 mm of interocclusal distance measured phonetically referred to as ‘clinical rest position’ and physiologic rest position. The results of this study suggest that this position is not one of rest. In the upright position, some jaw muscles must be in slight contraction to maintain the clinical rest position.
6. **Williamson et al (1983)**[15] compared the effect of canine guidance and group function on the EMG activity of the masseter and anterior part of the temporal muscles. The electrodes to the temporal muscles were placed 1 inch posterior and 1 inch superior to the outer canthus of eye. For masseter muscles it was determined by palpation, and they were placed on the body of the muscle midway between origin and insertion, they concluded that, it was not the contact of the canines that decreases the activity of the elevator muscles, but the elimination of the posterior contacts.

7. **J. D. Rugh et al (1984)[16]** recorded nocturnal bruxism using EMG in the subjects in whom experimentally deflective occlusal contacts were placed. The results of the study and the studies of Kardachi et al. and Bailey and Rugh suggest that occlusal factors have little, if anything, to do with the levels of nocturnal bruxism. This conclusion is in sharp contrast to the common clinical assumption that nocturnal bruxism is caused by occlusal conditions and can be eliminated through occlusal adjustment.
8. **Ronald J. Shupe et al (1984)[17]** studied the effect of different occlusal guidance on jaw muscle activity. The occlusal schemes were developed in a single maxillary heat cured acrylic resin occlusal splint with minimal palatal coverage and a minimal increase in vertical dimension of occlusion. The effect of each guidance on integrated EMG activity of the masseter and temporal muscles is measured during clenching, guiding and chewing. Results suggest that canine protected guidance should be considered when restoration of occlusal guidance is required so that the forces generated to posterior teeth are reduced.
9. **J.W.C. Mac Donald et al (1984)[18]** described the relationships between EMG activity in the jaw-closing muscles and the location, area, and direct ion of effort applied to specific contact points, some of which were selected to simulate clinical conditions. They concluded that vertical clenching efforts in the natural or simulated inter cuspal position generally showed the highest muscle activities for all the muscles recorded. When the contact point moved posteriorly along the arch from incisors to molars, the activity in the ipsilateral temporal muscles was seen to increase, while the activity in the ipsilateral medial pterygoid and the masseter muscle. When the size and number of contacts were

increased anteriorly, a generalized increase in muscle activity was seen. The same trend occurred posteriorly.

10. **U.C. Belser et al (1985)[19]** measured the physiologic behavior when a naturally acquired group function was changed into canine guidance, and then into a hyper balanced occlusion. When a naturally acquired group function was temporarily and artificially changed into a dominant canine guidance, a significant general reduction of elevator muscle activity was observed when subjects exerted full isometric tooth-clenching efforts in a lateral mandibular position. The results suggest that canine protected occlusions do not significantly alter muscle activity during mastication but significantly reduce muscle activity during parafunctional clenching. They also suggest that non-working side contacts dramatically alter the distribution of muscle activity during parafunctional clenching, and this redistribution may affect the nature of react ion forces at the temporomandibular joints.
11. **Gunne HS, Bergman B, Enbom L, Högström J (1985)[20]** A study was evaluated to assess the masticatory efficiency in complete denture wearers with their old and new dentures. The test chewing material was gelatin hardened by formalin. A standardized preparation of the test chewing material and the sieve-system described. The patients tested on seven different occasions from the period with the old dentures until about 1.5 years after the insertion of the new denture. The test pieces were chewed for ten seconds--a practice test--20 seconds and until ready to be swallowed. The chewed material was strained in a sieve-system and masticatory efficiency indices were calculated. The results revealed no statistically significant differences in masticatory efficiency between any of the seven testing occasions with the method used. Thus, no significant difference was

noticed when patients changed from old to new dentures or during the first 18 months after insertion of new denture.

12. **William W. Wood (1987)**[21] said that there was a direct relationship between integrated electromyographic activity and tension in the muscle during isometric tasks. Surface electrodes are generally regarded as satisfactory for recording global activity of the muscle, but they also pick up some activity from surrounding muscles. Even so, surface electrodes have been shown to be effective for recording from both superficial and deep masseter muscles and superficial parts of both anterior and posterior temporal muscles. He reviewed the actions of the major muscles of mastication during clenching tasks in centric occlusion and eccentric jaw positions, mandibular opening and unilateral chewing.
13. **Arturo Manns et al (1989)**[22] conducted a study to determine the influence of variation in anterioposterior occlusal contacts on electromyographic activity. A full maxillary stabilization splint divided into three pairs of occlusal bilateral blocks was made. The EMG activity of masseter and temporal muscles was recorded with surface electrodes during maximum voluntary clenching in centric occlusion. The results of this study suggest that the use of blocks with nearly equivalent periodontal surface areas allows more accurate differentiation between the biomechanics and neurophysiologic factors.
14. **Shi CS et al (1991)**[23] compared the mastication between complete denture wearers and dentate subjects. A computer system was used for simultaneously calculating and processing the mandibular movements and myoelectric activities of masticatory muscle and it was found that myoelectrical potentials of mandibular elevator muscle of complete

denture wearers tend to increase at opening phase; however, the potentials decreases at the closing phase.

15. **Randall C. Duncan et al (1992)**[24] made a study to determine whether a decrease in intraoral sensory afferent discharge significantly altered the onset of the jaw-unloading reflex using EMG. They placed the bipolar surface electrode parallel to muscle fibres with inter electrode distance of 2 cm. Line connecting outer canthus of eye and the angle of mandible was used as guide in placing electrodes on masseter muscle, with most inferior electrode 1 cm from mandibular inferior border. Electrodes were placed on temporal muscle as close to hairline as possible. Ground electrode was placed at the ipsilateral side of the mastoid region.
16. **Ad P. Slagter et al (1992)**[25] investigated the relationship between the ability of patients with complete dentures to comminute a tough artificial test food, and their answers to questions about chewing experience. It has concluded that the subjective chewing experiences of complete denture wearers were related to ability to comminute test foods and degree of resorption of mandibular ridge was related to comminute test foods.
17. **Bakke M. (1993)**[26] analyzed the physiology and action of mandibular elevators, with emphasis on the temporalis and masseter muscles, and the effect of the dental occlusion on their function. He concluded that the pathogenesis, the type of muscular performance associated with the development of fatigue, discomfort, and pain in mandibular elevators seems to be influenced by the dental occlusion. The extent of occlusal contact clearly affects electric muscle activity, bite force, jaw movements, and masticatory efficiency. Occlusal stability keeps the muscles fit and enables the masticatory system to meet its functional demands.

18. **Slagter AP, Bosman F, Van Der Glas HW and Van Der Bilt (1993)[27]** A conducted a study on human jaw elevator muscle activity and food communition in dentate and edentulous state. They divided subjects into 2 groups – one group consist of 7 dentate subjects and other group consist of 6 complete denture wearers. The participants were asked to chew two artificial test foods with different textures. The dentate subjects comminuted both foods much better than the denture wearers. Peak amplitudes of activity during mastication and maximal voluntary clenching were more than twice as large in the dentate subjects as in the denture wearers. In both groups, the peak forces determined from electromyographic activity were larger than the estimated forces required for fragmenting the particles between the teeth.

19. **Lindauer SJ, Gay T, Rendell J (1993)[28]** concluded a study to evaluate the effect of jaw opening on masticatory muscle. In this study changes in vertical jaw opening affected the relative contributions of various masticatory muscles to bite force production. EMG activity was recorded simultaneously from the masseter, and anterior, middle, and posterior temporalis muscles, during controlled isometric biting at different force levels and vertical jaw openings. EMG force characteristics were compared between muscles and bite openings. The posterior temporalis muscle displayed significant increase in muscle activity with increased bite force production; the masseter muscle demonstrated the largest activity increments. They concluded that changes in masticatory muscle length resulting from vertical jaw opening cause alterations in muscle contractile properties, but the relative contributions of various masticatory muscles toward bite force production may also be affected by biomechanical factors and neural control adaptations.

20. **Grunert I, Kofler M, Gausch K and KronenbergM(1994)[29]** compared anterior and posterior occlusal concepts of masseter and temporalis surface electromyography in patients wearing complete denture – a pilot study, in 17 patients wearing complete dentures with anterior-canine guidance. Baseline electromyography was recorded with the dentures and compared to recordings obtained with two different splints adapted to the upper denture, providing anterior guidance leading to immediate disclusion of the posterior teeth during any jaw movement, the other providing posterior guidance buccally on the working side and lingually on the non-working side. Recordings were obtained during a sequence of different jaw movements: postural position, maximal tooth contact in intercuspal position, protrusive movement of the mandible and during lateral excursions, also carried out under tooth contact. Muscle activity was not significantly different as recorded with dentures only versus with the splints providing anterior guidance a significant increase in activity was observed with bilaterally balanced occlusion. They concluded that edentulous people are like those found in patients with natural teeth.

21. **Garrett NR, Kaurich M, Perez P and Kapur KK (1995)[30]** conducted a cross- sectional study, was done to record masseter muscle activity in denture denture wearers with superior and poor masticatory performance. 70 denture wearers were selected 35 with superior (SP) (mean 46.3%) and 35 with poor (PP) (mean 30.7%) masticatory performance. Right and left masseter muscle electromyographic (EMG) activity was recorded during the masticatory tests and peak bite force during chewing was estimated from the bite force-EMG ratios on guided maximal biting trials. The only significant differences ($p < 0.05$) were evident in the ratios of the preferred to non-preferred side

masseter EMG activity during chewing. The ratios were 1.2 for peanuts and 1.3 for carrots in the SP group compared to 1.8 for both foods in the PP group. They concluded that application of more equivalent force by the right and left masseter muscles during unilateral chewing is consistent with improved chewing ability in denture wearers.

22. **A.C. Akoren et al (1995)**[31] they conducted a study to investigate occlusal schemes (canine guidance and group function) in relation to masticatory muscle activity. It was performed on 30 subjects, 15 with canine guidance and 15 with group function. Bilateral electromyographic recordings of masseter and anterior temporal muscles were obtained by surface electrodes during gum chewing and sliding laterally from centric relation while the teeth were in contact. They concluded with the Observation of the gum chewing electromyograms disclosed a narrow chewing model with canine guidance and a wide chewing model with group function. In both occlusion groups, during lateral sliding, the anterior temporal muscle showed more activity than the masseter muscle. However, this activity was least in the case of canine guidance occlusion. They suggested that both occlusal schemes could be used for the treatment of subjects who have lost their natural occlusion but, in case of the healthy canine teeth with good support, canine guidance occlusion will be advantageous.
23. **G. L. Borromeo et al (1995)**[32] conducted a study using EMG to investigate the effects on masseter muscle function of interocclusal devices constructed to provide either balanced and unbalanced group function or canine guidance in normal subjects. They concluded that, no difference was found between the different subjects.
24. **Riad E. Youssef et al (1997)**[33] compared the habitual masticatory patterns in men and women using a custom computer program. Masticatory cycles of 20 normal men and 17

women were examined during mastication of a constant bolus at a sampling rate of 500 Fps. They observed that men had significantly shorter chewing cycles, with faster velocities than women and men used significantly greater chewing force than women, though their EMG activity levels were equivalent. The total duration of the chewing cycle and the amount of opening had the least error, and the amount of lateral excursion and jaw-muscle EMG magnitudes had the most.

25. **Irwin Becker et al (1999)[34]** measured the effect of a prefabricated anterior bite stop on the electromyographic activity of anterior temporalis, posterior temporalis, masseter and anterior diagnostic during clenching, and grinding. Prefabricated anterior bite stop was fabricated for 30 subjects. Electromyographic activity was measured during clenching and grinding both with and without the anterior bite stop. The bite stop had a significant effect in decreasing electromyographic activity for both clenching and grinding for temporal is and masseter muscles.
26. **K. Yugami, s. Yamashita, m. Ai & j. Takahashi (2000)[35]** a study was conducted to clarify the relationship between the mandibular position with tooth contacts and jaw-closing muscle activity during sleep using electromyography and newly devised equipment for detecting tooth contacts and confirm the validity of this system. Occurrences of tooth contacts at eccentric mandibular positions in addition to the intercuspal position during sleep system were detected using micro photo sensors and sensor targets prepared for the individuals. Electromyographic activities (EMG) from right and left masseter and anterior temporalis muscles were also recorded. Results of the polygraphic recordings demonstrated that the mandibular positions during bruxism could be distinguished clearly, whether it is in the right or left position, or has no lateral

deviation, and further, that bruxing events could be categorized based on mandibular position pattern.

27. **Iva AlajbegMelita, ValentiE-PeruzoviE and Ivan Alajbeg (2003)[36]** A study investigated through Electromyographic Evaluation of Masticatory Muscle Activity in Patients with Temporomandibular Dysfunction. Results of this investigation showed the presence of altered masticatory muscle activity in TMD patients and confirmed the use of electromyography in TMD diagnosis.

28. **A. L. Roark, a. G. Glaros & a. M. O'mahony (2003)[37]** study conducted to evaluate the flat plane interocclusal appliance affects the electromyographic (EMG) activity of the temporalis and masseter muscles in pain-free individuals. Maxillary splints were fabricated for individuals who reported no history, signs or symptoms of myofacial pain or arthralgia as deter-mined by two trained, independent examiners. Subjects were instructed to establish light tooth contact, maximum clenching, and moderate clenching with ⁄ without the splint in place (as determined by random assignment) while EMG data from the left and right temporalis and masseter muscles were recorded. The effectiveness of interocclusal appliances may be due to mechanisms other than redistribution of adverse loading.

29. **Tadasu Haketa et al (2003)[38]**: conducted a study to test the utility and validity of a newly developed EMG-based bruxism recording system. This system allowed high-resolution digital recordings of the masseter EMG in the patient's home environment and, systematic discrimination of artifact signals with the aid of semiautomated software. Simulated bruxism and non-bruxism signals were recorded in two subjects. Two independent scorers were shown these signals and asked to differentiate bruxism from

non-bruxism signals. And it was concluded that the EMG-based bruxism recording system has high utility and reasonable accuracy and precision.

30. **F. Ferrario, g. M. Tartaglia, a. Galletta, g. P. Grassi (2006)**[39] Study conducted to examine the electromyographic (EMG) characteristics of masseter, temporalis, and sternocleidomastoid (SCM) muscles during maximum voluntary teeth clench. In conclusion, the presence of a complete or partial Angle occlusal Class I did not seem to influence the standardized contractile activities of masseter, temporalis and SCM muscles during a maximum voluntary clench. Subjects with a complete Angle Class I were somewhat a more homogenous group than subjects with partial Angle Class I.

31. **Alajbeg Z, Peruzovic MV, Cifrek AM (2006)**[40] conducted a study to determine the influence of age and dental status on elevator and depressor muscle activity. 30 edentulous subjects were included, Surface Electromyographic (EMG) recordings were obtained from the anterior temporal, masseter and depressor muscles. Muscle activity was recorded during maximal voluntary contraction (MVC), maximal opening (Omax) and in six different mandibular positions. One way ANOVA and the Bonferroni tests were used to determine the differences between groups. Significant differences between the three tested groups were found at MVC and Omax for all examined muscles (P < 0Æ001). The differences in muscle activity in dentate subjects of different age were found in protrusion for depressor muscles (P < 0Æ05) and in lateral excursive positions for the working side temporal (P < 0Æ05) and non-working side masseter and depressor muscle (P < 0Æ05). There was a significant effect regarding the presence of natural teeth or complete dentures in protrusion and maximal protrusion for all muscles (P < 0Æ05) and in lateral excursive positions for non-working side temporal (P < 0Æ05) and working

side masseter muscle (P < 0Æ05). They concluded that the pattern of relative muscle activity was not changed because of ageing.

32. **N. Okano et al (2007)[41]** investigated the influence of experimentally altered occlusal guidance on masticatory muscle activity. Electromyography activities in the bilateral masseter, anterior and posterior temporal were recorded during maximal clenching. They concluded that EMG activity in the anterior temporalis significantly increased in the simulated group function occlusion and the simulated bilateral balanced occlusion compared with the simulated cuspid protected occlusion. The increased teeth contacts to the posterior region altered the unilateral pattern of the anterior temporal is activity to the bilateral pattern, while that of masseter activity remained unchanged. They suggest that group function occlusion and balancing contact may allow a large parafunctional activity. They also indicate that canine protected occlusion may reduce the parafunctional activity, at least in a controlled experiment.
33. **Henrique Casselli, Alexandre Brait Landulpho (2007)[42]** Study investigated, through computerized electrognathographic evaluations the mandibular movement pattern of patients rehabilitated with complete dentures presenting no symptoms of stomatognathic functional alterations. The patients were instructed to wear an intra-oral appliance for occlusal plane coverage over their usual superior denture and were then rehabilitated with new dentures preserving a free -way space of 3 mm. After sixty days, the occlusal vertical dimension was increased, and the modified inferior dentures were used for another 60 days. It was concluded that the presence of a free-way space at the end of the treatment confirms the importance of its existence for maintaining the balance of the masticatory system, assuming the occurrence of a postural repositioning.

34. **Yu-Ying Chen et al (2008)[43]** this study showed that the healthy anterior teeth and/or natural canines are present, the occlusion allows the teeth to distribute horizontal forces in excursions, while the posterior teeth disocclude any excursion. Anterior bite force measurements and electromyographic studies also showed that the stomatognathic system elicits significantly less force when the posterior segments are not in contact in the lateral mandibular excursion. According to Weinberg and Kruger with every 10° change in the angle of disclusion, there is a 30% difference in load. They suggested that the anterior guidance of implant - supported prostheses should be as shallow as possible to avoid greater forces on the anterior implants by steeper incisal guiding angles.
35. **Felix GB, Filho HN, Padovani CR, Junior AST, Machado WM (2008)[44]** conducted a study to evaluate the mastication and swallowing in elderly individuals with mandibular fixed implant supported prosthesis by the help of electromyograph. They performed the study on 15 patients with age more than 60 yrs. Electromyography was done of masseter, superior orbicularis oris and the submental muscles before surgery and 3, 6 and 18 months postoperatively using foods of different texture. Results were recorded at the different periods statistically by Kruskal-Wallisnon-parametric test. Statistical analysis showed that only the masseter muscle had a significant loss in electromyographic activity ($p<0.001$), with a tendency of similar response for the submental muscles, there was an increase in the activity of the orbicularis oris muscle during rubber chewing after treatment. Mandibular fixed implant-supported prostheses in elderly individuals revealed a decrease in electromyographic amplitude for the masseter muscles during swallowing, which can indicate adaptation to new conditions of stability provided by fixation of the complete denture in the mandibular arch.

36. **Maria Jose Campillo et al (2008)[45]** conducted a study to determine the effect of the occlusal scheme on masseter EMG activity at different jaw posture tasks. They included 30 healthy subjects with natural dentition and bilateral molar support, 15 with bilateral canine guidance, and 15 with bilateral group function. They concluded that, experimentally gained data about EMG pattern of masseter muscles during the jaw posture tasks studied promote a better understanding of the control strategies of the motor system. They suggested that canine guidance and group function have a similar effect on masseter muscles to avoid excessive muscular activity during laterotrusive occlusal excursion.
37. **Francesca Trovato, Bruno Orlando, Mario Bosco (2009)[46]** study conducted review of electromyographic studies, in order to assess the relationship between various occlusal features and masticatory muscles activity. The results obtained seem to suggest that occlusal features can affect the electrical signals recordings of masticatory muscles.
38. **Meiqing wang1, Jianjun He1, Kelun Wang & Peter Svensson (2009)[47]** Study examined to test whether changes in occlusal support differentially modulate masseter and anterior temporalis muscle electromyographic (EMG) activity during controlled maximal voluntary clenching. EMG activity decreased in both muscles when occlusal support was moved from the molar to the premolar region. When occlusal support was moved from bilateral to unilateral contacts, EMG activity in the balancing-side anterior temporalis muscle and in bilateral masseter muscles decreased. Unilateral clenching on the molars, but not on the premolars, was associated with lower EMG activity in the balancing-side masseter and always associated with lower EMG activity in the balancing-side anterior temporalis compared to the working side. Masseter and anterior temporalis

muscles respond differently to changes in occlusal support, which may have implications for stability of the mandible during intense clenching.

39. **Marcelo Coelho Goiato et al (2010)**[48] assessed masticatory efficiency and duration of the masticatory cycle in patients with complete denture wearer for 10 years. A sieved system used to assess the masticatory efficiency with artificial foods. The recording made before 5 months and, after 1-year, new dentures insertion. It found that an improvement in masticatory efficiency and reduction in mastication time observed with new dentures after 1 year.

40. **Ignacio Ardizone, Alicia Celemin Fernando Aneiros(2010)**[49] A comparison was made between the electromyographic patterns specific to patient with temporomandibular disorders and that of normal healthy patients. The results showed significant differences among patients with a different degree of clinical dysfunction. These differences were more important during maximum effort clenching and mastication.

41. **A. Van der bilt, j. Mojet, f. A. Tekamp& j. H. Abbink (2010)**[50] A study was conducted to compare comminution of an artificial test food and mixing of a two-coloured chewing gum. The degree of mixing of the colours of the chewing gum was quantified with an optical method. However, the comminution test was better in discriminating the masticatory performance of the two groups. The mixing ability test with the two coloured chewing gum proofed to be a good method to determine masticatory function in subjects with a compromised masticatory performance (elderly subjects). However, the method appeared to be less suitable for subjects with a good masticatory performance (young subjects).

42. **Ashraf H(2011)[5]** conducted a study to evaluate the elevator and depressor muscle activity with and without complete denture prosthesis.15 patients were selected between age group of 40-70 years, Surface electrodes from the electromyographic unit were placed in the region of right and left anterior temporal muscles, Masseter muscle and depressor muscle at the region of anterior belly of digastric and the electromyographic activity were recorded . They concluded that the elevator muscles showed higher activity in subjects wearing the denture prosthesis when compared to those without denture prosthesis and no significant changes were found in muscle activity seen on maximal opening of the depressor muscle between the subjects with and without denture prosthesis.
43. **Venus Sidana et al (2012)[51]** this review of the literature reveals that, Group function is most often encountered in elderly. With this type of occlusion, it is possible to achieve harmonious balance of all involved structures including muscles, temporomandibular joint, teeth and their occlusal anatomy. Furthermore, a patient with parafunctional bruxing habit might welcome the lateral excursive freedom of group function. Consideration of a patient's chewing pattern, craniofacial morphology, static occlusion type current oral health status parafunctional habits might provide the important and relevant information about the suitable functional occlusion type for each patient.
44. **Neeta Pasricha et al (2012)[52]** this review of the literature reveals that, In order for canine-protected occlusion to function, the anterior teeth must be healthy. The patient's existing occlusal scheme should not be altered unless such alterations are required to correct a non-physiological dentition. If the restoration must reestablish lateral guidance canine- protected occlusion is preferred when remaining canines are present and not

periodontally compromised. Canine guidance reduces horizontal forces on posterior teeth and promotes a more vertical chewing cycle.

45. **Oliveira NM, Shaddox LM, Toda C, Paleari AG, Pero AC, Compagnoni MA (2014)[53]** conducted a study to evaluate the methods of masticatory efficiency in conventional complete denture wearers: A Systemic Review. A survey was conducted in the databases PubMed, Scopus, and Cochrane, seeking scientific articles according to the previously selected terms: "Masticatory performance", "Masticatory efficiency" and "Chewing ability complete denture". complementary studies were also carried out with library manual search/databases, which included studies related to different ways to assess masticatory efficiency, specifically as it related to conventional complete denture wearers,43 papers were selected and the sieves method was considered the gold standard method to evaluation of conventional complete denture wearers masticatory efficiency, since it is the simplest, does not depend on specific devices (beyond the set of sieves), allows for a rational assessment, and it has been widely reproduced in various types of oral rehabilitation.

The study was conducted in the Department of Prosthodontics, Babu Banarasi Das College of Dental Science, Lucknow and Neuro Care Centre, Lucknow, to evaluate muscles of mastication of masseter and temporalis in geriatric patients with and without complete denture prosthesis.

MATERIALS:

A. Materials used for fabrication of Complete Denture:

1) Edentulous stock impression trays* (Fig. 1)
2) Impression compound (medium fusing)# (Fig.1)
3) Autopolymerizing Denture Base Resin$ (Fig.1)
4) Low fusing dental compound% (Fig.1)
5) Zinc oxide eugenol impression paste^ (Fig.1)
6) Glass slab (Fig.1)
7) Stiff bladed steel spatula¥ (Fig.1)
8) Flexible rubber bowl£ (Fig.1)
9) Stiff bladed spatula (Fig.1)
10) Dental stone (Type III) ® (Fig.1)

* M.A. Dental, Chowk Lucknow, India

\# Rolex™ Impression Compound, Ashoo Sons, Wazipur, Delhi, India

$ PYRAX rapid repair, Roorkee, India

% DPI Pinacle Tracing Sticks, The Bombay Burmah Trading Corporation Ltd.

^ DPI Impression Paste, The Bombay Burmah Trading Corporation Ltd.

¥ Essago SBC, Germany

£ Diamond, India

11) Dental plaster (Type II)∞ (Fig.1)

12) Modelling wax± (Fig.1)

13) Hanau Articulatorµ (Fig.1)

14) Ivoclar Acrylic denture teethß (Fig.1)

15) Hanau flask with clampΣ (Fig.1)

16) Heat cured PMMA÷ (Fig.1)

17) Polymerization unitα (Fig.1)

18) Micromotor and straight hand piece™ (Fig.1)

19) Cold Mould Sealω (Fig.1)

20) Bardparker blade and handle° (Fig.1)

® Kalstone, Kalabhai Karson Pvt. Ltd, Mumbai

∞ Plaster of Paris Neelkanth Dentico Riico Industrial Area, Jodhpur, India

± Trulon Modelling Wax, Jayna Industries, Ghaziabad, India

µ M.A Dental, Chowk, Lucknow, India

ß Premident, Premi and Sons J.P., Lucknow

Σ M.A Dental, Chowk, Lucknow, India

÷ Trevalon Denture Base Material, Dentsply India Pvt. Ltd, India

α Unident Acrylizer, India

™ Marathon, Saeyang, Korea

ω Pyrax cold mould seal separating liquid, Roorki, India

° Paramount, India

Electromyographic Equipment:

EMG activity will be recorded on a four-channel instrument (Neuromatrix EMG system, U.S.A) (Fig. 2). EMG analog signal will amplify with an input of 0 to 1000 μV with the analysis time of 10 ms/div and digitally filter at the range of 200 Hz to 2 Kz to remove the high frequency signal above 2 Kz. The instrument was directly interfaced with a computer which presented the data graphically and recorded them on them on magnetic media for further quantitative and qualitative analysis.

METHODOLOGY:

The study was divided in two phases. The first phase included fabrication of complete denture. Second phase includes, electromyographic study of the major muscles of mastication, temporalis and masseter with and without complete denture prosthesis.

PHASE I

PATIENT SELECTION-

A total of 20 edentulous subjects of both sexes, between the age group of 65 to 80 years having no evident signs and symptoms or history of stomatognathic system and neuro muscular disorders were selected. Patients on medications that can alter the normal muscle activity were also excluded.

DENTURE FABRICATION-

Denture (Fig.10) was constructed for the subjects in Department of Prosthodontics, Babu Banarasi Das College of Dental Sciences, Lucknow. The process consists of making preliminary impressions, making definitive impressions in zinc oxide eugenol (SS White Manufacturing Ltd, Gloucester, UK). The maxillomandibular relationship with a central bearing tracing device and a face-bow transfer (Fig.8) will be done and mounted on a Hanau semi-adjustable articulator (Fig.9). The denture was processed by conventional compression molding technique and remounting to be done for occlusion adjustments.

A thorough clinical examination of the denture for proper extension, adequate retention and stability, and occlusion in maximum intercuspation was done. EMG recordings were made when patient became comfortable with denture approximately after one month.

PHASE II-

ELECTROMYOGRAPHIC

EMG Measurement protocol:

- **a)** EMG Equipment
- **b)** Placement of surface electrode
- **c)** EMG recording

a) EMG Equipment:

EMG activity was recorded on a four-channel instrument (Neuromatrix EMG system, U.S.A) (Fig.2). The EMG analog signal was amplified with a input of 0 to 1000 µV with the analysis time of 10 ms/div and digitally filtered at the range of 200 Hz to 2 Kz to remove the high frequency signal above 2 Kz. The instrument was directly interfaced with a computer which presented the data graphically and recorded them on magnetic media for further quantitative and qualitative analysis.

b) Placement of Surface Electrode-

Surface EMG recordings (Fig.11) were obtained from right and left anterior temporal muscles, the right and left masseter muscles. The electrodes were fixed with double- sided adhesive tapes. A plate ground electrode was secured to the forehead.

Temporalis Muscle-

Bipolar surface electrodes were placed over the right and left temporalis muscle 1 inch posterior and 1 inch superior to the outer canthus of the eye.

Masseter Muscle-

Electrodes over the right and left Masseter Muscle were placed 2 cm above the lower margin of the mandible, halfway between the mandibular angle and anterior border of the muscle.

To reduce electrode impedance, the skin was cleaned with 99.5% alcohol swabs and a skin preparation gel. The recordings will be performed 5-6 minutes later, after allowing the conductive paste to adequately moisten the skin surface.

During testing, silver/ silver chloride bipolar electrodes with a diameter of 10mm interelectrode distance of 5cm were used while a ground electrode was attached to the forehead.

c) EMG Recording

With complete denture prosthesis:

EMG activity (Fig.12) was recorded at maximum intercuspation in subjects with complete denture prosthesis.

Without complete denture prosthesis:

Edentulous subjects were asked to clench with their edentulous ridges in contact and maximal activity of the elevator muscle was established.

The subjects clenched manually for 5 seconds and rested for 15 seconds and repeated the clenching cycle for five times. Each recording was analyzed for peak amplitude and duration of the longest well-formed wave was subjected to statistical analysis.

Fig. 1: Miscellaneous Material

Fig. 2: EMG Equipment

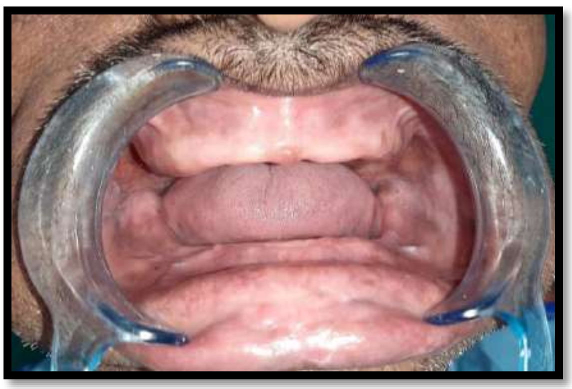


Fig. 3: Extra Oral View

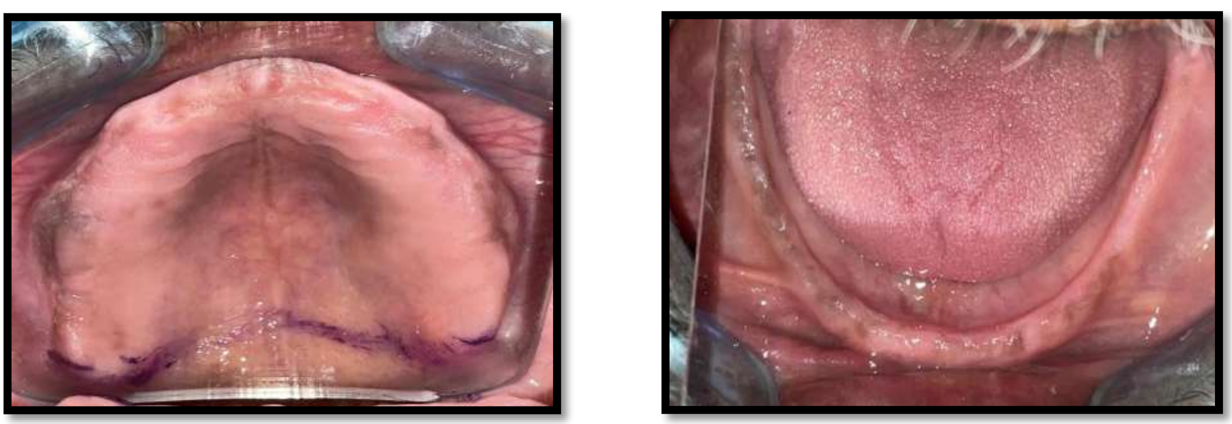


Fig 4: Intra Oral View

Fig 5: Primary Cast

Fig 6: Final Impression

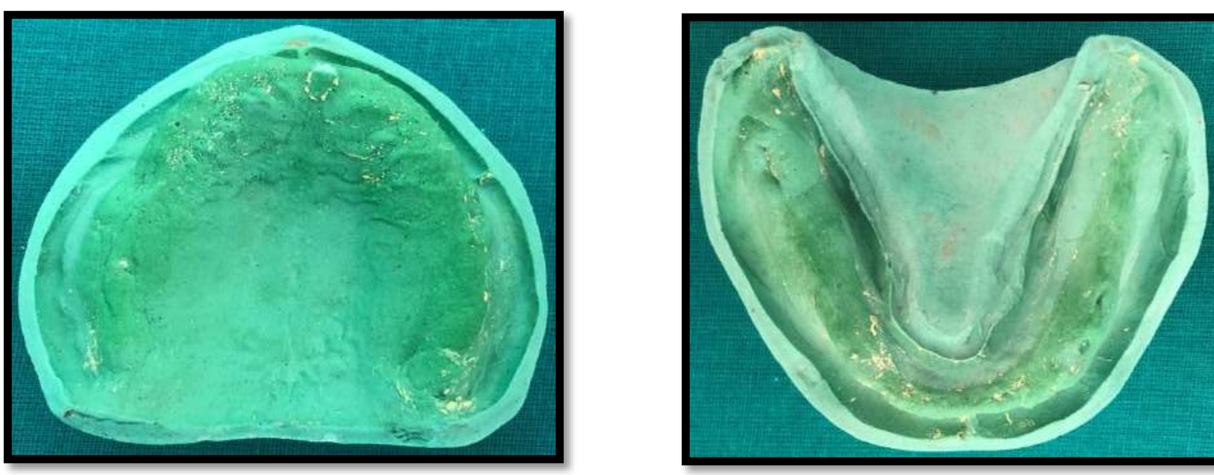


Fig 7: Final Cast

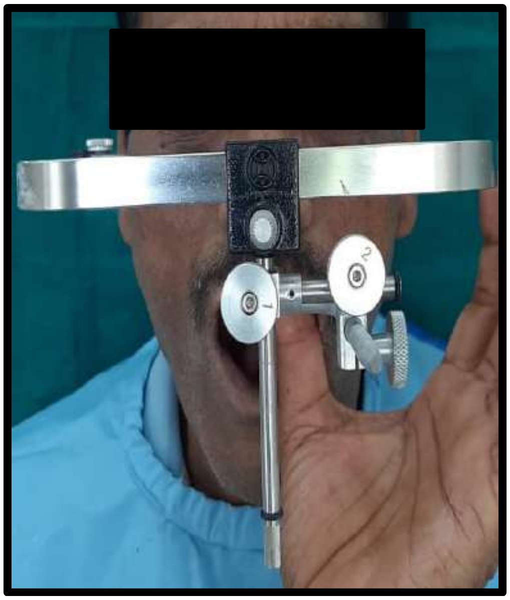


Fig 8: Facebow Transfer

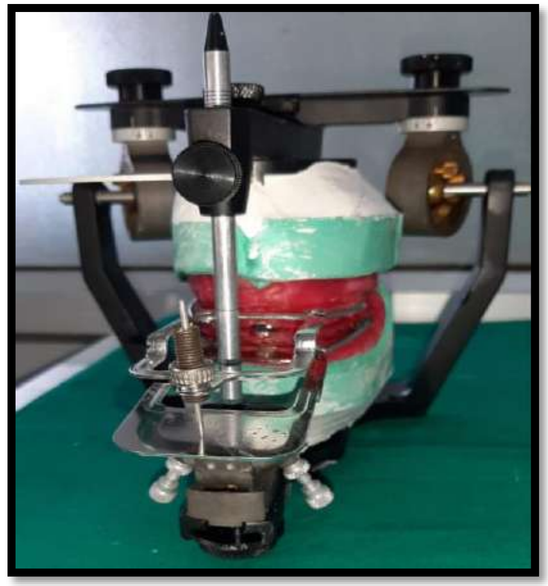
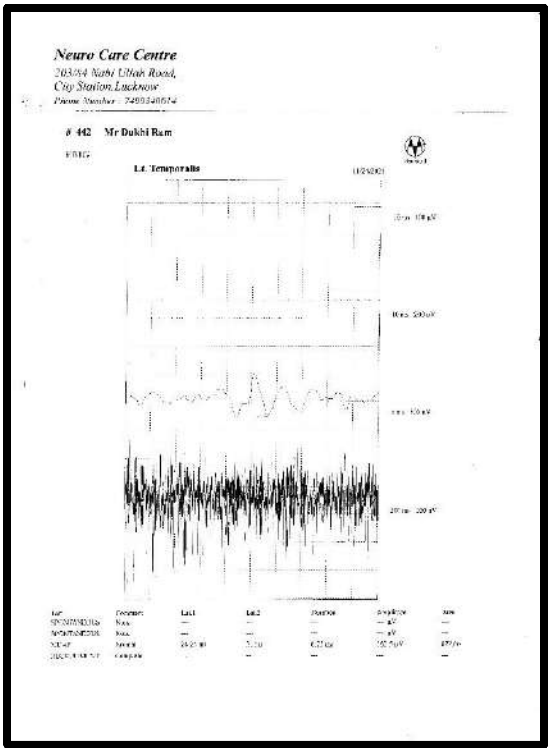
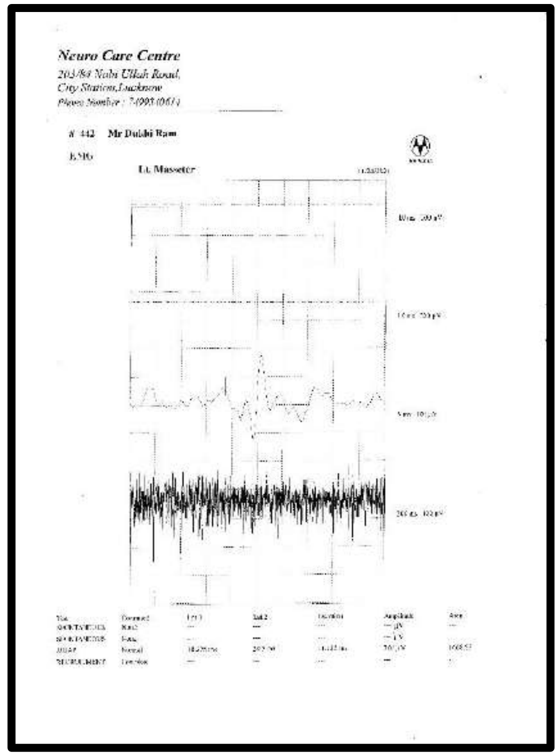


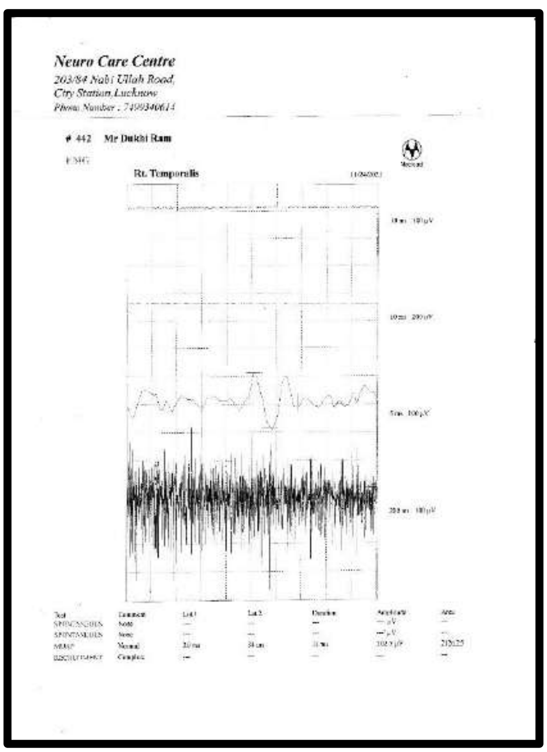
Fig 9: Maxillo Mandibular Relationship

Fig 10: Final Prosthesis

Fig 11: Electromyography Procedure







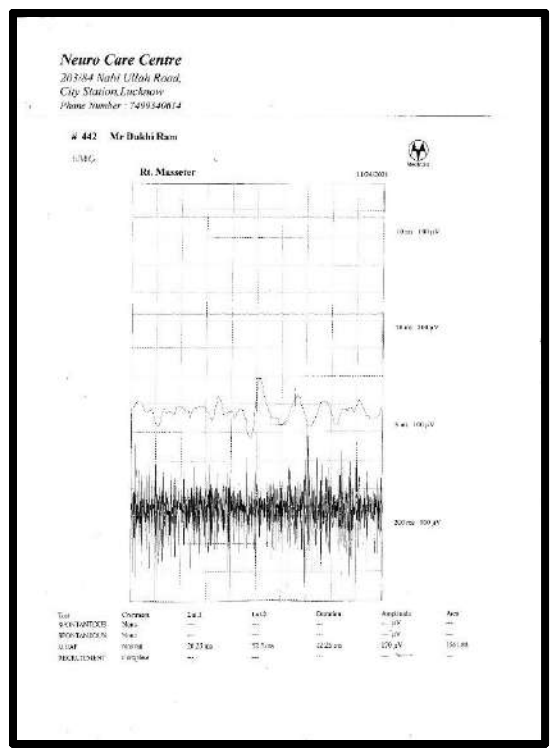


Fig 12: Electromyographic Readings

Statistical analysis: Data was analyzed using Statistical Package for Social Sciences (SPSS) version 21, IBM Inc. Descriptive data will be reported for each variable. Descriptive statistics such as mean and standard deviation for continuous variables and frequency along with percentages of categorical variables were calculated.

Summarized data was presented using Tables and Graphs. Shapiro Wilk test was used to check which all variables were following normal distribution. As Data was found to be normally distributed (p-value was more than 0.05) bivariate analyses was performed using Independent t test for inferential statistics. Level of statistical significance will be set at p-value less than 0.05.

Results and observations:

The present *in vivo* electromyographic study evaluates and compares the activity of masseter and temporalis muscle activity in geriatric patients with and without complete denture prosthesis. Total 20 completely edentulous patients desiring replacement of missing teeth by conventional acrylic maxillary and mandibular complete dentures, age between 65-80 years, both sexes (1 to 10 male and 11 to 20 female) were recruited. The age and sex matched patients were randomized equally into two groups and assess with complete denture (Group I) or without complete denture (Group II). The outcome measures of the study were left, and right masseter and temporalis muscle activity assessed by electromyography (EMG) machine and measured in µV. The objective of the study was to compare the outcome measures (left and right masseter and temporalis muscle activity between the two groups (Group I and Group II).

Outcome measures

1. **Temporalis muscle activity- Right side**

The observed temporalis muscle activity (μV) of two groups (Group I and Group II). Group I- with denture / Group II- without denture; (S.NO. 1-10 male patients/ 11-20 female patients) at right side is presented.

Table 1. Observed temporalis muscle activity (μV) of two groups at right side

S.NO.	Temporalis muscle activity (μV)- Right side	
	Group I	Group II
1.	260.0	125.0
2.	265.0	127.5
3.	202.5	180.0
4.	195.0	177.5
5.	167.5	140.0
6.	380.0	357.5
7.	142.5	120.0
8.	180.0	147.5
9.	172.5	160.0
10.	190.0	180.0
11.	300.0	215.0
12.	277.5	237.5
13.	205.0	162.5
14.	267.5	172.5
15.	177.5	175.0
16.	172.5	125.0
17.	145.0	142.5
18.	170.0	140.0
19.	177.5	157.5
20.	177.5	165.0

2. Temporalis muscle activity- Left side

The observed temporalis muscle activity (µV) of two groups (Group I and Group II).

Group I- with denture / Group II- without denture; (1-10 male patients/ 11-20 female patients) at left side is presented.

Table 2. Observed temporalis muscle activity (µV) of two groups at Left side

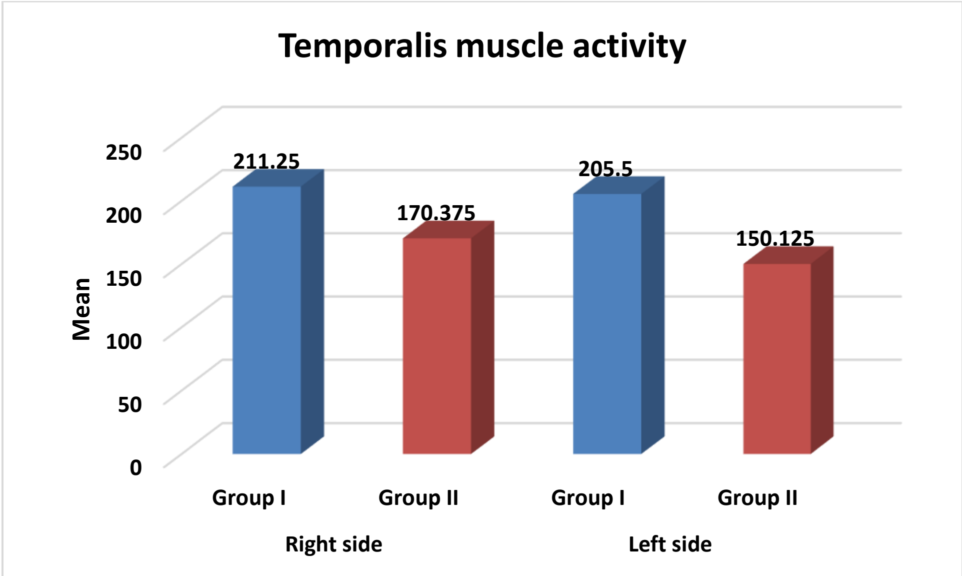
S.NO.	Temporalis muscle activity (µV)- Left side	
	Group I	Group II
1.	197.5	132.5
2.	365.0	82.5
3.	162.5	152.5
4.	207.5	87.5
5.	190.0	180.0
6.	397.5	232.5
7.	177.5	150.0
8.	152.5	137.5
9.	172.5	167.5
10.	160.0	112.5
11.	285.0	215.0
12.	210.0	192.5
13.	180.0	175.0
14.	295.0	125.0
15.	175.0	167.5
16.	177.5	170.0
17.	140.0	122.5
18.	132.5	112.5
19.	165.0	140.0
20.	167.5	147.5

Table 3: Intergroup comparison of muscle activity of temporalis on right and left side

Temporalis	group	N	Mean	Std. Deviation	Std. Error Mean	P value
Right side	Group I	20	211.250	60.7546	13.5851	0.029
	Group II	20	170.375	53.2019	11.8963	
Left side	Group I	20	205.500	72.7767	16.2734	0.005
	Group II	20	150.125	38.8017	8.6763	

On right side, muscle activity of temporalis muscle was found to be 211±60.75 among Group I subjects and 170.37±53.20 among Group II subjects. On left side, muscle activity of temporalis muscle was found to be 205.50±72.77 among Group I subjects and 150.12±38.80 among Group II subjects. On electromyography, muscle activity of temporalis muscle was found to be significantly more among Group I subjects as compared to Group II subjects on both left and right side when compared using Independent t test as $p<0.05$.

Graph 1: Intergroup comparison of muscle activity of temporalis on right and left side



3. Masseter muscle activity- Right side

The observed masseter muscle activity (μV) of two groups (Group I and Group II).

Group I- with denture / Group II- without denture; (1-10 male patients/ 11-20 female patients) at right side is presented.

Table 4. Observed masseter muscle activity (μV) of two groups at right side

S.NO.	Masseter muscle activity (μV)- Right side	
	Group I	Group II
1.	477.5	207.5
2.	492.5	450.0
3.	220.0	170.0
4.	162.5	140.0
5.	205.0	197.5
6.	367.5	285.0
7.	130.0	115.0
8.	215.0	202.5
9.	180.0	175.0
10.	135.0	127.5
11.	210.0	130.0
12.	242.5	230.0
13.	177.5	165.0
14.	235.0	232.5
15.	142.5	135.0
16.	162.5	135.0
17.	157.5	125.0
18.	195.0	142.5
19.	140.0	135.0
20.	190.0	172.5

4. Masseter muscle activity- Left side

The observed masseter muscle activity (µV) of two groups (Group I and Group II).

Group I- with denture / Group II- without denture; (1-10 male patients/ 11-20 female patients) at right left is presented.

Table 5. Observed masseter muscle activity (µV) of two groups at left side

S.NO.	Masseter muscle activity (µV)- Left side	
	Group I	Group II
1.	152.5	127.5
2.	470.0	402.5
3.	200.0	167.5
4.	205.0	135.0
5.	260.0	190.0
6.	362.5	347.5
7.	132.5	125.0
8.	217.5	197.5
9.	170.0	162.5
10.	147.5	132.5
11.	260.0	227.5
12.	490.0	265.0
13.	180.0	175.0
14.	190.0	160.0
15.	162.5	140.0
16.	165.0	162.5
17.	187.5	180.0
18.	170.0	155.0
19.	165.0	160.0
20.	160.0	145.0

Table 6: Intergroup comparison of muscle activity of masseter on right and left side

Masseter	group	N	Mean	Std. Deviation	Std. Error Mean	P value
Right side	Group I	20	221.875	104.2545	23.3120	0.195
	Group II	20	183.625	76.9419	17.2047	
Left side	Group I	20	222.375	102.1881	22.8500	0.227
	Group II	20	187.875	73.0234	16.3285	

On right side, muscle activity of masseter muscle was found to be 221.87±104.25 among Group I subjects and 183.62±76.94 among Group II subjects. On left side, muscle activity of masseter muscle was found to be 222.375±102.18 among Group I subjects and 187.87±73.02 among Group II subjects. On electromyography, muscle activity of masseter muscle did not differ significantly among Group I and Group II subjects on both left and right side when compared using Independent t test as $p>0.05$.

Graph 2: Intergroup comparison of muscle activity of masseter on right and left side

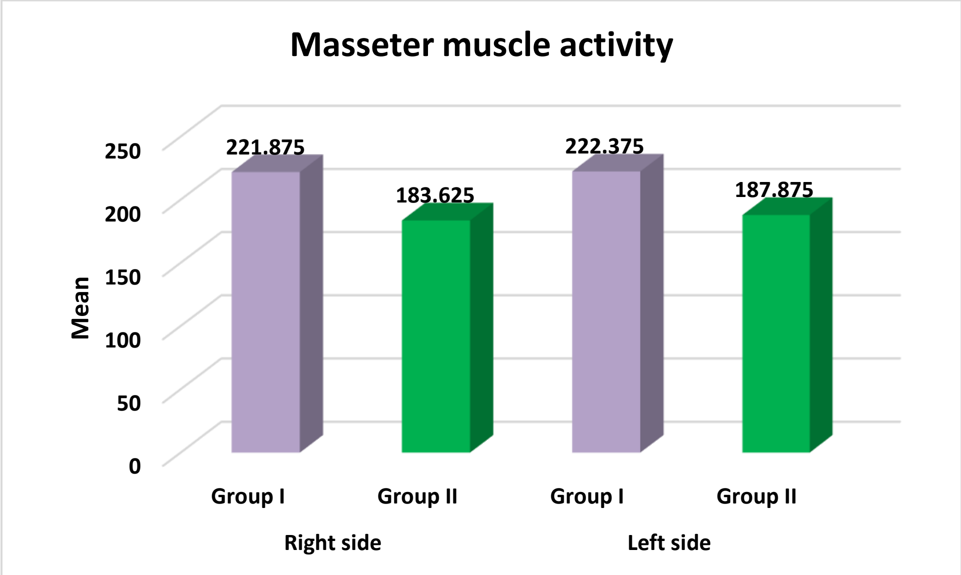


Table 7: Intragroup comparison of muscle activity of temporalis on right and left side among males and females in Group I subjects

Temporalis	Group I	N	Mean	Std. Deviation	Std. Error Mean	P value
Right side	male	10	215.500	69.5002	21.9779	0.764
	female	10	207.000	54.0550	17.0937	
Left side	male	10	218.250	87.9319	27.8065	0.448
	female	10	192.750	55.5709	17.5731	

Among Group I subjects on right side, muscle activity of temporalis muscle was found to be 215.5±69.50 among males and 207±54.05 among females. On left side, muscle activity of temporalis muscle was found to be 218.25±87.93 among males and 192.75±55.57 among female subjects. Among Group I subjects, no statistically significant difference was seen in the muscle activity of temporalis muscle among male and female subjects on both left and right side as $p>0.05$ when compared using independent t test.

Graph 3: Intragroup comparison of muscle activity of temporalis on right and left side among males and females in Group I subjects

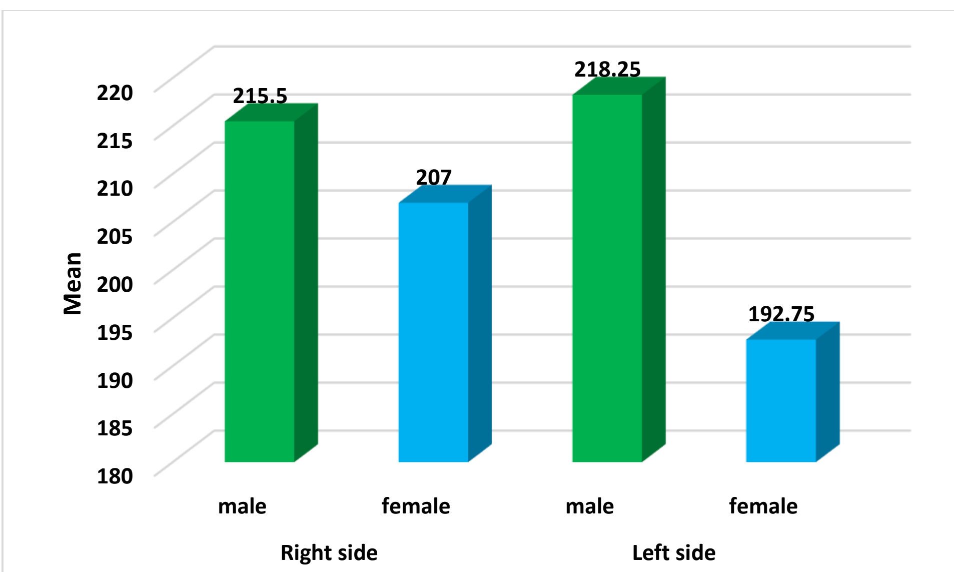


Table 8: Intragroup comparison of muscle activity of temporalis on right and left side among males and females in Group II subjects

Temporalis	Group II	N	Mean	Std. Deviation	Std. Error Mean	P value
Right side	male	10	171.500	69.3041	21.9159	0.928
	female	10	169.250	34.1982	10.8144	
Left side	male	10	143.500	44.6312	14.1136	0.460
	female	10	156.750	32.9994	10.4353	

Among Group II subjects, on right side, muscle activity of temporalis muscle was found to be 171.50±69.30 among males and 169.25±34.19 among females. On left side, muscle activity of temporalis muscle was found to be 143.5±44.63 among males and 156.75±32.99 among female subjects. Among Group II subjects, no statistically significant difference was seen in the muscle activity of temporalis muscle among male and female subjects on both left and right side as $p>0.05$ when compared using independent t test.

Graph 4: Intragroup comparison of muscle activity of temporalis on right and left side among males and females in Group II subjects

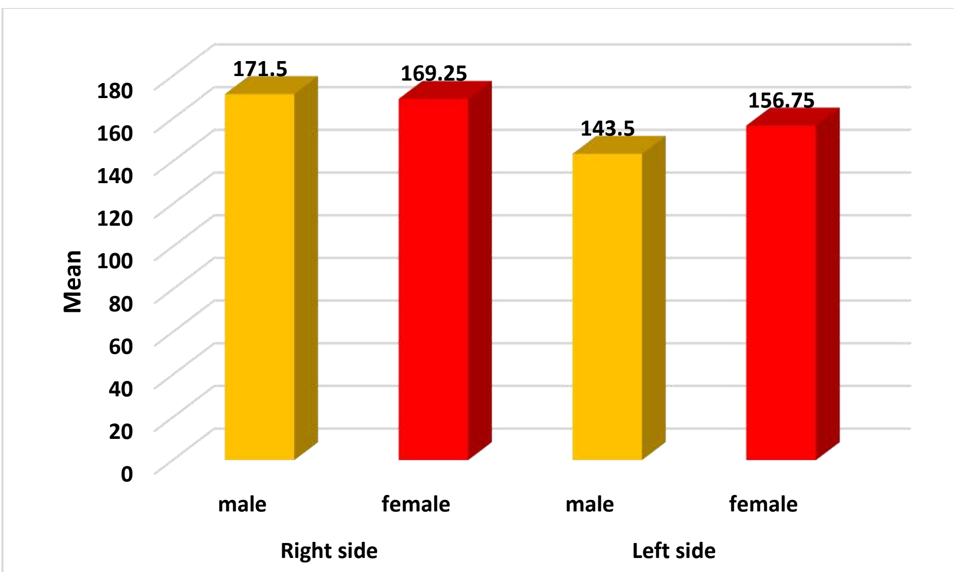


Table 9: Intragroup comparison of muscle activity of masseter on right and left side among males and females in Group I subjects

Masseter	Group I	N	Mean	Std. Deviation	Std. Error Mean	P value
Right side	male	10	258.500	136.6169	43.2020	0.118
	female	10	185.250	36.0642	11.4045	
Left side	male	10	231.750	107.3031	33.9322	0.693
	female	10	213.000	101.6653	32.1494	

Among Group I subjects, on right side, muscle activity of masseter muscle was found to be 258.500±136.61 among males and 185.25±36.06 among females. On left side, muscle activity of masseter muscle was found to be 231.75±107.30 among males and 213±101.66 among female subjects. Among Group I subjects, no statistically significant difference was seen in the muscle activity of masseter muscle among male and female subjects on both left and right side as $p>0.05$ when compared using independent t test.

Graph 5: Intragroup comparison of muscle activity of masseter on right and left side among males and females in Group I subjects

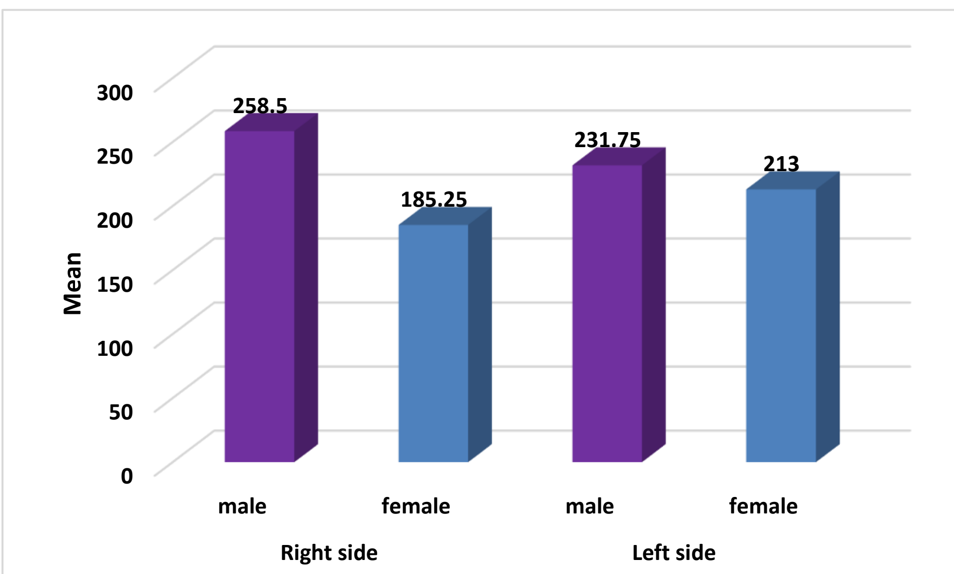
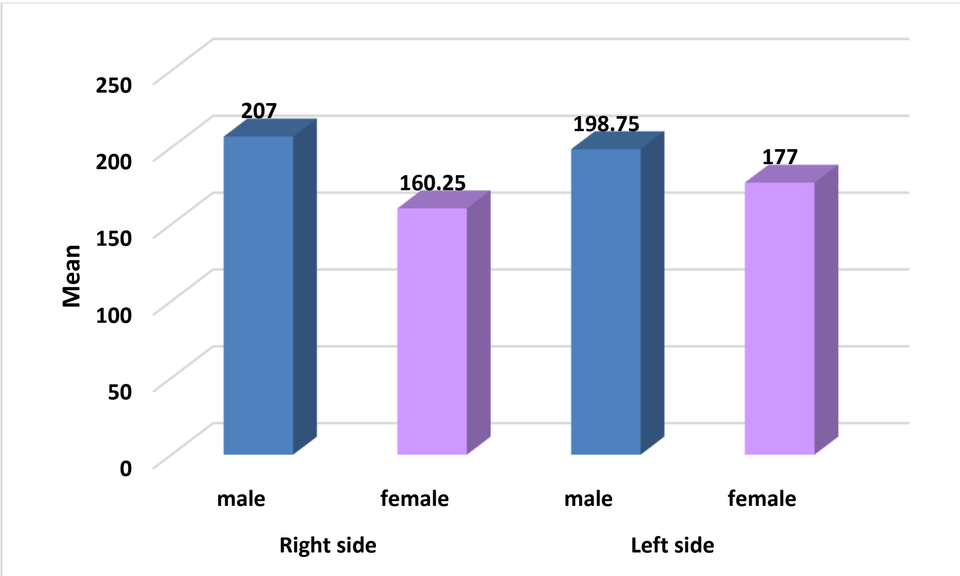


Table 10: Intragroup comparison of muscle activity of masseter on right and left side among males and females in Group II subjects

Masseter	Group II	N	Mean	Std. Deviation	Std. Error Mean	P value
Right side	male	10	207.000	98.2683	31.0752	0.181
	female	10	160.250	40.3363	12.7554	
Left side	male	10	198.750	97.1700	30.7279	0.520
	female	10	177.000	39.4018	12.4599	

Among Group II subjects, on right side, muscle activity of masseter muscle was found to be 207±98.26 among males and 160.25±40.33 among females. On left side, muscle activity of masseter muscle was found to be 198.75±97.17 among males and 177±39.40 among female subjects. Among Group II subjects, no statistically significant difference was seen in the muscle activity of temporalis muscle among male and female subjects on both left and right side as p>0.05 when compared using independent t test.

Graph 6: Intragroup comparison of muscle activity of masseter on right and left side among males and females in Group II subjects



The masticatory system is the functional unit composed of the teeth, their supporting structures, the jaws, the temporomandibular joints, the associated muscles, and vascular and nervous systems for these tissues. Mastication is a highly coordinated neuromuscular function involving fast effective movements of the jaw and continuous modulation of force[54].

The aging process causes physiological changes that affect the whole organism. Specifically in relation to the stomatognathic system, in addition to tooth loss, there is reduced masticatory force, alveolar bone decomposition, changes in oral mucosa, and reduction in the number of functional motor units, leading to decreased muscular activity[44].

When teeth are lost, a change occurs in the mandibular posture, the speech pattern, esthetics, and deglutition as well as in the individual’s social, emotional and psychological behavior. Along with this, some age-related changes, such as deterioration in the fast and slow-twitch fibers of the striated muscles, results in impaired muscle force[55]. Edentulous persons have reduced capacity to perform various functions of the stomatognathic system such as occlusal forces, tactile thresholds and chewing ability[5]. The loss of teeth and elimination of periodontal afferent innervations flow lead to changes in the neuromuscular patterns causing the reduced chewing efficiency when new complete denture replaces teeth. Other factors can affect chewing ability in complete denture wearer such as age, gender, personality type, denture experience, denture quality and occlusal schemes. Ellsworth K reported that age did not affect masticatory performance except the patient who is lower than 35 years old and upper than 75 years old. Yamashita S showed that the maximum in masticatory performance found in natural dentition, lower in removable partial denture and the lowest in complete denture wearer[35].

Age and muscular fatigue affect the function of the masticatory system, and this is frequently accompanied by tooth loss, prosthetic rehabilitation, and, also by the development of local and systemic circumstances that may greatly influence this physiological process and reduce the masticatory ability of elderly individuals. Because of ageing in the oral cavity, there is a reduction in food intake, as well as opting for softer foods, which leads to an imbalance in nutritional intake. This fact leads to metabolic alterations, which can cause general ageing of tissues of the body[20]. With regard to the masticatory process, there is a motor adaptation to the textural characteristics of food, leading to changes in the amplitude and duration of electromyographical activity of the masticatory cycle, which, in turn, change the duration and form of specific phases of the cycle. The occlusion of natural teeth is one of the factors that guarantee the quality of life, in as much as the stomatognathic function influences the health of individuals. As age advances, the swallowing capability of the individual decreases with time spent in preparing the bolus and swallowing larger quantity of food than might be appropriate[56]. Peyron et al. found a progressive muscular loss as age advances, ranging around 40% when individuals were 75 years old, and also a decrease in masticatory performance.

The Effect of gender on masticatory performance did not differ in complete denture wearer. On the contrary, gender affected masticatory performance in natural dentition. However, the improvement in denture quality significantly affected masticatory performance in complete denture wearer[47]. The major complaints of edentulous patient wearing old/faulty denture are atrophy of supporting tissues, poor adaptation, reduced masticatory efficiency, and psychosocial embarrassment[25]. Changes in the occlusal vertical dimension are a common procedure in prosthodontic treatment. An increase in the vertical dimension may lead to changes in the orofacial structures, i.e. jaw elevator muscles and temporomandibular joints. Furthermore, an increase in the vertical dimension will lead to a decreased activity of the jaw elevator muscles in postural position. Restorative procedures, in which the vertical dimension is increased, may alter the length of the main jaw elevator muscles as well as the position of the mandibular head in the fossa temporalis[47].

Dental prosthetics helps in restoration of quality of life and functional ability of a patient. Despite the success of implant- retained prosthesis in treating edentulism, their use is often limited due to systemic, financial, or psychological constraints (Kimoto et al.)[57]. For this reason, conventional complete dentures are still widely used to treat edentulism.

Although, conventional dentures improve mastication, speech, and esthetics; however, many patients are unsatisfied with them and in particular with mandibular dentures, because of its discomfort, instability, and lack of retention (Forgie et al.).[58]

It is hypothesized that with reduced stresses on the denture bearing area, might help in achieving the maximum efficacy of muscles involved in the masticatory process and thus help in improving the functional performance of the patients apart from reducing the stresses on the alveolar ridge (Shim and Watts; Murata et al.; Cunha; Gupta et al., dos Santos et al.,).[59,60,61,62]

Bite forces in complete denture wearers are significantly decreased in relation to people with natural teeth. There is a fundamental difference in the distribution of the functional energy in complete denture wearers and subjects with intact teeth. Reduction of masticatory efficacy in denture wearers may be caused by irregular activity of masticatory musculature or is the consequence of irregular flow of energy during mastication.[63]

I.Z. Alajberg et al. evaluated a significant effect on the muscle activity in different mandibular positions, as edentulous subjects had to use higher muscle activity levels (percentages of maximal EMG value) than age matched dentate subjects in order to perform same mandibular movement. It was also found that different elevator muscles were preferentially activated in the edentulous subjects when compared with dentate group especially in lateral excursive positions of the mandible. Thus, the elevator and depressor muscles need stronger activation by the ageing.[40]

Nagasawa T et al., showed that reduced masticatory efficiency could be associated with a relation of small contacts between the teeth and reduced activity of masseter muscle and temporalis muscle. A lot of researchers showed that complete denture wearers, compensate reduced efficiency of mastication with a larger amount of bolus and not with extended chewing.[64]

Shala et al. also analyzed masticatory index according to the duration using the index of muscular activity in time(A/t) and according to frequency, using indexes of muscular frequency during masticator cycles in Standard masticatory task. During the measurements, the side of the jaw that showed higher masticatory force was named as a dominant side (DS) while the opposite side was named as a non-dominant side (NDS). The study concluded that in the DS the values of the masticatory index A/t are higher in women then in man. The reason for this can be that women react more intensively in the beginning while a man needs more time for the functional adaptation. In NDS the values of masticator index are higher in patients with no experience with complete dentures then in those who have some experience.[65]

Miralles *et al.* (1989) concluded that, the values for maximum voluntary contraction of the dentate subjects were more than twice those of the denture wearers, as were the maximum bite forces. This is in accordance with several reports (e.g., Helkimo *et al.*, 1977; Haraldson, Karlsson and Carlsson, 1979; Michael et al., 1990). Apparently, upper limits of muscle activity and bite force in the denture wearers are more than halved compared with those of dentate subjects.

Activities of jaw elevator muscles depend on the chewing side (Stohler, 1986), on the site in the dental arch where force is exerted, and on the direction of the force (van Eijden, 1990; van Eijden et al., 1990)[27].

Though many different methods of evaluating masticatory efficiency have been reported, including the sieve method, which is used to measure the degree of comminution of different kinds of tests foods after a specified number of masticatory strokes. The mixing ability index of 2-coloured paraffin wax cubes has also been used to evaluate masticatory efficiency. Color changeable chewing gum has been confirmed for validity and reliability as a self-implementable method of evaluating masticatory efficiency. Despite the acceptance of some of these methods, the search continues for a simplified and effective way of obtaining an appropriate index. Providing all the required data with a single method may be impossible.[53]

Although, various techniques are available for examining the stomatognathic system, the electromyographic recording is one of the convenient and useful methods because it directly measures muscle activity. Electromyographic techniques have permitted more precise assessment of the muscle functions compared to previously possible clinical observation. Technological development has led to an optimized application of computerized diagnostic systems such as electrognathography[5]. The first documented experiments dealing with EMG started with Francesco Redi's works in 1966. Redi discovered a highly specialized muscle of electric ray fish generated electricity. Marey made the first actual recording of this electrical activity in 1890, who also introduced the term EMG. In 1922, Gasser and Erlanger used an oscilloscope to show the electrical signals from muscles. Clinical use of SURFACE EMG

[SEMG] for the treatment of more specific disorders began in 1960's and was used by Hardyek. The first effort to apply electromyography in dentistry was made by Robert E. Moyers. It used to corroborate the neuropsychological analysis of the factors linked to prosthetic rehabilitation procedures[66].

Electromyographic evaluation emerged as a more accurate and scientific tool which helps in understanding the impact as well as the underlying physiology behind such conservation. It is an objective method as it records the muscle activity in terms of evoked potentials and is done through highly sensitive equipment, thus giving an opportunity to study the impact of intervention without much delay[67].

Slagter *et al.* evaluated that, the dentate subjects used much larger forces and cornminuted Optocal much more quickly than the denture wearers. In conclusion, regardless of dental state, the peak EMG activities of the elevator muscles during mastication generate forces in excess of those needed to achieve the measured reduction in particle size. As compared with the dentate subjects, the denture wearers seemed to adapt the amounts of food fragmented per chewing stroke to their limitations in muscle activity and bite force. Therefore, masticatory performance and chewing efficiency depend on the relations between the activities of the elevator muscles, the resulting chewing forces, food texture and the amounts of food engaged per chewing stroke[27].

The EMG activities of masticatory muscles during function are affected by factors including body position, physiologic function, emotional stress, parafunctional activity, type of electrode used for recording; type, size, and texture of food; state of dentition; and presence of a dental prosthesis.[53]

In a previous study by Miralles R et al[68] showed that the integrated EMG activity of both muscles during maximal voluntary clenching was significantly lower in patients with complete dentures than in subjects with natural dentition.

This study reveals that maximum elevator activity levels in maximum voluntary contraction were higher in subjects with denture prosthesis than edentulous subjects while during maximal opening depressor muscle activity levels were similar in these groups[5].

Numerous studies have compared the muscle activity in complete denture wearers with superior and poor masticatory performance and showed that new dentures or improvements in occlusion vertical dimension and stability of poorly fitting dentures produce better chewing efficiency and masticatory performance.[69] Millers et al showed that low muscle activity in patients with complete denture might be a consequence of a change in the influence of peripheral or central neural mechanisms, since in edentulous patients the periodontal receptors are missing, and mucosal mechanoreceptors play a main role in replacing them.[40]

The present study was thus an attempt to analyze the effect of complete denture in geriatric patients on the muscle functioning of two major muscles of mastication, masseter and temporalis, by using electromyographic reading. The purpose of this study was to clarify the influence of complete denture on masticatory function and assess the EMG activity in geriatric patients with and without complete denture prosthesis.

Electromyographic output monitors the sum of electrical signals or action potentials generated by contracting muscle fibers and this summation reflects a measure of the total contractile force exerted by the muscle. The electrical signals generated by the contraction of muscle are measured in terms of change in potential (measured in volts) and can be picked up with electrodes placed at different locations. The electrodes used in the study were bipolar surface electrodes, one pole being the active electrode and another pole being the reference. These electrodes were 10 mm in diameter and were attached parallel to the muscle bellies at a fixed distance to each other. The signals produced were then magnified in an amplifier which allowed sufficient power to activate the mechanism for recording electromyographic activity of the muscles. Consequently, these signals were filtered digitally, recorded on the magnetic media and were finally presented graphically as numerous waves on the oscilloscope (Visual display unit) with varied amplitude and duration. It is a noted fact that more the amplitude of the wave more is the total contractile force in recruitment (maximum biting). Hence amplitude and duration per wave was used to assess the muscle function during maximum biting in intercuspal position (Kuriki et al.).[70]

We have evaluated the muscular activity and masticatory efficiency in geriatric patients with and without complete denture prosthesis by studying the temporalis and masseter muscles. As these are the two main muscles involved in masticatory procedures apart from pterygoidus externus and pterygoideus internus (Drake et al.).[71] Among these the Temporalis, Masseter, and Pterygoideus internus raise the mandible against the maxillae with great force. The Pterygoideus externus assists in opening the mouth, but its main action is to draw forward the condyle and articular disk so that the mandible is protruded, and the inferior incisors are projected in front of the maxillary incisors; in this action it is assisted by the Pterygoideus internus. The mandible is retracted by the posterior fibers of the Temporalis. When the Pterygoideus internus and externus of one side act, the corresponding side of the mandible is rotated forward and to the opposite side, while the opposite condyle remains comparatively fixed. Side-to-side movements such as those that occur during the trituration of food are produced by alternating activity in the left and right sets of muscles. The reason for evaluating only masseter and temporalis muscles was that they are directly involved in the masticatory process while the role of pierygoideus externus and pterygoideus internus is of a supportive one only. Moreover, anatomically, it is difficult to place the electrodes at the appropriate places to record the electromyographic activity of pterygoideus externus. The action of masseter and temporalis muscles is likely to be more affected owing to their proximity with the alveolar ridge and the site of denture placement. In an experimental study, the evaluation of the reliability of EMG activity of temporalis, masseter, and suprahyoid muscles bilaterally in relation to static bite force in humans, Gonzalez et al. (2011) has also shown that slopes of the EMG versus bite-force for a given biting situation were reliable for masseter and temporalis[67].

In a previous study of elevator muscle activity in patients before and after complete dentures suggest that the use of complete denture provokes electromyographic changes by increasing the occlusal vertical dimension.[72]

In the present study, on comparing the mean masseter muscle activity of two groups, On right side, muscle activity of masseter muscle was found to be 221.87±104.25µV among Group I subjects and 183.62±76.94µV among Group II subjects. On left side, muscle activity of masseter muscle was found to be 222.375±102.18µV among Group I subjects and 187.87±73.02µV among Group II subjects. On electromyography, muscle activity of masseter muscle did not differ significantly among Group I and Group II subjects on both left and right side when compared using Independent t test as $p>0.05$.

Similarly on comparing the mean temporalis muscle activity of two groups, on right side, muscle activity of temporalis muscle was found to be 211±60.75µV among Group I subjects and 170.37±53.20µV among Group II subjects. On left side, muscle activity of temporalis muscle was found to be 205.50±72.77µV among Group I subjects and 150.12±38.80µV among Group II subjects. On electromyography, muscle activity of temporalis muscle was found to be significantly more among Group I subjects as compared to Group II subjects on both left and right side when compared using Independent t test as $p<0.05$.

In the study mentioned by Verkindere et al[73] showed that the electrical activity of temporal muscles was slightly affected by the absence and replacement of teeth, whereas the electrical activity was markedly altered for the masseter muscles.

The previous study by Raustia et al[23] suggested that a long edentulous period is visible not only in functioning of the masticatory muscles (in terms of decreased EMG activity) but also as decreased density of the muscles which proves muscle atrophy, as observed by computed tomography in masticatory muscles.

On comparing the masseter muscle among male and female, In Group I subjects on right side the muscle activity of masseter muscle was found to be 258.500±136.61µV among males and 185.25±36.06µV among females. On left side, muscle activity of masseter muscle was found to be 231.75±107.30µV among males and 213±101.66µV among female subjects. On concluding with Group I subjects, no statistically significant difference were seen in the muscle activity of masseter muscle among male and female subjects on both left and right side as $p>0.05$ when compared using Independent t test.

Similarly in Group II subjects, on right side, muscle activity of masseter muscle was found to be 207±98.26µV among males and 160.25±40.33µV among females. On left side, muscle activity of masseter muscle was found to be 198.75±97.17µV among males and 177±39.40µV among female subjects. On concluding with Group II subjects, no statistically significant difference was seen in the muscle activity of temporalis muscle among male and female subjects on both left and right side as $p>0.05$ when compared using Independent t test.

Whereas on comparing the temporalis muscle among male and female, in Group I subjects on right side, muscle activity of temporalis muscle was found to be 215.5±69.50μV among males and 207±54.05μV among females. On left side, muscle activity of temporalis muscle was found to be 218.25±87.93μV among males and 192.75±55.57μV among female subjects. On concluding with Group I subjects, no statistically significant difference was seen in the muscle activity of temporalis muscle among male and female subjects on both left and right side as $p>0.05$ when compared using Independent t test.

Similarly in Group II subjects, on right side, muscle activity of temporalis muscle was found to be 171.50±69.30μV among males and 169.25±34.19μV among females. And on left side, muscle activity of temporalis muscle was found to be 143.5±44.63μV among males and 156.75±32.99μV among female subjects. On concluding with Group II subjects, no statistically significant difference was seen in the muscle activity of temporalis muscle among male and female subjects on both left and right side as $p>0.05$ when compared using Independent t test.

Moreover, it has also been reported that in general population sample, male subjects showed higher masticatory EMG levels than did female subjects during maximal voluntary contractions. The hypotheses for these findings may be explained by differences in the diameter and number of muscle fibers, differences in distribution of fiber type within the muscles, and differences in head and body size between males and females. Therefore, the usefulness of any diagnostic test using SEMG must define and adjust for the difference in parameters between males and females.[74]

Based on the above-mentioned observations and results, the subjects without denture show decreased elevator muscle activity during maximum voluntary contraction when compared to subjects with dentures. No statistically significant difference was seen in the muscle activity of elevator muscle among male and female subjects with and without denture.

In complete dentures stable base with least adverse effect on the supporting tissues is the ultimate goal. Total stability is not possible because of the yielding nature of the supporting structures, but control of the physical factors that apply to the relationship of the teeth to each other and that apply to the position of the teeth in the denture base as related to the ridge must be understood. When forces act on a body in such a way that no motion results, there is balance or equilibrium This should be a primary biomechanical consideration of the dentist when considering the forces that act on the teeth and the denture bases with their resultant effect on the movement of the base and stresses on residual ridge.

Further Scope of the study

- The preservation of alveolar ridge and other supporting tissues without loss of masticatory efficiency is an issue that needs a further long-term evaluation.
- Further investigations are needed to explore the relationship between occlusal features and muscular activity, designed following specific criteria (randomization, inclusion and exclusion criteria, similarity between groups at baseline, detailed description of the protocols to facilitate replication, blinding methods) in order to establish if a causal association between these variables really exist, thus avoiding spurious associations.
- Longitudinal studies with the purpose to appraise the long-lasting effects of occlusal disturbance on the activity of masticatory muscles.
- Finally, a greater accuracy of the electromyography would be desirable to confer to the results obtained an absolute reliability.

Mastication being a complex biologic function utilizing various components, such as muscles, dentition and neural control; requires these various controlling components to be in harmony and optimal health. When one of these components loses their function the masticatory efficiency of the individual is hampered. The restoring of the lost or affected component may, to some extent, bring back the patient's masticatory efficiency.

The present in-vivo study assessed the influence complete denture wearers muscle activity of two main muscles of mastication masseter and temporalis upon electromyographic parameter for both the groups.

On the basis of present study, the following conclusions have been drawn:

1. Mean muscle activity bite-force measurement with complete denture (Group I) was 221.87±104.25, 222.375±102.18, 211±60.75, 205.50±72.77µV respectively for right masseter, left masseter, right temporalis and left temporalis muscles respectively.
2. Mean muscle activity bite-force measurement without complete denture (Group II) was 183.62±76.94, 187.87±73.02, 170.37±53.20, 150.12±38.80µV respectively for right masseter, left masseter, right temporalis and left temporalis muscles respectively.
3. Mean muscle activity bite-force measurement with complete denture (Group I) among male was 258.500±136.61, 231.75±107.30, 215.5±69.50, 218.25±87.93µV respectively for right masseter, left masseter, right temporalis and left temporalis muscles respectively.
4. Mean muscle activity bite-force measurement with complete denture (Group I) among female was 185.25±36.06, 213±101.66, 207±54.05, 192.75±55.57µV respectively for right masseter, left masseter, right temporalis and left temporalis muscles respectively.

5. Mean muscle activity bite-force measurement with complete denture (Group II) among male was 207±98.26, 198.75±97.17, 171.50±69.30, 143.5±44.63µV respectively for right masseter, left masseter, right temporalis and left temporalis muscles respectively.
6. Mean muscle activity bite-force measurement with complete denture (Group II) among female was 160.25±40.33, 177±39.40, 169.25±34.19, 156.75±32.99µV respectively for right masseter, left masseter, right temporalis and left temporalis muscles respectively.
7. Statistically, muscle activity of masseter muscle did not differ significantly among Group I and Group II subjects on both left and right side when compared using Independent t test as $p>0.05$.
8. Statistically, muscle activity of temporalis muscle was found to be significantly more among Group I subjects as compared to Group II subjects on both left and right side when compared using Independent t test as $p<0.05$.
9. Statistically, among Group I subjects, no statistically significant difference was seen in the muscle activity of temporalis and masseter muscle among male and female subjects on both left and right side as $p>0.05$ when compared using Independent t test.
10. Statistically, among Group II subjects, no statistically significant difference was seen in the muscle activity of temporalis and masseter muscle among male and female subjects on both left and right side as $p>0.05$ when compared using Independent t test.

The finding in present study showed that muscle activity of both the masticatory muscles showed higher activity in subjects wearing the denture prosthesis when compared to those without denture prosthesis.

1. Goiato MC, Garcia AR, Dos Santos Dicatory M, Zuim PR. Analysis of masticatory cycle efficiency in complete denture wearers. Journal of prosthodontics.2010;19:10-13.
2. Alajbeg IZ, Valentic- Peruzovic M, Alabeg I, Illes D, CelebicA.The influence of dental status on masticatory muscles activity in elderly patients. Int J Prosthodont. 2005;18:333-8.
3. Zarb-Bolender. Prosthodontic treatment for edentulous patients. Elsevier:2005;12' Edition:41-60.
4. Slagter AP, Bosman F, Van der Glas HW, Van Der Bilt A. Human jaw-elevator muscle activity and food comminution in the dentate and edentulous state. Archives of oral biology. 1993 Mar 1;38(3):195-205.
5. Ashraf H. To determine the influence of the complete denture prosthesis on masticatory muscle activity in elderly patients: an in vivo study. Int J of Prosthodontics Restorative Dent. 2011;1(1):35-40.
6. Brewer AA. Reibel PR, Nassif NJ. Comparison of zero degree teeth and anatomic teeth on complete dentures. J Prosthet Dent 1967;17:28-35.
7. Thompson M.J. Masticatory efficiency as related to cusp form in denture prosthesis. J Am Dent Assoc 1937;24: 207-19.
8. Hickey JC. Woelfel JB, Allison ML, Boucher CO. Influence of occlusal schemes on the muscular activity of edentulous patients. J Prosthet Dent 1963;13: 444-51
9. Castroflorio T, Bracco P, Farina D. Surface electromyography in the assessment Of jaw elevator muscles. J Oral Rehabil 2008;35: 638-45.

10. Hickey J.C, Stacy R.W, Rinear L.L "Electromyographic studies of mandibular muscles in basic jaw movements." J Prosthet Dent ; July 1957; 7; no 4; 565-570
11. Luis Angelone, Joseph. Clayton and William. An approach to quantitative electromyography of the masseter muscle. J D Res.1960; 39(1): 17-23.
12. Peter Schaerer, Richard E, Stallard and Helmut A. Zander "Occlusal interferences and mastication: An electromyographic study. J Prosthet Dent; May 1967; 17; no 5; 438-449.
13. Arturo Manns, Rodolfo Miralles, and Carmen Palazzi "EMG, bite force, and elongation of the masseter muscle under isometric voluntary contractions and variations of vertical dimension." J Prosthet Dent; Dec 1979; 42; no 6; 674-682.
14. John D. Rugh, and Carl J. Drago "Vertical dimension: A study of clinical rest position and jaw muscle activity." J Prosthet Dent ; June 1981; 45; no 6; 670-675.
15. Williamson EH, Lundquist DO. "Anterior guidance: its effect on electromyographic activity of the temporal and masseter muscles." J Prosthet Dent 1983;49:816-23.
16. Rugh J.D, Barghi, and Drago C.J "Experimental occlusal discrepancies and nocturnal bruxism." J Prosthet Dent ; Apr 1984; 51; no4; 548-553.
17. Ronald J. Shupe, Shawky E Mohammed, Lars V.Christensen, Israel M. Finger and Roger Weinberg "Effects of occlusal guidance on jaw muscle activity." J Prosthet Dent; June 1984; 51; no6; 811 -818.
18. Mac Donald and Hannam "Relationship between occlusal contacts and jaw closing muscle activity during tooth clenching: Part 1." J Prosthet Dent ; Nov 1984; 39; no5; 718-728.

19. Belser U.C and Hannam A.G “The influence of altered working side occlusal guidance on masticatory muscles and related jaw movement.” J Prosthet Dent; Mar 1985; 53; no 3; 406 -413.

20. Gunne HS, Wall A: The effect of new complete dentures on mastication and dietary intake. ActaOdonto Scand. 1985; 43: 257-268.

21. William W. Wood “A review of masticatory muscle function.” J Prosthet Dent ; Feb 1987; 57; 222-232.

22. Arturo Manns, Clifford Chan, Rodolfo Miralles “Influence of group function and canine guidance on electromyographic activity of elevator muscles .” J Prosthet Dent; April 1987; 57; no4; 494 -501.

23. Shi CS, Ouyang G, Guo TW: A comparative study of mastication between complete denture wearers and dentate subjects. J Prosthet Dent 1991; 66(4): 505-09.

24. Randall C. Duncan, Arthur T. Storey, John D. Rugh, and Stephen M. Parel, “Electromyographic activity of the jaw-closing muscles in patients with osseointegrated implant fixed partial dentures.” J Prosthet Dent ; Mar 1992; 67; no 4; 544 -549.

25. Ad P. Slagter, Lambertus W. Olthoff.: Masticatory ability, denture quality, and oral conditions in edentulous subjects. J Prosthet Dent 1992; 68: 299-307.

26. Bakke M. “Mandibular elevator muscles: physiology, action, and effect of dented occlusion.” Scand J Dent Res 1993: 101: 314-31.

27. Slagter AP, Bosman F, Van der Glas HW, Van Der Bilt A. Human jaw-elevator muscle activity and food comminution in the dentate and edentulous state. Archives of oral biology. 1993 Mar 1;38(3):195-205.

28. Lindauer SJ, Gay T, Rendell J. Effect of jaw opening on masticatory muscle EMG-force characteristics. Journal of dental research. 1993 Jan;72(1):51-5.
29. Grunert I, Kofler M, Gausch K, Kronenberg M. Masseter and temporalis surface electromyography in patients wearing complete dentures comparing anterior and posterior occlusal concepts--a pilot study. Journal of oral rehabilitation. 1994 May;21(3):337-47.
30. Garrett NR, Kaurich M, Perez P, Kapur KK. Masseter muscle activity in denture wearers with superior and poor masticatory performance. The Journal of prosthetic dentistry. 1995 Dec 1;74(6):628-36.
31. Akoren A, Karaagaclioglu L: Comparison of electromyographic activity of individuals with canine guidance and group function occlusion. J Oral Rehabil 1995; 22:73 -77.
32. Borromeo GL, Suvinen TI, Reade PC: A comparison of the effects of group function and canine guidance interocclusal device on masseter muscle electromyographic activity in normal subjects. J Prosthet Dent 1995; 74:174-180.
33. Riad E. Youssef, Gaylord Throckmortan, Edward Ellis and Douglas P.Sinn "Comparison of habitual masticatory pattern in men and women using a custom computer program." J Prosthet Dent; Aug 1997; 78; no2; 179-186.
34. Irwin Becker, Gregory Tarantola, Jaime Zambrano, Susan pitzer and Diego Oquendo "Effect of a prefabricated anterior bite stop on electromyographic activity of masticatory muscles." J Prosthet Dent;July 1999; 82; no 1; 22-26.

35. K. Yugami, s. Yamashita, m. Ai & j. Takahashi. Mandibular positions and jaw closing muscle activity during sleep. Journal of Oral Rehabilitation 2000 27; 697–702.

36. Iva AlajbegMelita, ValentiE-PeruzoviE and Ivan Alajbeg. Electromyographic evaluation of masticatory muscle activity in patients with temporomandibular dysfunction. ActaStomat Croat. 2003; 37(2): 141-145.

37. L. Roark, a. G. Glaros & a. M. O'mahony: Effects of interocclusal appliances on EMG activity during par functional tooth contact. Journal of Oral Rehabilitation 2003 30; 573–577.

38. Tadasu Haketa, Kazuyoshi Baba, Satoshi Akishige, Kenji Fueki, Koji Kino, Takashi Ohyama. Utility and Validity of a New EMG based Bruxism Detection System. Int J Pros-thodont 2003; 16: 422–428.

39. V. F. Ferrario, g. M. Tartaglia, a. Galletta, g. P. Grassi& c. Sforza: The influence of occlusion on jaw and neck muscle activity: a surface EMG study in healthy young adults. Journal of Oral Rehabilitation 2006 33; 341–348.

40. Alajbeg IZ, Valentic-Peruzovic M, Alajbeg I, Cifrek M. The influence of age and dental status on elevator and depressor muscle activity. Journal of oral rehabilitation.2006 Feb;33(2):94-101.

41. Okano N, Baba K, Igarashi Y: "Influence of altered occlusal guidance on masticatory muscle activity during clenching." J Oral Rehabil 2007; 34:679- 684.

42. Henrique Casselli, Alexandre Brait Landulpho, wilkens and Frederco. Electromyographic evaluation of rehabilited edentulous patients. Braz Oral Res. 2007; 21(4): 355-61.

43. Yu-Ying Chen, Chung-Ling Kuan, Yi-Bing Wang; "Implant occlusion: biomechanical considerations for implant –supported prostheses." J Dent Sci 2008 · Vol 3 · No 2;65-74.

44. Berretin-Felix G, Nary Filho H, Padovani CR, Trindade Junior AS, Machado WM. Electromyographic evaluation of mastication and swallowing in elderly individuals with mandibular fixed implant-supported prostheses. Journal of Applied Oral Science. 2008 Apr;16(2):116-21.

45. Maria Jose Campillo, Rodolfo Miralles, Hugo Santander, Saul Valenzuela, Maria Javiera Fresno, Aler Fuentes & Claudia Zuniga, "Influence of Laterotrusive Occlusal Scheme On Bilateral Masseter EMG Activity During Clenching and Grinding.", The journal of craniomandibular practice,2008, 26:4, 263-273.

46. Francesca Trovato, Bruno Orlando, Mario Bosco. Occlusal features and masticatory muscles activity. A review of electromyographic studies. Stomatologija, Baltic Dental and Maxillofacial Journal. , 2009; 11: 26-31.

47. Meiqing wang1, jianjun he1, kelun wang2,3 & peter svensson Influence of changing occlusal support on jaw-closing muscle electromyographic activity in healthy men and women. ActaOdontologicaScandinavica, 2009; 67: 187-192.

48. Marcelo Coelho Goiato, Alicio Rosaline Garcia, Daniela micheline dos Santos, & Paulo Renato Junqueira Zuim: Analysis of Masticatory Cycle Efficiency in Complete Denture Wearers. J Prosthet Dent 2010; 19: 10-13.

49. Ignacio Ardizone, Alicia Celemin, Fernando Aneiros, Jaime del Rio, Teresa Sanchez, Isabel Moreno. Electromyographic study of activity of the masseter

and anterior temporalis muscles in patients with temporomandibular joint (TMJ) dysfuction: Comparison with the clinical dysfunction index. Med Oral Patol Oral Cir Bucal. 2010; 15(1): 14-9.

50. A. Van der bilt, j. Mojet, f. A. Tekamp& j. H. Abbink. Comparing masticatory performance and mixing ability. Journal of Oral Rehabilitation 2010 37; 79–84.
51. Venus Sidana, Neeta Pasricha, Monika Makkar, Satpreet Bhasin “Group function occlusion”. Indian Journal of Oral Sciences 2012 Sep-Dec Vol . 3 Issue 3.124-128.
52. Neeta Pasricha, Venus Sidana, Satpreet Bhasin, Monika Makkar, “Canine protected occlusion”. Indian Journal of Oral Sciences 2012 Jan-Apr Vol. 3 Issue 1.13-18.
53. Oliveira NM, Shaddox LM, Toda C, Paleari AG, Pero AC, Compagnoni MA. Methods for Evaluation of Masticatory Efficiency in Conventional Complete Denture Wearers: A Systematized Review Oral Health Dent Manag.2014 Sep;13(3):757-62.
54. Karkazis HC, Kossioni AE. Surface EMG activity of the masseter muscle in denture wearers during chewing of hard and soft food. J Oral Rehabil 1998;25:8-14.
55. Juliana malta, Gabriel denser campolongo, Tarley eloy pessoa de barros, Reginaldo perilo de oliveira. Electromyography applied to chewing muscles. Acta Ortop Bras. 2006; 14(2): 106-107.

56. Rodrigo Galo, Mathias Vitti1, Maria da Glo´ ria Chiarello Mattos and Simone Cecı´lioHallakRegalo. Masticatory muscular activation in elderly individuals during chewing. Gerodontology 2007; 24: 244–248.
57. Emami E, de Souza RF, Kabawat M, Feine JS. The Impact of Edentulism on Oral and General Health. International Journal of Dentistry 2013; Article ID 498305, 1-7.
58. Samara SA, Haider ZA. Re-visiting Edentulism: Complete Removable Dentures vs Implant Overdentures. JOHCD 2011; 5(3): 107-109.
59. Nath DK, Bagchi G, Arora V, Nath M, Kahar B, Gaunkar RB. Priority of Prosthodontic Need Assessment: Functional vs Other Quality of Life Needs - A Quality of Life Assessment Using APS-ARG QOL(DS) – A Pilot Project. JOHCD 2013; 7(2): 96-101.
60. Kimoto S, So K. Yamamoto S, Ohno Y, Shinomiya M, Ogura K et al. Randomized controlled clinical trial for verifying the effect of silicone-based resilient denture liner on the masticatory function of complete denture wearers. Int J Prosthodont 2006; 19, 593-600.
61. Forgie AH, Scott BJ, Davis DM. A study to compare the oral health impact profile and satisfaction before and after having replacement complete dentures in England and Scotland. Gerodontology 2005; 22,137-142
62. Shim JS, Watts DC. An examination of the stress distribution in a soft-lined acrylic resin mandibular complete denture by finite element analysis. Int J Prosthodont 2000; 13, 19-24.

63. Piancino MG, Farina D, Talpone F, Castroflorio T, Gassino G, Margarino V, Bracco P. Surface EMG of jaw-elevator muscles and chewing pattern in complete denture wearers. Oral Rehabil Dec 2005;32(12):863-70.
64. Nagasawa T, Yoshida K, Minagi S, Tamura H and Tsuru H. A new objective parameter for the electromyographic evaluation of the masticatory function of edentulous patients. J Oral Rehabilit. 1988; 15: 295-300.
65. Shala K, Bicaj T, Pustina-Krasniqi T, Ahmedi E, Dula L, Lila-Krasniqi Z. Evaluation of the Masticatory Efficiency at the Patients with New Complete Dentures. *Open Access Maced J Med Sci*. 2018;6(6):1126-1131.
66. Lippold OCJ. The relation between integrated action potentials in a human muscle and its isometric tension. J Physiol 1952; 117:492-499.
67. A. F. Sutton and J. F. McCord A randomized clinical trial comparing anatomic, lingualized, and zero-degree posterior occlusal forms for complete dentures. J Prosthet Dent 2007;97:292-8.
68. Verkindere M, Lodter JP, Alzieu X. Electromyographic study of mastication as a function of the denture in humans. J Biol Buccale Sep 1988;16(3):169-78.
69. Garrett Neal R, Perez Paul, Elbert Charles, Kapur Krishan K. Effects of improvements of poorly fitting dentures and new dentures on masseter muscle activity during chewing. J Prosthet Dent 1996;76:394-402.
70. Youssef RE, Throckmorton GS, Ellis-E-3rd J Prosthet Dent. 1997 Aug; 78: 179 – 186
71. Heydecke G, Akkad AS, Wolkewitz M, Vogeler M, Strub JR. Patient ratings of chewing ability from a randomised crossover trial: lingualised vs. first

premolar/canine-guided occlusion for complete dentures. Gerodontology. 2007 Jun;24(2):77-86.

72. Liu ZJ, Yamagata K, Kasahara Y, Ito G. Electromyographic examination of jaw muscles in relation to symptoms and occlusion of patients with temporomandibular joint disorders. Journal of Oral Rehabilitation 1999;26:33-47.
73. Nuño Licona A, Angeles Medina F, Pacheco Segura ME, Sarabia Villa A, García Moreira C. Electromyographic activity (EMG) of masseter and temporal muscles in edentulous patients before and after complete dentures. Pract Odontol Aug 1990;11(8):54-56.
74. Shilpa Sinnurkar, Saquib Ahmed Shakh and Ramesh Nadiger. "Analysis of Changes in Bilateral Masseter and Anterior Temporalis Muscle Efficiency in Complete Denture Wearers. –An EMG Study. *Int. J. of Adv. Res.* **5** (Feb).2017.2672-2683(ISSN 2320-5407).

Babu Banarasi Das University
Babu Banarasi Das College of Dental Sciences,
BBD City, Faizabad Road, Lucknow – 226028 (INDIA)

Dr. Lakshmi Bala
Professor and Head Biochemistry and
Member-Secretary, Institutional Ethics Committee

Communication of the Decision of the VIII[th] Institutional Ethics Sub-Committee

IEC Code: 22 **BBDCODS/03/2020**

Title of the Project: A Comparative Evaluation of Masseter and Temporalis Muscle Activity in Geriatric Patients with and without Complete Denture Prosthesis- An Electromyographic Study.

Principal Investigator: Dr. Aisha Mirza **Department:** Prosthodontics and Crown & Bridge

Name and Address of the Institution: BBD College of Dental Sciences Lucknow.

Type of Submission: New, MDS Project Protocol

Dear Dr. Aisha Mirza,

The Institutional Ethics Sub-Committee meeting comprising following four members was held on 18[th] March, 2020.

1.	Dr. Lakshmi Bala Member Secretary	Prof. and Head, Department of Biochemistry, BBDCODS, Lucknow
2.	Dr. Amrit Tandan Member	Prof. & Head, Department of Prosthodontics and Crown & Bridge, BBDCODS, Lucknow
3.	Dr. Sahana S. Member	Reader, Department of Public Health Dentistry, BBDCODS, Lucknow
4.	Dr. Sumalatha M.N. Member	Reader, Department of Oral Medicine & Radiology, BBDCODS, Lucknow

The committee reviewed and discussed your submitted documents of the current MDS Project Protocol in the meeting.

The comments were communicated to PI thereafter it was revised.

Decisions: The committee approved the above protocol from ethics point of view.

Forwarded by:

Lakshmi Bala 18/03/20

(Dr. Lakshmi Bala)
Member-Secretary
IEC

Member-Secretary
Institutional Ethic Committee
BBD College of Dental Sciences
BBD University
Faizabad Road, Lucknow-226028

(Dr. B. Rajkumar)
Principal
BBDCODS

PRINCIPAL
Babu Banarasi Das College of Dental Sciences
(Babu Banarasi Das University)
BBD City, Faizabad Road, Lucknow-226028

BABU BANARASI DAS COLLEGE OF DENTAL SCIENCES
(FACULTY OF BBD UNIVERSITY), LUCKNOW

INSTITUTIONAL RESEARCH COMMITTEE APPROVAL

The project titled **"A Comparative Evaluation of Masseter and Temporalis Muscle Activity in Geriatric Patients with and without Complete Denture Prosthesis- An Electromyographic Study"** submitted by **Dr Aisha Mirza** Post graduate student from the **Department of Prosthodontics & Crown and Bridge** as part of MDS Curriculum for the academic year 2019-2022 with the accompanying proforma was reviewed by the Institutional Research Committee present on **19th December 2019** at BBDCODS.

The Committee has granted approval on the scientific content of the project. The proposal may now be reviewed by the Institutional Ethics Committee for granting ethical approval.

Prof. Vandana A Pant
Co-Chairperson

Prof. B. Rajkumar
Chairperson

PATIENT'S NAME : SEX : AGE :

ADDRESS : TELEPHONE :

OCCUPATION : OPD NO. :

CASE ALLOTTED TO :

FEE FOR THE TREATMENT, IF ANY :

HISTORY

I. CHIEF COMPLAINT :

What is your problem and why do you seek treatment ?

a. Lost all teeth & need dentures
b. Old dentures are unsatisfactory / ill fitting
c. Old dentures worn out / broken / lost
d. Any Other.

II HISTORY OF PRESENT ILLNESS :

1. How long have you been without natural teeth ?
   Upper -
   Lower -

2. Primary reason for the loss of the teeth
   (a) Periodontal disease :
   (b) Dental caries
   (c) Any others

3. Previous denture experience & its duration

4. Why do you mainly require dentures for ?
   (a) Mastication
   (b) Esthetics
   (c) Phonetics

III EVALUATION OF SYSTEMIC STATUS / GENERAL HEALTH :

1. General constitution Robust / Average / Frail
2. Past Medical History
   I. Any Major illness ?
      Diabetes
      Tuberculosis
      Cardiovascular diseases
      Arthritis
      Neurological disorder
      Palsy
      Epilepsy
      Allergy
      Anaemia
      Bleeding disorders
      Asthma
      Jaundice
      Radiotherapy
      Drug history
      Any other
   II. Present medical illness
      H/o Hospitalization

IV. PERSONAL HISTORY

1. Oral hygiene habits: Methods
   Frequency
2. Other habits
   Smoking/ Pan/ Tobacco chewing/ Betel nut/Alcohol/ clenching/ Bruxism.
3. Parafunctional

V. SOCIO - PSYCHOLOGICAL STATUS:

1. Family Status:
2. Educational status
3. Mental attitude: Philosophical, Exacting
   Hysterical Indifferent
4. Patient's expectations :

CLINICAL EXAMINATION

I. (A) EXTRA ORAL EXAMINATION:

1. Form : Ovoid/ Tapering/ Square
2. Profile : Normognatic/Prognathic /Retrognathic
3. Symmetry : Symmetrical/ Asymmetrical
4. Facial height : Decreased/ Normal/Increased
5. Facial muscle tone : Normal/Flabby/ Spastic
6. Eyes : Black/Brown/ Blue/ Grey
7. Complexion : Dark/ Fair/ Medium
8. Lips : Thick/ Average/Thin
9. Length : Short/Average/ Long
10. T.M.J. Examination : a. Normal b. Pain / tenderness.
    c. Clicking d. Movements - Normal/ Deviated/ Restricted
11. Lymph node (Submandibular, Submental, Cervical, Preauricular, Mastoid)
    Examination Palpable/ Non Palpable, tender/ Non tender, Movable/ fixed

(B) INTRA ORAL EXAMINATION

I. EVALUATION OF RESIDUAL RIDGES:

1. Arch form : Maxillary : U shaped/ V shaped/ Combination/ Square / Other
   Mandibular : U shaped/ V shaped/ Combination/ Square / Other
2. Residual ridge form : a. High well rounded b. Low well rounded
   c. Knife edge d. Flat
   e. Depressed
   Maxillary : Anterior Posterior
   Mandibular : Anterior Posterior
3. Ridge Relation : Normognathic/ Prognathic/ Retrognathic/ Cross arch
4. Interarch distance : (NORMAL 16-20 mm) (Adequate/Inadequate/ Excessive)
5. Under cut location : Upper Anterior Lower Anterior
   Upper Posterior Lower Posterior
6. Bony irregularities location :
7. Retained root stumps :
8. Mucosa : Well Keratinised/ Smooth/ Firm/ Loose/ Abnormal (details)
   Resilient
   Hard unyielding
   Inflammed
   Hyperplastic or dysplastic
   Other mucosal abnormalities

9. Special treatment (if any)

(Condition of the maxillary tuberosities, Mylohyord ridge, etc)

MAXILLARY TUBEROSITY	:	Normal/Enlarged/Pendulous
MUCOSA	:	Normal / Abnormal
CHEEK MUCOSA	:	Normal / Abnormal
FLOOR OF THE MOUTH	:	a. Lingual Frenum : Normal/ Prominent/ Absent/ Tongue- Tie
		b. Genial tubercles: Not seen/ Prominent
		c. Plica : Normal / Prominent
		d. Retromylohyoid fossa classification : Type I/ Type II/ Type III
TONGUE	:	a. Mucosa : Normal/ Abnormal
		b. Size : Normal/ Hypertrophic/ Atrophic
GAGGING REFLEXES	:	Normal/ Exaggerated
PALATE	:	a. Incisive papilla - Normal/ Prominent
		b. Rugae- Normal/ Prominent/ Not Prominent
		c. Mucosa - Normal / Abnormal
		d. Compressibility
		Median area : Rigid/ Compressible
		Lateral area : Rigid/ Compressible
		e. Palatal vault - V Shaped/ U Shaped/ Flat
		f. Junction of hard and soft palate - class I/ Class II/ Class III
		g. Posterior palatal seal area - Compressible/ Non Compressible

VESTIBULE	:	Maxillary	Labial	- Shallow/Deep
			Buccal	- Shallow/ Deep
		Mandibular	Labial	- Shallow/ Deep
			Buccal	- Shallow/ Deep
			Lingual	- Shallow/ Deep
FRENAL ATTACHMENTS	:	Maxillary	Mandibular	
		Normal		
		Close at crest		
		Broad		
		Prominent Freni	Maxillary	Mandibular
SALIVA	:	Quality		Quantity
		1. Serous or Thin		1. Scanty
		2. Mucous or Thick		2. Abundant
		3. Mixed		3. Normal

OBSERVATION OF ANY OTHER RELEVANT FINDINGS:

REMARKS ON THE EXISTING DENTURES :

Cleanliness	Stability	Condition of base
Vertical dimension	Condition of the teeth	Centric occlusion
Extension of base	Esthetics	Retention
		Phonetics

DENTAL INVESTIGATION : a. Radiographs
b. Diagnostic casts
c. Other

TREATMENT PLAN :

a. Motivation/ Patient Education :

b Surgical / Non- Surgical preparation of tissues Systemic/ Local treatment

(C) CLINICAL STEPS/ LABORATORY PROCEDURES

S.No.	Step	Material	Date	Checked by
1.	Primary impression Maxillary Mandibular			
2.	Primary model preparation			
3.	Special tray preparation			
4.	Final impression Maxillary Mandibular			
5.	Preparation of stone models (working model)			
6.	Preparation of Wax occlusal rim			
7.	Recording of jaw relation • Orientation relation • Vertical relation • Centric relation			
8.	Articulation			
9.	Selection of teeth			
10.	Teeth arrangement			
11.	Anterior Try in			
12	Final Try in			
13.	Flasking and dewaxing and processing			
14.	Deflasking, Trimming, Finising			
	and polishing			
15.	Denture insertion & instruction			
16.	Post insertion adjustments -I			
17.	Post insertion adjustment - II			

Patient's Signature Staff Signature HOD Signature

APPENDIX-V

Babu Banarasi Das College of Dental Sciences
(A constituent institution of BabuBanarasi Das University)
BBD City, Faizabad Road, Lucknow – 227105 (INDIA)

Participant Information Document (PID)

Study title A COMPARATIVE EVALUATION OF MASSETER AND TEMPORALIS MUSCLE ACTIVITY IN GERIATRIC PATIENTS WITH AND WITHOUT COMPLETE DENTURE PROSTHESIS - AN FLECTROMYOGRAPHIC STUDY.

1. **Invitation paragraph**

   You are being invited to take part in a research study. It is therefore important for you to understand why the study is being done and what it will involve. Please take time to read the following information carefully. Ask us for any clarifications or further information. Whether or not you wish to take part is your decision.

2. **What is the purpose of the study?**

   To evaluate the masticatory muscle activity in geriatric patients with and without complete denture prosthesis through Electromyographic study of masseter and temporalis muscles.

3. **Why have I been chosen?**

   You have been chosen for this study as you are fulfilling the required criteria for this study.

4. **Do I have to take part?**

   Your participation in the research is entirely voluntary. If you do, you will be given this information sheet to keep and will be asked to sign a consent form. During the study you still are free to withdraw at any time and without giving a reason.

5. **What will happen to me if I take part?**

   One set of complete dentures will be fabricated with no extra appointments. Then electromyography investigation will take approximately 30 minutes.

6. **What do I have to do?S**

You do not have to change your regular lifestyles for the investigation of the study.

7. What is the procedure that is being tested?

Electromyography will be performed with and without fabrication of complete denture.

8. What are the interventions for the study?
There will be no interventions.

9. What are the side effects of taking part?

There are no side effects on patients of this study.

10. What are the possible disadvantages and risks of taking part?

There are no risks or disadvantages of taking part in this study.

11. What are the possible benefits of taking part?

The elevator muscles will show higher activity in subjects wearing the denture prosthesis when compared to those without denture prosthesis.

12. What if new information becomes available?

If additional information becomes available during the course of the research you will be told about these and you are free to discuss it with your researcher, your researcher will tell you whether you want to continue in the study. If you decide to withdraw, your researcher will make arrangements for your withdrawal. If you decide to continue in the study, you may be asked to sign an updated consent form.

13. What happens when the research study stops?

If the study stops/finishes before the stipulated time, this will be explained to the patient/volunteer.

14. What if something goes wrong?

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If any severe adverse event occurs, or something goes wrong during the study, the complaints will be handled by reporting to the institution (s), and Institutional ethical committee.

15. Will my taking part in this study be kept confidential?

Yes it will be kept confidential.

16. What will happen to the results of the research study?

Result is the soul properties of the department of The Prosthodontics BBDCODS Lucknow. Your identity will be kept confidential in case of any report/publications.

17. Who is organizing the research?

This research study is organized by Department of Prosthodontics, BBDCODS Lucknow.

18. Will the results of the study be made available after study is over?

Yes.

19. Who has reviewed the study?

The study has been reviewed and approved by the Head of the Department of Prosthodontics the (IEC) (IRC) of the institution.

BBDCODS

Contact for further information

Dr. Aisha Mirza
PG student
Department of Prosthodontics
Babu Banarasi College of Dental
Sciences.
Lucknow-226028
Email id :- aisha.mirza15@gmail.com
Mob - 7905555756

,

Dr. Lakshmi Bala,
Member Secretary IEC
Babu Banarasi College of
Dental Sciences.
Lucknow
bbdcods.iec@gmail.com

Signature of PI……………………………………………………….
Name………………………………………………………………
Date ……………………………………………………………….

,

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APPENDICES-VI

बाबू बनारसी दास कॉलेज ऑफ़ डेंटल साइंस
(बाबू बनारसी दास विश्व विद्यालय के एक घटक संस्था)
बीबीडी सिटी, फैजाबाद रोड, लखनऊ - 227105 (भारत)
प्रतिभागी जानकारी दस्तावेज़ (पीआईडी)

अध्यन्न ख़िताब

एक तुलनात्मक मूल्यांकन मैंसेटर और टेम्पोरल मांसपेशियों की गतिविधि बुज़ुर्ग रोगियों में पूरे डेन्चर प्रोस्थेसिस के साथ और बिना -एक इलेक्ट्रोमोग्राफिक अध्ययन।

2. निमंत्रण पैरा

आपको इस शोध में भाग लेने के लिए आमंत्रित किया जा रहा है, इसलिए यह समझना आवश्यक है की यह अध्यन्न क्यों किया जा रहा है और इसमें क्या शामिल होगा । कृपया निम्न जानकारी को सावधानी पूर्वक पढ़ें । किसी भी स्पष्टीकाण के लिए हमें पूछे । आप भाग लेना चाहते है या नहीं आपका निर्णय है ।

3. अध्यन्न का उद्देश्य क्या है?

मैंसेटर और टेम्पोरल मांसपेशियों के इलेक्ट्रोमोग्राफिक अध्ययन के माध्यम से पूरे डेन्चर प्रोस्थेसिस के साथ और बिना जेरिएटिक मरीज़ों में चबाने वाली मांसपेशियों की गतिविधि का मूल्यांकन करना।

4. मैं क्यों चुना गया हूँ?

आपको इस अध्यन्न के लिए चुना गया है क्यूंकि, आप इस अध्यन्न के लिए आवश्यक मापदंडो को पूरा कर रहे है ।

5. क्या इसमें मुझे भाग लेना चाहिए?

अनुसंधान के छेत्र में आपकी भागीदारी पूरी तरह स्वैछिक है। यदि आप करते है तो आपको इस जानकारी को रखने के लिए पत्र दिया जायेगा और एक सहमित पत्र पर हस्ताक्षर करने के लिए कहा जाएगा।

अध्यन्न के दौरान आप कभी भी किसी भी समय और बिना कारण दिए वापस लेने के लिए स्वतंत्र हैं ।

6. क्या होगा यदि मैं इस अध्यन्न में भाग लेता हूँ?

इलाज के पहले और बाद में आपको इलेक्ट्रोमोग्राफि से गुजरना होगा ।

7.मुझे क्या करना होगा?

आपको अध्ययन के लिए अपनी नियमित जीवन शैली बदलने की ज़रूरत नही है ।

8. किस प्रक्रिया का परीक्षण किया जा है?

इलेक्ट्रोमोग्राफी के पूरे डेन्चर निर्माण के साथ और उसके बिना की जाएगी।

9. इस शोध में कौन से हस्तक्षेप दिए जायेंगे?

कोई हस्तक्षेप नहीं होगा।

10 इस अध्यन्न में भाग लेने का क्या दुष्प्रभाव है?

इस अध्यन्न के मरीजो पर कोई दुष्प्रभाव नही होते है ।

11. इस अध्यन्न में भाग लेने के संभावित जोखिम और नुक्सान क्या है?

इस अध्यन्न में भाग लेने में कोई जोखिम या संभावित नुकसान नही है ।

12. भाग लेने के संभावित लाभ क्या है?

एलेवेटर की मांसपेशियां बिना डेंटल प्रोस्थेसिस वाले लोगों की तुलना में डेन्चर प्रोस्थेसिस पहनने वाले लोगों में ज्यादा गतिविधि दिखाएंगी।

13. यदि कोई नयी जानकारी उपलब्ध हो जाती है ?

यदि अनुसंधान के दौरान अतिरिक्त जानकारी उपलब्ध हो जाती है तो आपको इनके बारे में बताया जाएगा और आप अपने शोधकर्ता के साथ चर्चा करने के लिए स्वतंत्र हैं, आपका शोधकर्ता आपको बताएगा कि क्या आप अध्ययन को जारी रखना चाहते हैं। यदि आप तय करते हैं तो वापस लेने, आपका शोधकर्ता आपके वापसी के लिए व्यवस्था करेगा अगर तुम अध्ययन में जारी रखने का निर्णय लेते हैं, तो आपको एक अद्यतन सहमति फॉर्म पर हस्ताक्षर करने के लिए कहा जा सकता है।

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14. जब शोध अध्यन्न बंद हो जाता है तो क्या होता है?

अध्यन्न बंद हो जाता है / निर्धारित समय से पहले ख़त्म हो जाता है मरीज / स्वयंसेवक के लिए समझाया जाएगा ।

15. क्या कुछ गलत हो सकता है?

यदि कोई गंभीर प्रतिकूल घटना होती है, या अध्ययन के दौरान कुछ गलत हो जाता है, तो शिकायतों को संस्था (संस्थाओं), और संस्थागत नैतिक समिति को रिपोर्ट करके संभाला जाएगा।

16. इस अध्ययन में मेरे हिस्से को गोपनीय रखा जाएगा?

हाँ, यह गोपनीय रखा जाएगा।

17. शोध अध्ययन के परिणामों का क्या होगा?

परिणाम प्रोस्थोडॉन्टिक्स दन्त चिकित्सा विज्ञानं के बाबू बनारसी दास कॉलेज लखनऊ के विभाग की आत्मा गुण है लखनऊ। किसी भी रिपोर्ट / प्रकाशन के मामले में आपकी पहचान को गोपनीय रखा जाएगा।

18. जो अनुसंधान का आयोजन किया जाता है?

यह शोध अध्ययन प्रोस्थोडॉन्टिक्स विभाग दन्त चिकित्सा विज्ञानं के बाबू बनारसी दास कॉलेज लखनऊ द्वारा आयोजित किया जाता है।

19. क्या अध्ययन ख़त्म हो जाने बाद अध्ययन के परिणामों को उपलब्ध कराया जाएगा ?

हाँ।

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20. कौन अध्ययन की समीक्षा किया है?

अध्ययन की समीक्षा की गई है और विभाग के प्रमुख ने

मंजूरी दे दी है, संस्था की आईईसी और आईआरसी ।

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21.अिधक जानकारी के लिए संपर्क

डॉ. आयशा मिर्जा
पीजी छात्र
प्रोस्थोडॉन्टिक्स दन्त चिकित्सा विज्ञानं विभाग
बाबू बनारसी दास कॉलेज ऑफ़ डेंटल साइंस
लखनऊ-226028
Email id aisha.mirza15@ gmail.com
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डॉ लक्ष्मी बाला,
सदस्य सचिव आईईसी
बाबू बनारसी दास कॉलेज ऑफ़ डेंटल साइंसेज
लखनऊ- 226028
bbdcods.iec@gmail.com

पीआई के हस्ताक्षर ....।
नाम ....
तारीख__

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Babu Banarasi Das College of Dental Sciences

(Babu Banarasi Das University)

BBD City, Faizabad Road, Lucknow – 227105 (INDIA)

Consent Form (English)

Title of the Study ………..

Study Number……..

Subject's Full Name……….

Date of Birth/Age ………

Address of the Subject…………………….

Phone no. and e-mail address………………

Qualification ………………………………

Occupation: Student / Self Employed / Service / Housewife/

Other (Please tick as appropriate)

Annual income of the Subject………………

Name and of the nominees(s) and his relation to the subject .... (For the purpose of compensation in case of trial related death).

1. I confirm that I have read and understood the Participant Information Document dated ……..for the above study and have had the opportunity to ask questions. **OR** I have been explained the nature of the study by the Investigator and had the opportunity to ask questions.
2. I understand that my participation in the study is voluntary and given with free will without any duress and that I am free to withdraw at any time, without giving any reason and without my medical care or legal rights being affected.
3. I understand that the sponsor of the project, others working on the Sponsor‘s behalf, the Ethics Committee and the regulatory authorities will not need my permission to look at my health records both in respect of the current study and any further research that may be conducted in relation to it, even if I withdraw from the trial. However, I understand that my Identity will not be revealed in any information released to third parties or published.
4. I agree not to restrict the use of any data or results that arise from this study provided such a use is only for scientific purpose(s).
5. I permit the use of stored sample (tooth/tissue/blood) for future research. **Yes [ ]** **No [ ]** **Not Applicable [ ]**
6. I agree to participate in the above study. I have been explained about the complications and side effects, if any, and have fully understood them. I have also read and understood the participant/volunteer's Information document given to me.

Signature (or Thumb impression) of the Subject/Legally Acceptable Representative:……………..

Signatory‘s Name……………. Date ……….

Signature of the Investigator………………… Date………..

Study Investigator‘s Name.......................... Date………..

Signature of the witness…………………… Date………..

Name of the witness…………………………

Received a signed copy of the PID and duly filled consent form

Signature/thumb impression of the subject or legally Acceptable representative Date…….

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Babu Banarasi Das College of Dental Sciences

(Babu Banarasi Das University)
BBD City, Faizabad Road, Lucknow – 227105 (INDIA)

<u>सहमति पत्र</u>

अध्ययन शीर्षक...
अध्ययन संख्या...
प्रतिभागी के पूर्ण नाम..
जन्म तिथि / आयु...
प्रतिभागी का पता ....
फोन नं. और ई–मेल पता ....
योग्यता ....
व्यवसाय: छात्र / स्व कार्यरत / सेवा / ग्रहिणी ....
अन्य (उचित रुप मे टिक करें) ....
प्रतिभागी की वार्षिक आय ....
प्रत्याशीयो के नाम और प्रतिभागी से संबंध...(परीक्षण से संबंधित मौत के मामले मे मुआवजे के प्रयोजन के लिए)

1. मेरी पुष्टि है कि मैने अध्ययन हेतु सुचना पत्र दिनांक .... को पढ व समझ लिया तथा मुझे प्रश्न पुछने या मुझे अध्ययन अन्वेषक ने सभी तथ्यों को समझा दिया है तथा मुझे प्रश्न पुछने के समान अवसर प्रदान किए गये।

2. मैंने यहाॅ समझ लिया कि अध्ययन में मेरी भागीदारी पूर्णतः स्वैच्छिक है और किसी भी दबाव के बिना स्वतंत्र इच्छा के साथ दिया है किसी भी समय किसी भी कारण के बिना , मेरे इलाज या कानूनी अधिकारो को प्रभावित किए बिना , अध्ययन में भाग न लेने के लिए स्वतंत्र हुं ।

3. मैंने यह समझ लिया है कि अध्ययन के प्रायोजक , प्रायोजक की तरफ से काम करने वाले लोग, आचार समिति और नियामक अधिकारियों को मेरे स्वास्थ्य रिकार्ड को वर्तमान अध्ययन या आगे के अध्ययन के सन्दर्भ देखने के लिए मेरी अनुमति की जरूरत नही है, चाहे मैने इस अध्ययन से नाम वापस ले लिया है। हॅालाकि मै यह समझता हुं कि मेरी पहचान को किसी भी तीसरे पक्ष या प्रकाशित माध्यम में नही दी जायेगी।

4. मै इससे सहमत हूॅ कि कोई भी डेटा या परिणाम जो इस अध्ययन से प्राप्त होता है उसका वैज्ञानिक उद्देश्य (ओं) के उपयोग के लिए मेरी तरफ से कोई प्रतिबंध नही है।
5. भविष्य के अनुसंधान के लिए भंडारित नमूना (ऊतक/रक्त) पर अध्ययन के लिए अपनी सहमति देता हुं।
हॉ [ ] नही [ ] अनउपयुक्त [ ]

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6. मै परीक्षण की अनुमति देता हुॅं। मुझे इसके द्वारा यदि कोई परेशानी होती है, इसके बारे में जानकारी दे दी गई है। मैने रोगी जानकारी सूचना पत्र को पढ तथा समझ लिया है।
प्रतिभागी / कानूनी तौर पर स्वीकार्य प्रतिनिधि का हस्ताक्षर (या अंगूठे का निशान..
हस्ताक्षरकर्ता का नाम.. दिनांक ....अन्वेषक के हस्ताक्षर .... दिनांक ....
अध्ययन अन्वेषक का नाम ....
गवाह के हस्ताक्षर .... दिनांक ....गवाह के नाम ....
मैनें पीआईडी और विधिवत भरे सहमति फार्म का एक हस्ताक्षर की नकल प्राप्त की.

प्रतिभागी कानूनी तौर पर प्रतिनिधि का हस्ताक्षर / अंगूठे का निशान .... दिनांक..........................

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TOOLS FOR STATISTICAL ANALYSIS

Formula used for the analysis

The Arithmetic Mean

The most widely used measure of central tendency is arithmetic mean, usually referred to simply as the mean, calculated as

$$\bar{X} = \frac{\sum_{i=1}^{n} X_i}{n}$$

Standard Deviation and standard Error

The standard deviation (SD) is the positive square root of the variance, and calculated as

$$SD = \sqrt{\frac{\sum X_i^2 - \frac{(\sum X_i)^2}{n}}{n-1}}$$

where, n= no. of observations

and also denoted by subtracting minimum value from maximum value as below

Range = Maximum value - Minimum value

Tests of significance

Test of significance are used to estimate the probability that the relationship observed in the data occurred purely by chance was there a relationship between the variables. They are used to test the hypothesis proposed at the start of the study.

In this study Parametric tests were used

a) **The data was normally distributed**

b) **The data was obtained from the sample which is randomly selected**

c) **The data was quantitative data**

I. T TEST.

T tests are based on the t distribution which is a symmetrical, bell-shaped curve like the normal distribution, but having different area and probability properties.

T distribution is a family of curves which are differentiated by their degrees of freedom.

With increasing sample sizes, the t distribution assumes the shape of the normal distribution. 2 A sample size of 100 is often chosen as the cut-off point for deciding when to apply For t or z.

TYPES OF T TESTS INDICATIONS.

a) Paired T Test

The paired t test is used to decide whether the differences between variables measured on the same or similarly matched individual are on average zero. As the data are matched there must be an equal number of observations in each sample.

Assumption: The paired t-test assumes that the differences in scores between pairs are approximately normally distributed, although the two sets of data under scrutiny do not need to be normally distributed.

b) Unpaired or two-sample t test (equal variance assumed)

The unpaired t test is used for comparing two independent groups of observations when no suitable pairing of the observations is possible.The samples do not need to be of equal sizes.

Assumptions: The test requires the populations to be normally distributed with equal variance, though the test is relatively robust to deviations from these assumptions. Unpaired t test or two-sample t test (unequal variance).

When the variances of the two groups differ and transformation does not produce equal variance, the calculation of the t test becomes more complex. Instead of using the pooled variance, estimates of the individual population variances are used.

Formula:

$$t = \frac{M_x - M_y}{\sqrt{\frac{S_x^2}{n_x} + \frac{S_y^2}{n_y}}}$$

M =mean

n = number of scores per group

x =individualscore

$$S^2 = \frac{\sum (x - M)^2}{n - 1}$$

M =mean

n= number of scores in group

-
- Define the problem
- State null hypthesis(H_0) & alternate hypothesis(H_1)
- Find t value, Find (X_1 - X_2)
- Calculate SE of difference between two means

SE = $\sigma\sqrt{1/n_1+1/n_2}$ or

t = (X_1 - X_2) / SE

- Calculate degree of freedom = $n_1 + n_2 - 2$

- Fix the level of significance (0.05)
- Compare calculated value with table value at corresponding degrees of freedom and significance level.
- If observed t value is greater than theoritical t value, t is significant, reject null hypothesis and accept alternate hypothesis.

Statistical significance

Level of significance "p" is level of significance signifies as below:

$p > 0.05$	Not significant (ns)
$p < 0.05$	significant (*)

Observed Masseter muscle activity (µV) of two groups at right side

S.NO.	Masseter muscle activity (µV)- Right side	
	Group I	Group II
1.	477.5	207.5
2.	492.5	450.0
3.	220.0	170.0
4.	162.5	140.0
5.	205.0	197.5
6.	367.5	285.0
7.	130.0	115.0
8.	215.0	202.5
9.	180.0	175.0
10.	135.0	127.5
11.	210.0	130.0
12.	242.5	230.0
13.	177.5	165.0
14.	235.0	232.5
15.	142.5	135.0
16.	162.5	135.0
17.	157.5	125.0
18.	195.0	142.5
19.	140.0	135.0
20.	190.0	172.5

Observed Masseter muscle activity (µV) of two groups at left side

S.NO.	Masseter muscle activity (µV)- Left side	
	Group I	Group II
1.	152.5	127.5
2.	470.0	402.5
3.	200.0	167.5
4.	205.0	135.0
5.	260.0	190.0
6.	362.5	347.5
7.	132.5	125.0
8.	217.5	197.5
9.	170.0	162.5
10.	147.5	132.5
11.	260.0	227.5
12.	490.0	265.0
13.	180.0	175.0
14.	190.0	160.0
15.	162.5	140.0
16.	165.0	162.5
17.	187.5	180.0
18.	170.0	155.0
19.	165.0	160.0
20.	160.0	145.0

Observed Temporalis muscle activity (μV) of two groups at right side

S.NO.	Temporalis muscle activity (μV)- Right side	
	Group I	Group II
1.	260.0	125.0
2.	265.0	127.5
3.	202.5	180.0
4.	195.0	177.5
5.	167.5	140.0
6.	380.0	357.5
7.	142.5	120.0
8.	180.0	147.5
9.	172.5	160.0
10.	190.0	180.0
11.	300.0	215.0
12.	277.5	237.5
13.	205.0	162.5
14.	267.5	172.5
15.	177.5	175.0
16.	172.5	125.0
17.	145.0	142.5
18.	170.0	140.0
19.	177.5	157.5
20.	177.5	165.0

Observed Temporalis muscle activity (μV) of two groups at left side

S.NO.	Temporalis muscle activity (μV)- Left side	
	Group I	Group II
1.	197.5	132.5
2.	365.0	82.5
3.	162.5	152.5
4.	207.5	87.5
5.	190.0	180.0
6.	397.5	232.5
7.	177.5	150.0
8.	152.5	137.5
9.	172.5	167.5
10.	160.0	112.5
11.	285.0	215.0
12.	210.0	192.5
13.	180.0	175.0
14.	295.0	125.0
15.	175.0	167.5
16.	177.5	170.0
17.	140.0	122.5
18.	132.5	112.5
19.	165.0	140.0
20.	167.5	147.5

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