EVALUATION OF ELEVATOR MUSCLE ACTIVITY USING ELECTROMYOGRAPHY IN PATIENTS RESTORED WITH FIXED PARTIAL DENTURE IN GROUP FUNCTION OCCLUSION AND CANINE GUIDED OCCLUSION

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In partial fulfillment of the requirements for the degree of

MASTER OF DENTAL SURGERY

(BRANCH – I)

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2014 – 2017

CERTIFICATE

This is to certify that **Dr. S. ELAVARASAN,** Post Graduate student (2014 - 2017) in the Department of Prosthodontics and Crown and Bridge, has done this dissertation titled **"EVALUATION OF ELEVATOR MUSCLE ACTIVITY USING ELECTROMYOGRAPHY IN PATIENTS RESTORED WITH FIXED PARTIAL DENTURE IN GROUP FUNCTION OCCLUSION AND CANINE GUIDED OCCLUSION"** under my direct guidance and supervision in partial fulfillment of the regulations laid down by **The Tamil Nadu Dr. M.G.R. Medical University, Guindy, Chennai – 32** for **M.D.S.** in **Prosthodontics and Crown & Bridge (Branch I)** Degree Examination.

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DECLARATION

I, **Dr. S. ELAVARASAN,** do hereby declare that the dissertation titled **"EVALUATION OF ELEVATOR MUSCLE ACTIVITY USING ELECTROMYOGRAPHY IN PATIENTS RESTORED WITH FIXED PARTIAL DENTURE IN GROUP FUNCTION OCCLUSION AND CANINE GUIDED OCCLUSION"** was done in the Department of Prosthodontics, Tamil Nadu Government Dental College & Hospital, Chennai 600 003. I have utilized the facilities provided in the Government Dental College for the study in partial fulfilment of the requirements for the degree of **Master of Dental Surgery** in the speciality of **Prosthodontics and Crown & Bridge (Branch I)** during the course period **2014-2017** under the conceptualization and guidance of my dissertation guide, **PROF. Dr. K. VINAYAGAVEL. MDS.,**

I declare that no part of the dissertation will be utilized for gaining financial assistance for research or other promotions without obtaining prior permission from the Tamil Nadu Government Dental College & Hospital.

I also declare that no part of this work will be published either in the print or electronic media except with those who have been actively involved in this dissertation work and I firmly affirm that the right to preserve or publish this work rests solely with the prior permission of the Principal, Tamil Nadu Government Dental College & Hospital, Chennai 600 003, but with the vested right that I shall be cited as the author(s).

Signature of the PG student **Signature of the HOD**

Signature of the Head of the Institution

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This agreement herein after the "Agreement" is entered into on this day, **December 23, 2016** between the **Tamil Nadu Government Dental College and Hospital** represented by its Principal having address at Tamil Nadu Government Dental College and Hospital, Chennai-3, (hereafter referred to as, 'the College')

And

Dr. K. VINAYAGAVEL, M.D.S., aged 44 years working as Professor, in the Department of Prosthodontics and crown and bridge at Tamil Nadu Government Dental College and Hospital, Chennai-3 having residence address at No.15, Guru Kirpa Apartments, G3, 4th Cross, United India Colony, Kodambakam, Chennai - 24 (herein after referred to as the 'Researcher and Principal investigator')

And

Dr. S. ELAVARASAN aged 33 years currently studying as Post Graduate student in the Department of Prosthodontics and Crown & Bridge, Tamil Nadu Government Dental College and Hospital, Chennai-3 (herein after referred to as the 'PG/Research student and Co- investigator').

Whereas the 'PG/Research student as part of her curriculum undertakes to research on the study titled **"EVALUATION OF ELEVATOR MUSCLE ACTIVITY USING ELECTROMYOGRAPHY IN PATIENTS RESTORED WITH FIXED PARTIAL DENTURE IN GROUP FUNCTION OCCLUSION AND CANINE GUIDED OCCLUSION"** for which purpose the Researcher and Principal investigator shall act as Principal investigator and the College shall provide the requisite infrastructure based on availability and also provide facility to the PG/Research student as to the extent possible as a Co-investigator

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Witnesses

1. PG Student

2.

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LIST OF ABBREVIATIONS

SL No.	ABBREVIATION	EXPANSION
1	**EMG**	Electromyography.
2	**CGO**	Canine Guided Occlusion
3	**GFO**	Group Function occlusion
4	**mm**	Millimetre
5	**µvolt**	Micro volt
6	**cm**	Centimetre
7	**TMJ**	Temporomandibular joint
8	**TMD**	Temporomandibular disorders
9	**LED**	Light Emitting Diode
10	**JVA**	Joint Vibration Analysis
11	**MUAP**	Motor Unit Action Potential
12	**FPD**	Fixed Partial Denture
13	**OPG**	Orthopantomogram
14	**IOPA**	Intra Oral Periapical Radiograph

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ABSTRACT

Introduction: There is no way to isolate one part of the Stomatognathic system and ignore the other parts. If one part gets affected the other parts prone to suffer. Establishing the optimum oral health cannot be achieved unless all the functional components are in harmony with each other. We should establish a harmonious inter-relationship of all parts, without excessive stress, since stress induces deterioration of the weaker components of the system. Group function and Canine guided occlusion have been used in the study.

Keywords: Electromyography, Canine guided occlusion, Group function occlusion, Elevator muscle activity.

Aim: The purpose of this study was to determine which of the two occlusal schemes causes a greater reduction in elevator muscle activity (Masseter, Temporalis) and decrease of muscle tension in lateral movements of mandible using EMG.

Materials and methods: 10 Partially edentulous patients were selected as per predetermined criteria. Each patient was restored with two fixed partial dentures with Canine guided occlusion (Group A) and Group function occlusion (Group B) with an interval of one week. After cementation, surface EMG recordings were made in maximum voluntary clenching and lateral excursion for Group function occlusion and Canine guided occlusion. The results were then statistically analyzed.

Results: Significant reduction of elevator muscle activity was observed in lateral excursion in patients restored with Canine guided occlusion, but it was nearly the same for clenching in both the occlusal patterns.

Conclusion: It was concluded from the above results that, when an entire occlusion is to be restored, reestablishment with canine guided occlusion is preferred when remaining canines are present with good periodontal support. The EMG values obtained in this study can be taken as base line data for future studies.

INTRODUCTION

United we stand, divide we fall. As we know the harmonious functioning of the stomatognathic system is not possible without the trio of TMJ, muscles and the teeth going hand in hand. Disturbance in one factor leads to a chain of events eventually leading to the collapse of the entire stomatognathic system.

Though treating TMJ disorders and muscle dysfunction seemed to be a vague area of diagnosis and treatment, the advent of medical facilities like Electromyography, T scan, Joint Vibration Analysis (JVA) has helped us a lot to locate the site causing the problem. Electromyography is nowadays being used increasingly in research and clinical dentistry.

There is an elegant synchrony in the input delivered to the masticatory system by means of proprioception and perception which in turn send signals to the muscles, teeth and TMJ through the pathway of motor responses. Perception relates to the sensory innervation of the periodontal membrane, epithelial surfaces of the oral cavity, muscles of the tongue and muscles of mastication and TMJ. Any break in this vicious cycle leads to dysfunction in the stomatognathnic system.

The extent and number of occlusal contacts and their periodontal mechanoreceptors play a keyrole as the peripheral occlusal control of the elevator muscles. It defines the electrical muscle activity, bite force, jaw movements and masticatory efficiency.

Anterior guidance is mandatory for the integrity of anterior teeth and the long time stability of the posterior teeth. Two conflicting concepts on occlusion has gained popularity nowadays which include Group function and Canine Guidance.

In the Glossary of Prosthodontic terms, canine protection is defined as "a form of mutually protected articulation in which the vertical and horizontal overlap of the canine teeth disengage the posterior teeth in the excursive movements of the mandible." Group function is defined as "multiple contact relations between the maxillary and mandibular teeth in lateral movements on the working side"[1].

According to Beyron who favoured the concept of Group function occlusion, exhibits attrition and abrasion as a positive adjustment as they distribute the occlusal stress and direct them in a more axial direction[2].

D'Amico claimed Canine Guided occlusion is more advantageous as Canine has a uniquely sensitive feedback mechanism leading to involuntary reduction in jaw muscle tension and force application. In lateral excursions canine, causes a break in tension of temporal and masseter and act as a natural stress breaker[3].

So a study is undertaken to find out which of these two types of occlusal guidance causes a greater quantitative reduction in the activity of elevator muscles (Masseter, Temporalis) using Electromyography.

AIM AND OBJECTIVES

AIM:

The aim of the study attempts to find out the elevator (Masseter, Temporalis) muscle activity using Electromyography with the help of surface electrodes when the patients are restored with fixed partial dentures in group function occlusion and canine guided occlusion.

OBJECTIVES:

1. To observe and compare the EMG values of the Masseter during clenching in patients restored with Fixed partial dentures in group function occlusion and canine guided occlusion.
2. To observe and compare the EMG values of the Masseter during lateral excursion in patients restored with Fixed partial dentures in group function occlusion and canine guided occlusion.
3. To observe and compare the EMG values of the Temporalis during clenching in patients restored with Fixed partial dentures in group function occlusion and canine guided occlusion.
4. To observe and compare the EMG values of the Temporalis during lateral excursion in patients restored with Fixed partial dentures in group function occlusion and canine guided occlusion.

REVIEW OF LITERATURE

ROBERT E. MOYERS (1956)[4] observed about the neurophysiologic regulation of centric relation and other jaw positions. He found that the muscles alone could not establish so a precise mandibular position, while muscles contracting. But the maximum intercuspation of teeth makes mandibular positions possible for the brain to learn quickly. The only reflex determining mandibular position present at birth is the postural position of the mandible. Centric relation is learned after the eruption of teeth. It is the first learned reflex determining the occlusal position of the mandible after expedient mechanisms for avoiding occlusal disharmonies. They are forgotten when the source of the afferent impulses prompting them is removed. Centric relation in the edentulous patient is determined largely by the muscle proprioceptors, and thus presents slightly different problems in registration.

J.C. HICKEY (1957)[5] 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.

ANGELO D'AMICO (1961)[3] conducted a study on attrition in the prewhite California Indians. He stated that the natural vertical and horizontal overlap relation of the upper cuspids is not strictly a mechanical block. Their function is more than a mechanical guidance of the mandible and mandibular teeth into centric occlusion. If the upper cuspids are in the ideal functional relation, attrition of the occlusal surfaces of premolars and molars is almost completely eliminated.

JERRY GARNICK et al (1962)[6] conducted a study on the rest position of the mandible clinically and electromyographically in 20 adult subjects with functionally adequate occlusion. Three commonly used methods for the clinical determination of the vertical relation of rest position gave adults that were not significantly different statistically. The average inter occlusal distance was about 1.7 mm clinically. A graded instrument was used to measure the amount of closure of the jaws from an opening position. The instrument was used in combination with EMG recordings of the anterior and posterior parts of temporalis and masseter muscles and the anterior parts of the digastric muscles. The clinically observed rest position was located in a space of more than minimal [resting] muscle activity in 13 of 20 subjects.

PERRY C. ALEXANDER (1963)[7] analysed about the cuspid protective occlusion and concluded that

1. The balanced occlusion theory is a valid in relation to the concept of physiologic, biologic, histologic and clinical evidence.

2. Role of canine tooth was to function in union along with the remaining teeth.
3. Proprioceptive response of the periodontal membrane of canine teeth is not more sensitive than those of periodontal membrane of other teeth.
4. 'Building up' of the maxillary canine tooth so that it will function alone in eccentric positions is contraindicated
5. Loss of vertical dimension based only on the attrition of teeth in prehistoric skulls is invalid in view of the well-documented evidence supporting the continuous eruption theory by GOTTLIEB and the relative stability of the vertical relation of rest position as supported by cephalometric, clinical and electromyographic studies.
6. Development of an edge-edge occlusion as proposed by D'AMICO was unacceptable as it refuses the concepts of relative stability of the rest vertical dimension and the continuous eruption theory.

SYLVAN SCHIRESON (1963)[8] outlined an approach to rational therapy of some problems encountered in periodontally involved mouths. These problems include food impaction into the gingival margins and pappilae, and loosening of teeth due to periodontal traumatism. He concluded that the periodontal disease and its sequelae, the loss of teeth were not due to deviate from nature's plan. Primitive man had the same problems has does modern man. The therapeutic

approach should attempt to limit towards the treatment of disease and its causes.

LAWRENCE A. WEINBERG (1964)[9] recorded 100 dentulous subjects cinematically to investigate the relationship between the occlusal pattern, centric relation, centric occlusion, and temporomandibular joint dysfunction. In that 81 percent exhibited lateral working side cuspal contact and only 19 percent had a canine-protected occlusion. A 2 mm. discrepancy between centric relation and centric occlusion was found in only one subject of the working side contact group, whereas more than half of the canine-protected group had this degree of "hit and slide." He suggested that the possibility of an association between a canine-protected occlusion and large discrepancies between centric relation and centric occlusion.

CHRALES R. JERGE (1964)[10] presented a hypothesis concerning the nervous mechanism subserving cyclic jaw movements. Data was obtained from 46 experiments and the animals were domestic cats. Experiment consisted of recording the electrical activity of individual cells in various parts of the trigeminal complex from an extra cellular position. The craniotomies were performed with animals in stereotaxic instrument.

The fundamental mechanism underlying cyclic jaw motion appeared to be the interaction of jaw closing muscle proprioceptors and intraoral pressure receptors of the teeth and soft tissue. The concept of two interacting dissimilar reflexes did not rule out the possibility of

reciprocal innervations in classical sense. The suggested mechanism of jaw muscle interaction and that of reciprocal innervations were compatible. Recent work of Kawamura proved that, reciprocal relationships may exist

PERRY C. ALEXANDER (1967)[11] evaluated the two theories of occlusions with clinical findings about the dentitions. The difference between these two theories was the treatment of the maxillary canine teeth. The canine function theory believed that the canine teeth support the forces of mastication during eccentric mandibular movements and balanced occlusion theory believed that the forces of mastication must be supported by as many teeth as possible during eccentric mandibular movements. The canine function theory claims that the periodontal ligament of the canines has a “protective mechanism” capable of protecting the periodontium from periodontal breakdown due to the horizontal forces. The clinical evidence presented does not support this claim. He suggested that the dentition should be treated according to the principles of the balanced occlusion theory.

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 insertion 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

contractions. 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.

ROBERT R. SCAIFE et al (1969)[13] investigated the natural occurrence of cuspid guidance in eccentric positions. 1,200 patients were examined to determine the natural incidence of a cuspid protected occlusion. The influence of the maxillary cuspids was observed in centric occlusion and in protrusive, left, and right lateral excursive positions. Bilaterally protected occlusion was found in 57 percent of the subjects, 16.4 percent had a unilateral cuspid protection, and 26.6 per cent had no evidence of this phenomenon in lateral excursions. In protrusive movements, 99.4 per cent of the subjects lacked a cuspid protection. They concluded that the natural occurrence of a cuspid protective mechanism was relatively large (57 per cent) but by no means overwhelmingly predominant. The results of this study showed factors both favorable and unfavorable to the cuspid protection theory and group function theory.

CHARLES H. GIBBS et al (1971)[14] focused on the results of jaw motion studies in relation to two objectives .The first objective was to provide an accurate and extensive study of jaw motion and maxillomandibular relationship during chewing. The second objective was to determine the manner and degree that differing states of occlusion affect jaw motion during chewing. Jaw motion data was

obtained from 12 subjects: 4 from normal occlusion, 4 with obvious malocclusions. The paths of motion of condyles are quite similar for subjects with "normal occlusion and malocclusions. The closed position repeatability is ranging from 0.01-0.06 inch.

TIMOTHY J O' LEARY et al, (1972)[15] assessed the mobility of teeth in 30 maxillary quadrants of each of two groups of subjects ie., cuspid-protected and group function occlusions. They found that the mean mobility of teeth was greater with cuspid protected lateral movements than in teeth with group function leads. Cuspid protection may be physiologic for many people but the practice of altering occlusal relations to establish a cuspid protection as prophylactic is open to question. They suggested that changing the occlusion from group function to canine protection may be deleterious to the periodontium.

ROBERT J. CRUM et al (1972)[16] This review of the literature reveals the discrete sensitivity that exists in the separate components of the masticatory system. The function of the masticatory system is dependent upon the input of the neural system by proprioception and perception. A defect or non integration of the proprioceptive or perceptive input may result in poor function or pathologic changes to parts of the system. The success or failure of a prosthodontic treatment is also dependent upon the integration of proper proprioceptive feedback and motor responses. They observed that the anterior teeth were more sensitive than the posterior teeth. This shows the importance of the incisal guidance in oral rehabilitation. They also observed that

the anterior and posterior teeth were more sensitive to lateral forces than to the axial forces. The lower thresholds to lateral forces may be a protective mechanism.

D.BLAKE McADAM (1976)[17] discussed tooth loading and cuspal guidance in canine and group function occlusions. He concluded that Canine guidance and group function occlusions were considered normal. When the entire occlusion is to be restored, either occlusal scheme will serve adequately. When small portion of occlusion is to be restored, the restoration must be consistent, with the existing occlusal scheme.

DAVID C. MCNAMARA (1977)[18] investigated the neuromuscular effects of tooth contact at the physiologic median occlusal position was conducted before and after adjustments of the occlusion. 18 patients with the history of disturbances in the masticatory system, but whose painful symptoms had subsided, were observed before and after occlusal adjustments. 9 patients with missing teeth restored with fixed partial dentures and occlusal adjustments were done. Another group of 9 subjects with normal occlusions were used as controls. EMG study of the bilateral temporal and masseter muscles enabled quantification of two reflex parameters, the EMG silent period duration, and the mechanical latency of the jaw-opening reflex. Phase-plane traces of jaw- closing velocity as a function of position displayed the repeatability of the median occlusal position. The statistical analysis disclosed that the mean duration of EMG silent periods and latency of

the jaw-opening reflex were significantly reduced following the treatment procedures. Within the limits of this study it was concluded that the described occlusal adjustments will reduce the masticatory reflexes evoked at median occlusal position to within the range of normal subjects. Furthermore these changes can be monitored by electrophysical methods.

STEPHEN P. BRODERSON (1978)[19] showed that the relationship between the maxillary and mandibular anterior teeth is the most important factor in the restoration and maintainence of the ideal occlusion. The anterior teeth occlusion is the key to developing an "ideal" occlusion. The anterior teeth protect the posterior teeth by disoccluding them in eccentric movements, and the posterior teeth protect the anterior teeth by receiving most of the forces of closure in centric position. The anterior guidance is a result of both anterior tooth position and condylar border movements; both factors must be considered in the creation of an anterior guidance.

GARY ROBERT GOLDSTEIN (1979)[20] conducted a study to determine the patterns of lateral occlusal excursions from the maximum intercuspal position (centric occlusion) and to relate with a periodontal index. He concluded that the teeth of mouths having canine-protected occlusions had lower mean periodontal disease index scores than the progressive disclusion or group function. Also, the canines and the molars in the canine-protected subjects showed lower mean periodontal disease index scores than their counter- parts in the progressive disclusion or group function.

ALAIN WODA et al (1979)[21] A review of the literature on occlusal contacts emphasizes the following points. Contacts in centric occlusion do not correspond to any ideal occlusal diagram. Canine protection and group function appear to correspond to two successive states of the evolving dentition under the effect of abrasion. In most lateral occlusions, two maxillary teeth, of which one is the canine, were involved.

ARTURO MANNS et al (1979)[22] studied the relations between EMG, force, and muscular elongations during submaximal isometric contractions of the masseter muscle measuring from 7mm to almost maximal jaw opening. EMG was recorded with superficial electrodes and bite forcerecorded 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.

ROBERT L. DICKSON (1980)[23] discussed the concepts of anterior disclusion such as the mechanical elements of a pair of discluder teeth, discluder dynamic interaction between these elements, and the guidance without causing undue stress on the grinding teeth themselves. A discluder study board was constructed to analyze the dynamic interaction between a pair of discluders. He concluded that, when there was a centric interference prior to equilibration, the dentist can determine whether to grind on the upper or lower tooth of a discluding pair. Precise shaping of the functioning surfaces of the

discluder comes about naturally. The common problem of "loosing the guide" is eliminated. When using the rules presented here, the final canine lift will impart minimum forces to the discluder periodontium.

JOHN D. RUGH et al (1981)[24] 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 – 12.6 mm 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 inter occlusal 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.

KEITH E. THAYER et al (1981)[25] described a technique where metal canine risers were attached to the lingual surface of maxillary canine teeth with acid-etch composite resin. They selected a patient with the chief complaint of grinding and clenching of his teeth. Two years postoperatively the patient was remains comfortable. The bruxing and clenching habits had been eliminated, and the patient was functioning properly.

WILLIAMSON et al (1983)[26] 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.

J. D. RUGH et al (1984)[27] 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.

RONALD J. SHUPE et al (1984)[28] 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.

J.W.C. Mac DONALD et al (1984)[29] described the relationships between EMG activity in the jaw-closing muscles and the location,

area, and direction 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.

U.C.BELSER et al (1985)[30] measured the physiologic behaviour 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 reaction forces at the temporomandibular joints.

Y. YAMADA et al (1985)[31] analysed the electromyograms in clinical dentistry. A neurophysiologic real – time data acquisition and analysis system with a versatile hardware / software combination to be applied in clinical dentistry is introduced. Its application in the clinical environment, allowed the analysis of jaw reflexes and the generation of hard copy output in approximately 31/2 minutes. Such a system provides the basis for advanced diagnostics in dentistry. Electromyography (EMG) is used increasingly as a research tool, as well as in clinical dentistry. The study of reflex responses can provide information about the excitability of alpha and gamma motor neurons of the masticatory muscles.

WILLIAM W. WOOD (1987)[32] 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.

He concluded that,

1. Elevator muscles demonstrate maximum activity. Whenever bilateral occlusal contacts occur during clenching in inter cuspal position.
2. Elevator muscles are activated together in the inter cuspal zone of tooth contact during chewing when the occlusal contacts are balanced bilaterally in this inter cuspal position.
3. Increasing the number of eccentric tooth contacts increases muscle activity during chewing and clenching.
4. Medical pterygoid muscle action is enhanced during mandibular closing.
5. Inferior pterygoid muscle contributes to forward and lateral bracing of the condyle of the mandible.

ARTURO MANNS et al (1987)[33] performed an EMG study between two types of occlusal guidance: group function and canine guidance. Full coverage occlusal splints were made with normal function of the stomatognathic system. Left and right side integrated EMG recordings were made of masseter and temporal muscles during static and dynamic maximal contractions. The results showed and EMG reduction of the elevator muscles with group function relative to their activity in centric occlusion. With canine guidance the reduction is much greater, mainly in the temporal muscle of the mediotrusive side. With canine guided occlusion the pressure is concentrated in a small periodontal surface area. Thus a small amount of pressure or isometric contraction of the elevator muscles is needed to activate the periodontal receptors. The clinical implications of this study suggest the use of canine

guidance in laterotrusion for therapy with full coverage occlusal splints.

In the lateral position with group function, the pressure is distributed over a larger periodontal surface. This allows for greater pressure or increased isometric elevator muscle contraction to reach the tolerance level, which in turn releases the inhibitory influence of the periodontal mechanoreceptors.

With canine-guided occlusion, the pressure is concentrated in a small periodontal surface area. Thus a small amount of pressure or isometric contraction of the elevator muscles is needed to activate the periodontal receptors.

Mechanosensitivity thresholds of the teeth demonstrate that the canines possess a much higher pressure sensitivity and stereotactility in other words, an essentially finer sensitivity-than posterior teeth. Because these are the first teeth to contact in lateral movements, the canines can take over regulatory functions and act as an important protective mechanism against excessive forces.

SHOJI KOHNO et al (1987)[34] described a method of measuring condylar and incisal angles in an effort to develop criteria for anterior guidance in clinical practice. They suggest that the inclination of the sagittal incisal path, which is transferred to the incisal table of an articulator as anterior guidance, should be equal to the inclination of the patient's condylar path. It is of course possible to make the incisal path steeper than the condylar path to some extent; however, it should

not be made more than 25 degrees steeper. Similarly, the incisal path should not be much flatter than the condylar path.

GAR S. GRAHAM et al (1988)[35] conducted a study and compared the canine guidance with first molar guidance to determine whether canine guidance is unique in its effect on masticatory muscle EMG activity during lateral movement and lateral excursive position clenching. They concluded that the EMG activity of the masseter and anterior part of the temporal muscles was reduced with canine guidance and also in first molar guidance during lateral excursive movement and excursive position clenching.

ARTURO MANNS et al (1989)[36] 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

LINDA J. THORTAN (1990)[37] reviewed the historical philosophies and development of group function and canine guidance. Anterior guidance, which can be categorized as group function or canine guidance, is essential for esthetics, phonetics, and mastication. There is no scientific evidence that supports one occlusal scheme over the

other. Where anterior guidance must be re established or where it changes, there currently appear to be more authorities who favour canine guidance over group function.

CARL G. GLASER et al (1991)[38] described the use of etched porcelain veneers in the treatment of a patient with a craniomandibular disorder. The restoration of a progressive delayed disocclusion on periodontally healthy canines by etched porcelain onlays had been presented as a suitable treatment alternative to interrupt bruxism and reverse destructive occlusal neuroses.

RANDALL C. DUNCAN et al (1992)[39] 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 interelectrode 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.

M. M ALSAWAF et al (1992)[40] assessed the influence of dynamic tooth guidance and the influence of change in vertical dimension on the recording of mandibular movements tracing, measuring, and comparing the path of hinge axis of the condyles in subjects with and without TMJ clicking through opening, protrusive, and lateral excursion movements.

The data gathered through computerized tracing of all subjects revealed no significant difference in the mean angles of condylar guidance regardless of whether the craniomandibular contact was an articulation of natural teeth or an articulation of maxillary natural teeth against a tray clutch. Therefore, within the parameters of this investigation, there was no evidence to support the notion that either the change in vertical dimension or the influence of the dynamic interarch tooth guidance reflected a significant alteration in the recordings of condylar path travel.

BAKKE M. (1993)[41] analysed 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.

L. ABD Al-HADI (1993)[42] conducted a study to estimate the prevalence of temporomandibular disorders (TMD) among a population group of nonpatients and to correlate their different symptoms with certain occlusal parameters. Survey included 600 women and men

between 18 and 22 years of age. Horizontal overlap value was determined by a dial caliper gauge. Presence of non- working contacts was detected by dental floss. Eccentric lateral occlusion was studied. They concluded that, TMDs were prevalent on the chewing sides. A low occurrence of TMD was found in Class II Division 2 patients. TMDs were low in the canine-protected occlusion. TMDS were associated with an increased incidence of non working side contacts and also in class II division I patients and in group function occlusion.

A.C. AKOREN et al (1995)[43] 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.

G. L. BORROMEO et al (1995)[44] 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.

VIRGILLIO F. FERRARIO et al (1996)[45] analyzed the maximum opening and mandibular lateral border movements in 165 patients with a considerable lateral deviation in maximum opening. Mandibular movements were measured with a kinesiograph. Half of men and women had a deviation in maximum opening toward the right side. Deviation toward the left side was found in 26 men and 40 women. The results of this investigation underline the importance of dental guidances in the mandibular movements: protection of the occlusal surfaces from abnormal and protection of the temporomandibular joint. The results may be explained by a correlation between the insufficient lateral protection and a temporomandibular mandibular joint dysfunction.

TAKAHIRO OGAWA et al (1996)[46] demonstrated the characteristic of masticatory movement related to the inclination of the occlusal plane in dentate subjects. No significant correlation was found between the inclination of the occlusal plane and the closing path during tapping, there was a significant correlation between the inclination of the occlusal plane and the closing path during masticatory movement outside of the intercuspal range. The incisal path approached the

occlusal plane maintaining a perpendicular relationship in the sagittal plane. These results serve as a background of the functional occlusal plane.

RIAD E. YOUSSEG et al (1997)[47] 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.

IRWIN BECKER et al (1999)[48] 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 temporalis and masseter muscles.

GLENN T. CLARK et al (1999)[49] summarized the research in which experimental occlusal interferences had been placed on the teeth of

animals and human volunteers. The outcome of these interferences was analyzed according to their local pulp – periodontal, jaw function, or bruxism effects. Experimental occlusal interferences in maximum intercuspation had a deleterious effect on periodontal and pulp tissues of the affected tooth. Experimental occlusal interferences that contact only in a lateral jaw movement are infrequently harmful to jaw function. Although occlusal therapy may be justified for reasons of esthetics, gross occlusal instability, or dental disease, the data do not exist showing that occlusal interferences are the cause of chronic jaw dysfunction problems.

TORSTEN JEMT et al (2004)[50] evaluated the effect of two distinctly different occlusal designs on the general chewing pattern as well as the movement in the terminal part of chewing cycle. Chewing pattern was registered by LED attached to on a mandibular tooth and on spectacle frames as a reference. Test subjects received a canine protection occlusion, and the chewing pattern was recorded after a 4 month adaptation period. The occlusion was altered to group function, and a second registration was made after 5 months. The results indicate that the chewing pattern may be influenced by the type of occlusion irrespective of the existence of the maxillary canines.

N. OKANO et al (2007)[51] investigated the influence of experimentally altered occlusal guidance on masticatory muscle activity. Electromyography activities in the bilateral masseter, anterior and posterior temporalis 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 temporalis 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.

PAUL H. POKORNY et al (2008)[52] Reviewing the literature and searching for a scientific basis for occlusion leads to the realization that the earliest reports were predicated upon years of successful clinical observations or subjective experiences and closely held anecdotal opinions that were sometimes associated with proprietary mechanical instrumentation. Occlusal concepts were initially formulated and developed for the edentulous patient requiring prosthetic rehabilitation. Following the exercise of these concepts in clinical practice, they were refined and applied to the fixed prosthodontic reconstruction of the natural dentition. While gnathological concepts offer a structured methodology for prosthodontic procedures, further research is needed to corroborate current occlusal treatment approaches.

YU-YING CHEN et al (2008)[53] this review of the literature reveals 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.

MARIA JOSE CAMPILLO et al (2008)[54] 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.

NEETA PASRICHA et al (2012)[55] 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 re establish 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.

VENUS SIDANA et al (2012)[56] 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.

SAPKOTA et al (2014)[57] conducted a study to find out the frequency of occlusal pattern in lateral position and compared the accuracy of shim-stock and articulating paper. They concluded that the majority of the contact pattern were group function was about 84% with shim stock

and 94% with articulating paper. Also shim stock exhibits superior accuracy and reliability.

JAAFAR ABDUO et al (2015)[58] this review of the literature reveals that, 1. There are some differences between the different lateral occlusion schemes in relation to parafunctional muscle activities and the magnitude of mandibular movement. However, physiologic function and patient acceptance appear to be minimally in fluenced by the lateral occlusion scheme. Nevertheless, the clinical significance of the reported differences cannot be confirmed since the long-term studies have confirmed the suitability of CGO and GFO. CGO or GFO are equally acceptable when restoring dentition. Multidirectional freedom of mandibular movement appears to be physiological. The evidence supports a flexible principle of occlusion rather than a preconceived occlusion theory. Similar lateral occlusion principles can be considered for implant prosthesis.

STUDY DESIGN:

The present study was performed to evaluate the elevator (Masseter, Temporalis) muscle activity using Electromyography with the help of surface electrodes when the patients were restored with fixed partial dentures in group function occlusion and canine guided occlusion.

PLACE OF STUDY:

1. Department of Prosthodontics, Tamil Nadu Government Dental College & Hospital, Chennai.
2. Institute of Neurology, Madras medical College & Rajiv Gandhi Government General Hospital, Chennai.

ETHICAL COMMITTE APPROVEL:

The study was done after obtaining approval from the Institutional Ethical Committee.

ARMAMENTARIUM USED IN THIS STUDY:

ARMAMENTARIUM FOR EXAMINATION:

1. Mouth mirror
2. Explorer
3. Periodontal probe
4. Kidney tray
5. Disposable Gloves
6. Mask
7. IOPA
8. OPG

ARMAMENTARIUM FOR MAKING DIAGNOSTIC MODEL:

1. Rubber Bowl and Alginate Spatula
2. Alginate
3. Stainless steel perforated dentulous stock trays
4. Dental stone
5. Dental plaster
6. Plaster spatula

ARMAMENTARIUM FOR TOOTH PREPARATION:

1. Injection Local Anesthesia (Lignocaine)
2. Sterile 3ml disposable syringe
3. Airotor Hand piece
4. Diamond points
5. Retraction cord

ARMAMENTARIUM FOR IMPRESSION MAKING:

1. Putty elastomeric impression material
2. Light body elastomeric impression material
3. Tray adhesives
4. Spacer (cellophane Sheet)
5. Metal Stock trays
6. Bite registration material
7. Triple tray

ARMAMENTARIUM FOR LAB PROCEDURE:

1. Die stone
2. Die pin

3. Die cutting saw
4. Semi- Adjustable articulator (HANAU WIDE VUE II)
5. Die spacer
6. Inlay wax
7. Casting ring
8. Investment material
9. Burnout machine
10. Casting machine
11. Metal pellets
12. Sand blasting machine
13. Metal trimmers
14. Micro motor
15. Cold mold seal
16. Auto polymerizing resin (tooth colored)

ARMAMENTARIUM TO DETERMINE ELEVATOR MUSCLE ACTIVITY:

1. Electromyograph-EMG 4 CHANNEL EMG.NP.NCS system; Allengers SCORPIO-4P model, including hard ware and soft ware systems. (Allengers Medical Systems Ltd., Chandigarh, India).
2. Active (Black colour), and passive (Red colour) silver-silver electrodes
3. Ground (Green) electrode
4. Electrode Gel
5. Surgical spirit (Hy-Chem Lab, Hyderabad)
6. Micropore surgical tape (3M, Europe)

GROUPING OF PATIENTS:

This clinical study was based on use of group function occlusion and canine guided occlusion in fixed partial denture patients. Hence for each patient two different occlusal types of fixed partial denture were cemented in one week interval. A total of 10 patients were selected.

Group A- Fixed partial denture with group function occlusion (10 samples)

Group B- Fixed partial denture with canine guided occlusion (10 samples)

GENDER:

Male and Female patients aged between 25 to 45 years were selected.

SAMPLE SIZE:

Total number of patients: 10

CRITERIA FOR SELECTION:

INCLUSION CRITERIA:

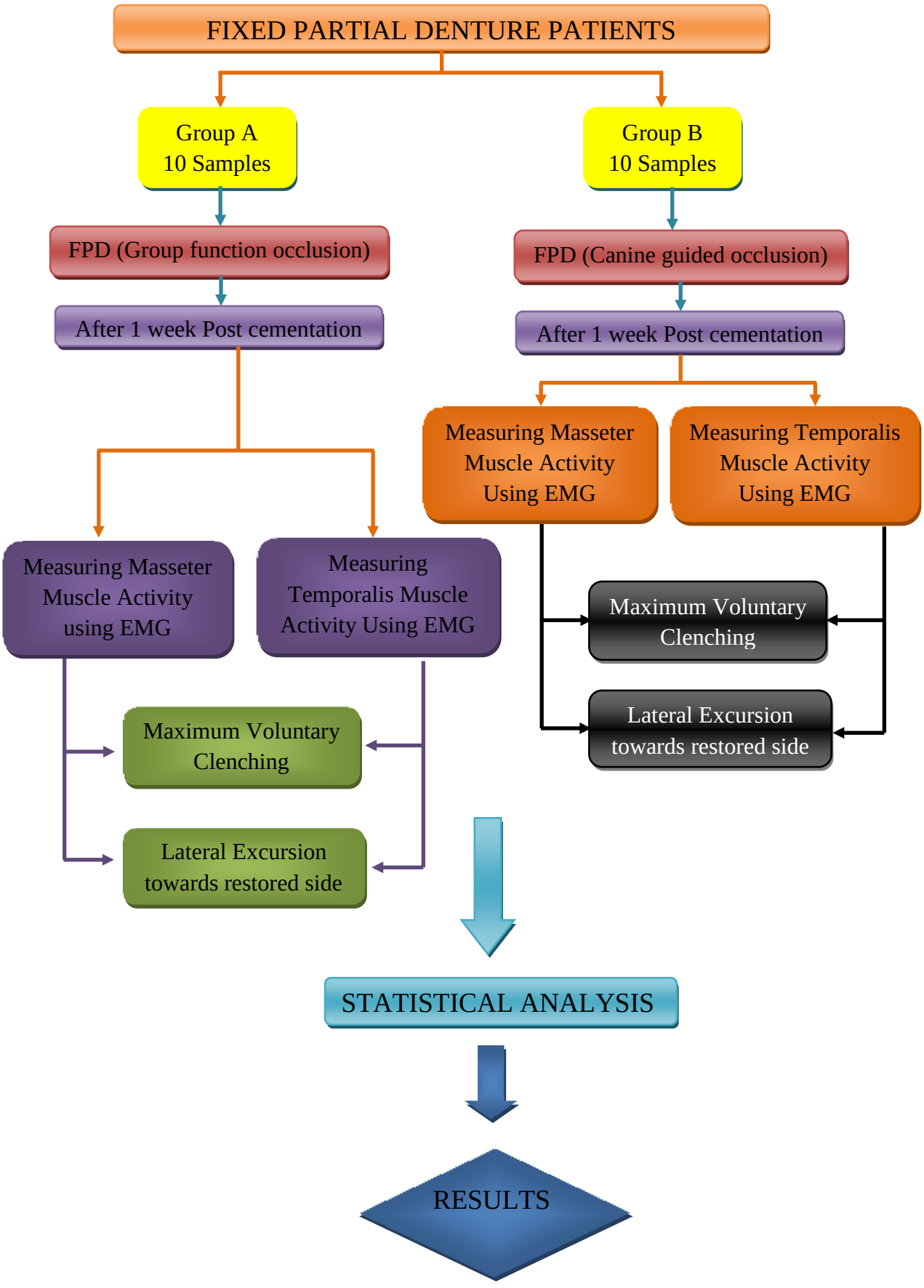
1. FPD preparation for replacing of missing two maxillary premolars which involves canine and first molar as abutments on one side was selected.
2. Intact dentition opposing the edentulous space (any restoration if required was completed before the study was undertaken).
3. The incisal guidance should be acceptable, if not it was corrected either by occlusal equilibration or by restorative procedures.
4. Elimination of posterior interferences and finally achieving good occlusal harmony

5. Presence of good periodontal health.

EXCLUSION CRITERIA:

1. Loss of anterior guidance, which cannot be corrected without extensive restorative procedures were excluded.
2. Multiple tooth missing (long span)
3. Poor periodontal health
4. Missing opposing teeth.
5. Medically compromised and debilitating patients.
6. Pregnant mothers
7. Mentally challenged patients
8. Rotated, supra erupted teeth
9. Recently extracted /unhealed edentulous space
10. Uncorrectable occlusal discrepancies
11. Teeth in cross bite
12. Patients having severely attrited teeth.
13. Patients lacking proper neuromuscular control
14. Patients having deep bite
15. Patients with history of orthodontic treatment
16. Patients having disharmony in occlusion and TMJ dysfunction.

FLOW CHART


FIXED PARTIAL DENTURE PATIENTS
Group A
10 Samples
Group B
10 Samples
FPD (Group function occlusion)
FPD (Canine guided occlusion)
After 1 week Post cementation
After 1 week Post cementation
Measuring Masseter Muscle Activity Using EMG
Measuring Temporalis Muscle Activity Using EMG
Measuring Masseter Muscle Activity using EMG
Measuring Temporalis Muscle Activity Using EMG
Maximum Voluntary Clenching
Lateral Excursion towards restored side
Maximum Voluntary Clenching
Lateral Excursion towards restored side
STATISTICAL ANALYSIS
RESULTS

MATERIALS USED IN THIS STUDY

S.No	Commercial name	Form of the Material	Manufacturer Details
1.	Vignette	Alginate	Densply, USA
2.	Variotime Easy Putty	Polyvinyl siloxane putty impression material	Heraeus, Germany
3.	Variotime Light flow	Polyvinyl siloxane light flow impression material	Heraeus, Germany
4.	Futar D	Vinyl polysiloxane bite registration material	Kettenbach & co. Germany
5.	Templute	Eugenol free temporary luting cement	Prime dental products P.Ltd, Thane
6.	Pearlstone	Type IV Die stone	Asian chemicals, Gujarat.
7.	Denstone	Type III Dental stone	Pankaj Ent. Mandideep (M.P)
8.	Uniwax	Crown wax	Normal, India
9.	Metavest	Phosphate bonded investment material	Delta,Germany
10.	Omin-Pak	#000 Knitted retraction cord	Ossum health care P.Ltd, Bangalore
11.	Mani-Dia Burs	Diamond abrasives	Mani, INC, Japan
12.	Pana-Air	Airotor hand piece	NSK, Japan
13.	DPI Self-cure tooth moulding powder	Auto polymerising resin	DPI, India
14.	Hanau Wide Vue II	Semi adjustable Arcon type articulator	Whipmix, USA
15.	Electromyograph-EMG 4 CHANNEL EMG.NP.NCS system;	Allengers SCORPIO-4P model	Allengers Medical Systems Ltd., Chandigarh, India

METHODOLOGY:

1. Making diagnostic impressions and diagnostic articulation
2. Tooth preparation and impression making
3. Provisional restoration
4. Articulation of Working cast with removable die
5. Fabrication of fixed partial dentures
    a. FPD with group function occlusion
    b. FPD with canine guided occlusion
6. Preparation of patient for Electromyographic Assessment
    a. Landmarks for electrode placement for Temporalis muscle
    b. Landmarks for electrode placement for Masseter muscle
7. Electromyographic recording procedure
    a. Group A patients (group function occlusion)
        (i) EMG Recordings of Temporalis and Masseter Muscles during Clenching on the restored side.
        (ii) EMG Recordings of Temporalis and Masseter Muscles during Lateral Eccentric movement towards the restored side
    b. Group B patients (canine guided occlusion)
        (i) EMG Recordings of Temporalis and Masseter Muscles during Clenching on the restored side.
        (ii) EMG Recordings of Temporalis and Masseter Muscles during Lateral Eccentric movement towards the restored side
8. Statistical analysis

SOURCE OF DATA:

Patients reporting to the Department of Prosthodontics, Tamil Nadu Government dental College and Hospital, Chennai were selected. The purpose and objective of the study was explained to all the patients and both the informed and written consent were obtained from all the patients.

1. **MAKING DIAGNOSTIC IMPRESSIONS AND DIAGNOSTIC ARTICULATION:** In the initial appointment, preliminary impressions were made with irreversible hydrocolloid impression material (Vignette, Dentsply, India) using stainless steel perforated dentulous stock trays. Diagnostic casts were obtained by pouring Type III dental stone. The diagnostic casts were mounted on a semi adjustable articulator (HANAU WIDE VUE II) using a face-bow transfer (HANAU WIDE VUE II) and centric relation record with polyviniyal siloxane bite registration material (Futar D, Kettenbach & Co. Germany).
2. **TOOTH PREPARATION:** After proper examination and analysis, premature contacts were eliminated and occlusal harmony was established. Putty index of the diagnostic cast was made involving the tooth to be prepared and the teeth adjacent to it, for verification of abutment tooth reduction. Test dose of local anesthesia was given to rule out allergy. Under local anaesthesia, Tooth preparation was done with diamond points and airotor hand piece after depth orientation grooves were made. Reductions of the occlusal and facial surfaces were done to 1.5mm and lingual and proximal surfaces to 1mm. Equigingival margin of shoulder with bevel was made in the facial aspect and

chamfer margin in the proximal and lingual aspects. Twisted Retraction cord {Omin-pak (#000)} was placed and subsequently two stage putty and light body impression technique was followed for the fabrication of wax pattern and castings. Second impression was made with irreversible hydrocolloid impression material for the fabrication of the provisional restoration.

3. **FABRICATION OF PROVISIONAL RESTORATION AND CEMENTATION:** Type- III dental stone was poured and cast was obtained from the impression made with the irreversible hydrocolloid after tooth preparation. In the study model the denture tooth was placed in wax in the edentulous area and putty index was made. The index was used to fabricate the provisional restoration using tooth colored auto polymerizing resin. Trimming, polishing was done after verification of occlusal morphology and the provisional restoration was cemented with Eugenol free temporary luting cement (Templute, Prime Dental Products).

4. **ARTICULATION OF WORKING CAST WITH REMOVABLE DIE:** The working casts were obtained by pouring Type IV die stone from the impression made with elastomeric impression material, later die pins were placed, base were made and die preparation was done. Face bow transfer was done and maxillary cast was mounted in the semi-adjustable articulator, mandibular cast was articulated according to the maximum intercuspation record using triple tray and vinyl polysiloxane impression material. Programming of articulator was done using protrusive interocclusal record.

5. FABRICATION OF FIXED PARTIAL DENTURE:

a.FPD with group function occlusion Die spacer was applied to the prepared teeth and wax pattern was fabricated using Inlay wax, with normal occlusal anatomy which was later carved and finished. The length of the maxillary buccal cusps was determined by moving the articulator into protrusive and a working lateral excursion. Upper and lower posteriors were checked whether that they made contact along with cuspids on the working side and established the group function occlusion.

Wax pattern was sprued, invested and casting was done. The casting was divested, sandblasted with 50μm alumina after the sprues were cut. They were subsequently trimmed with the metal trimmers and polishing done with the polishing kit and rouge.

The finished castings were inserted in the patient's mouth for fit and accuracy.

The surface of a coping that were to receive porcelain was again sand blasted with 50 micrometer aluminum oxide. The opaque porcelain was applied to the copings followed by dentin and enamel porcelain and firing was done. Trimming was done and checked in the semi-adjustable articulator by moving the articulator into protrusive and a working lateral excursion. Upper and lower posteriors were checked that they made contact along with cuspids on the working side and established the group function occlusion.

Bisque trial was done in the patient mouth. The patients were instructed to close on the posterior teeth. They were then made to move their mandible laterally to the side till the cusp tip of the lower canine contacted the cusp tip of upper canine. At this

position observations were made to ensure contacts between upper and lower posteriors along with the cuspids on the working side and established the group function occlusion. Final glaze was done.

(b) FPD with canine guided occlusion Same procedure was followed for casting. Checking was done with the semi-adjustable articulator by moving the articulator into protrusive and a working lateral excursion. Canine guided occlusion was developed by shortening of the maxillary buccal cusp tips and increase the lingual contour of the maxillary canine surface, so that the tip barely misses the opposing mandibular posterior cusp tips on the side of the working lateral mandibular excursion on the side of restoration.

Bisque trial was done in the patient mouth. The patients were instructed to close on the posterior teeth. They were then made to move their mandible laterally the side till the cusp tip of lower canine contacted the cusp tip of upper canine. At this position observation were made to ensure only the cuspids were contacting and checked for the disclusion of the posterior teeth of the working side and non-working side. Final glaze was done..

6. **Preparation of patient for electromyographic study:** Prior to recording EMG of muscle, the patients were made to sit in an upright position and the skin was cleaned with surgical spirit. Male patients were to be requested to shave. Electrode gel was applied and electrodes were placed.

a. **Landmarks: Temporalis Muscle:** A line along the Frankfort horizontal plane was drawn from the tragus to the infra orbitale. A point was then marked on the line 50 mm from the tragus. The electrodes for the temporal muscle was placed with the first electrode 20 mm vertically above the point and the second electrode was aligned 20 mm (center-to-center) from the first electrode in the direction of the muscle fibers.

b. **Landmarks: Masseter Muscle** The first electrode over the masseter muscle was placed 25 mm vertically below the point. The second electrode was aligned in the general direction of the muscle fibers at a distance of 20 mm (center-to-center) from the first electrode. A common ground electrode was adhered onto the forehead of the patients. Electrode alignments were assisted by palpation during voluntary clenching and relaxation in the intercuspal position.

7. ELECTROMYOGRAPHY RECORDING PROCEDURE:

a. **Group A patients (Group function occlusion)** The EMG recordings were made in the following pattern for group function occlusion. Fixed partial denture with group function occlusion was first cemented using Eugenol free temporary luting cement. After one week EMG recordings were done.

i.EMG Recordings of Temporalis and Masseter Muscle during Clenching on the restored side: After the electrodes were attached, the patients were instructed to clench maximally. The EMG activity recording for the temporalis and masseter muscle in each of the following series took place during maximal voluntary clenching with in a time period of 4 seconds and the results obtained were tabulated.

ii.EMG Recording of Temporalis and Masseter Muscle during Lateral Eccentric movement towards the restored side: After the electrodes were attached, the patients were instructed to move the mandible laterally towards the restored side until the desired lateral jaw position was reached (i.e., when the maxillary and mandibular canines were in tip to tip position). The EMG activity recording for temporalis and masseter muscle in each of the following series took place during lateral eccentric movement within a time period of 4 seconds and the results obtained were tabulated.

(b).Group B patients (canine guided occlusion): Fixed partial denture with canine guided occlusion was cemented using Eugenol free temporary luting cement to the same patients. EMG recording procedure was performed after one week. The EMG recordings were made in the same pattern as for group function, such as

I. EMG Recording of Temporalis and Masseter Muscle during Clenching on the restored side.

II.EMG Recording of Temporalis and Masseter Muscle during Lateral Eccentric movement towards the restored side.

8. **Statistical analysis:** The data was quantitative and followed normal distribution, parametric test of significance was employed. The mean Electromyographic values of masseter and temporalis during clenching and lateral excursion were compared using Independent sample T test. All analysis were done using SPSS software (version 19 IBM). P value of < 0.05 was considered to be statistically significant.

1.Materials and Armamentarium used during diagnostic stage

2. Materials and Armamentarium used during diagnostic mounting and face bow transfer

3. Materials and Armamentarium used during Tooth preparation, Impression and Temporization

4. Materials and Armamentarium used during Die preparation, Wax pattern fabrication and Casting.

5. Extra oral view

6. Pre-OP Intra oral view

7. Occlusal view
Maxillary Arch

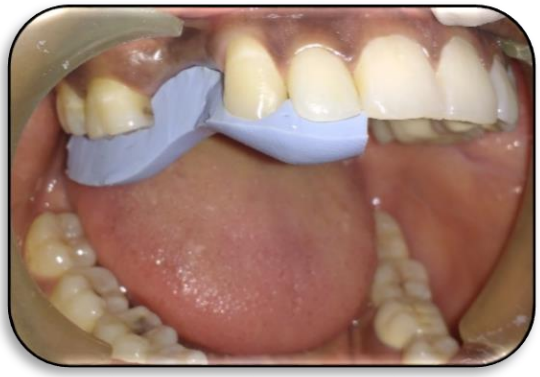
8. Occlusal view
Mandibular Arch

9.Diagnostic Impression

10. Diagnostic Cast

11. Diagnostic Articulation

12.Lingual half of the Index is Positioned to check its Accuracy



13.Gingival half of the Index is Positioned to check its Accuracy

14.Lingual half of the index over the preparation to check Occlusal reduction

15.Gingival half of the index over the preparation to check Labial reduction

16.Tooth preparation & Retraction cord placement- Front view

17.Tooth preparation & Retraction cord placement- Occlusal view

18.Final Master Impression & Alginate Impression

19.Working Cast for Provisionalization.

20.Putty index for Provisional Restoration.

21.Temporization

22. Die preparation in Master cast

23.Facebow Transfer

24.Triple tray & Maximum Intercuspation Record

25.Articulation done for fabrication of restorartion

26.Wax Pattern – Occlusal view

27.Wax Pattern for CANINE GUIDED OCCLUSION

28.Wax Pattern for GROUP FUNCTION OCCLUSION

29.Metal Coping – Occlusal view

30.Metal Coping for CANINE GUIDED OCCLUSION

31.Metal coping for GROUP FUNCTION OCCLUSION

32.Metal Trial in Patient mouth

33.Metal trial – Occlusal view

34.Finished Metal Ceramic FPD with GROUP FUNCTION & CANINE GUIDED OCCLUSION

35.Metal ceramic restoration for GROUP FUNCTION OCCLUSION

36.Metal Ceramic restoration for CANINE GUIDED OCCLUSION

37.Non-Working Interferences are relieved in Articulator

38.Metal Ceramic restoration checked in patient mouth at maximum Intercuspation

39.Metal Ceramic Restoration in Patient mouth-Occlusal view

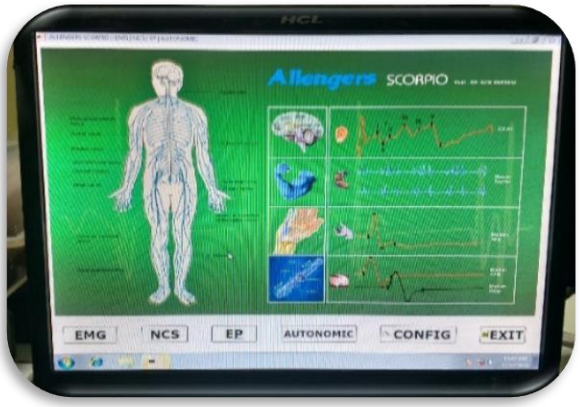
40.GROUP FUNCTION OCCLUSION achieved in WORKING SIDE

41.Non-Working Interferences was checked and relieved.

42.CANINE GUIDED OCCLUSION achieved in WORKING SIDE

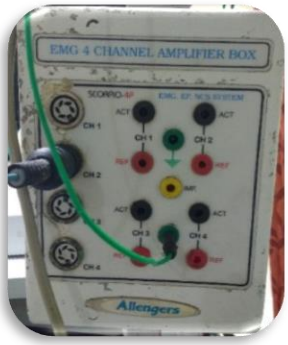
43.Electromyographic Unit

44.Electromyographic Software



45.Positive, Negative & Ground Electrodes

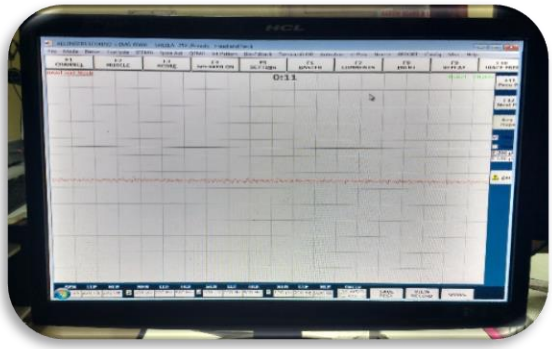
46.EMG 4 Channel Amplifier Box



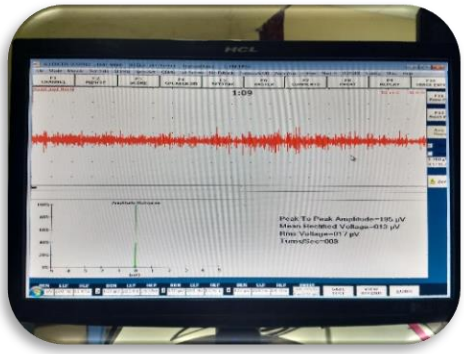
47.Placement of surface electrodes to record Masseter muscle activity

48.Placement of surface electrodes to record Temporalis muscle activity

49.Base line Readings Before Activity



50. EMG Recordings during movement



RESULTS

The following results were obtained from this study which evaluated the activity of Elevator muscles (Masseter and Temporalis) in patients restored with Group function occlusion and Canine guided occlusion.

Each of the ten patients were divided into two groups as Group A, restored with Fixed partial denture with group function occlusion and Group B, restored with Fixed partial denture with canine guided occlusion. Elevator muscle activity was recorded using Electromyography.

The mean and standard deviation for Group A & Group B samples are shown in the following tables with bar diagrams. Descriptive statistics was calculated and expressed in terms of mean and standard deviation.

Since the data was quantitative and followed normal distribution, parametric test of significance was employed. The mean Electromyographic values of masseter and temporalis during clenching and lateral excursion were compared using Independent sample T test. All analysis were done using SPSS software (version 19 IBM). P value of < 0.05 was considered to be statistically significant.

TABLE 1: EMG Values of Masseter and Temporalis muscles during Clenching in Group function and Canine guided occlusion on the Restored side.

VARIABLES	N	Group Function Occlusion		Canine Guided Occlusion		Mean Difference	P value
		Mean	S.D	Mean	S.D		
Masseter	10	415.60	20.48	418.80	26.63	3.20	0.767
Temporalis	10	332.90	36.47	339.70	37.17	6.80	0.685

TABLE 2: EMG Values of Masseter and Temporalis muscles during Lateral Excursion in Group function and Canine guided occlusion on the restored side.

VARIABLES	N	Group Function Occlusion		Canine Guided Occlusion		Mean Difference	P value
		Mean	S.D	Mean	S.D		
Masseter	10	100.00	27.94	56.40	5.27	43.60	<0.001
Temporalis	10	124.90	26.31	77.20	9.57	47.70	<0.001

Interpretation of the results

Comparison of group function and Canine guided occlusion of Masseter and Temporalis muscle during clenching on the restored side.

Activity of Masseter and Temporalis between Group A and Group B were compared by using the values of mean and standard deviation & P values. The results are presented in Table - 1

From the result it was observed:

In group function occlusion the mean EMG value for masseter muscle during clenching was 415.60 ± 20.48, whereas for canine guided occlusion it was 418.80 ± 26.63. The mean difference between the two types of occlusion was 3.20 and this difference was found to be statistically not significant with the P value of 0.767.

For temporalis muscle, the mean EMG value in group function occlusion during clenching was 332.90 ± 36.47, whereas for canine guided occlusion it was 339.70 ± 37.17. The mean difference between the two types of occlusion was 6.80 and this difference was found to be statistically not significant with the P value of 0.685.

This denotes, the elevator muscle (Masseter & Temporalis) activities was nearly the same in both the occlusal schemes during clenching.

Comparison of group function and Canine guided occlusion of Masseter and Temporalis muscle during Lateral excursion towards the restored side.

Activity of Masseter and Temporalis between Group A and Group B were compared by using the values of mean and standard deviation & P values. The results are presented in Table – 2

From the result it was observed:

In group function occlusion the mean EMG value for masseter muscle during lateral excursion was 100.00 ± 27.94, whereas for canine guided occlusion it was 56.40 ± 5.27. The mean difference between the two types of occlusion was 43.60 and this difference was found to be statistically significant with the P value of < 0.001.

For temporalis muscle, the mean EMG value in group function occlusion during lateral excursion was 124.90 ± 26.31, whereas for canine guided occlusion it was 77.20 ± 9.57. The mean difference between the two types of occlusion was 47.70 and this difference was found to be statistically significant with the P value of < 0.001.

This denotes, the elevator muscle (Masseter & Temporalis) activities are greatly reduced in Canine guided occlusion when compared to that of Group function occlusion during lateral excursion towards the restored side.

Fig : 1 **Comparison between Group function and Canine guided Occlusion of Masseter muscle during clenching and lateral Excursion towards the restored side.**

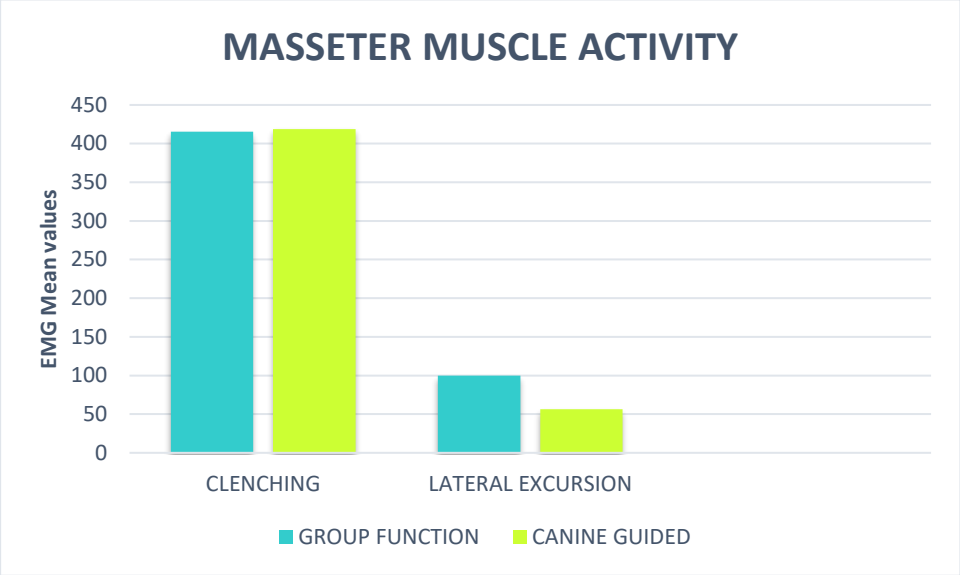


Fig : 2 **Comparison between Group function and Canine guided Occlusion of Temporalis muscle during clenching and lateral Excursion towards the restored side.**

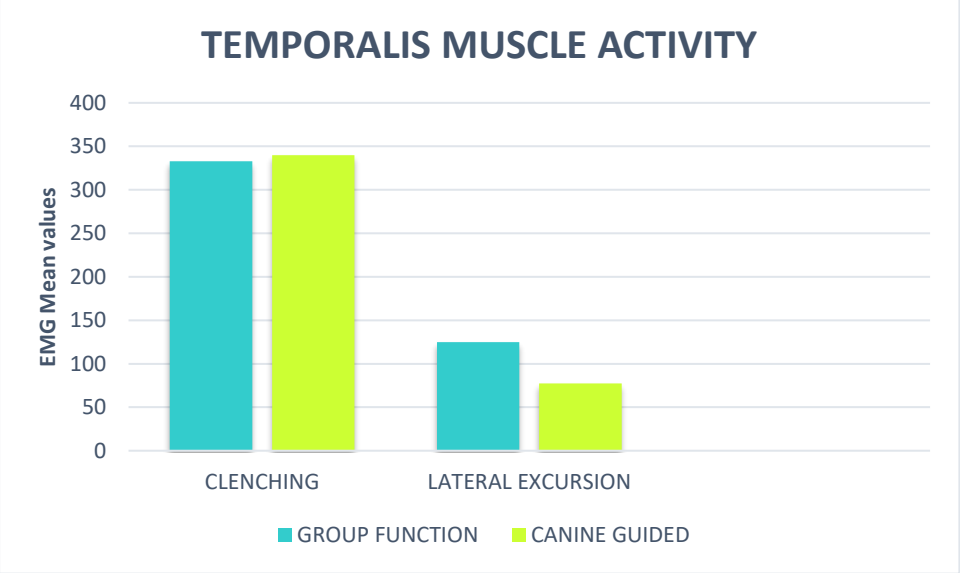


Fig-3 Comparison of Group function and Canine guided occlusion during Maximum Voluntary clenching of Masseter and Temporalis.

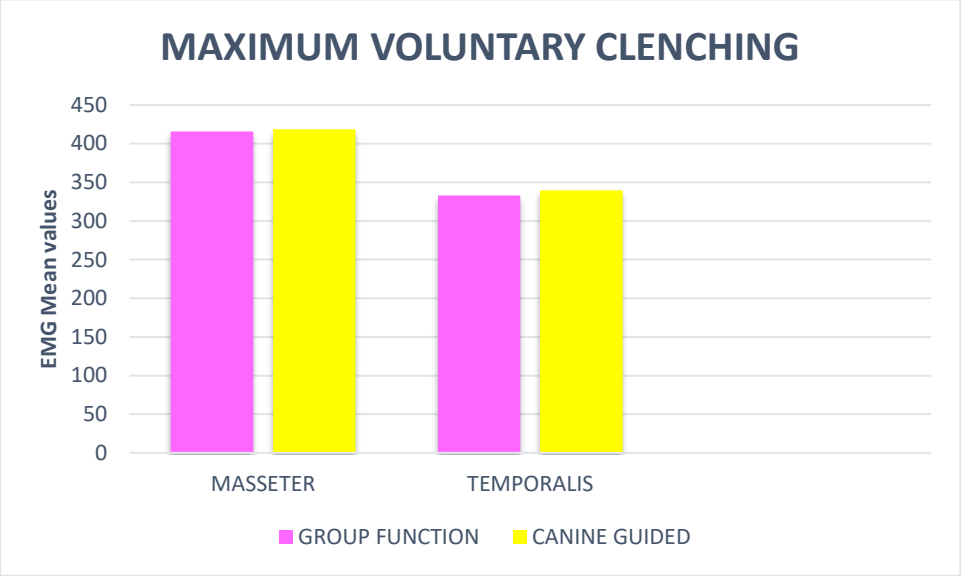
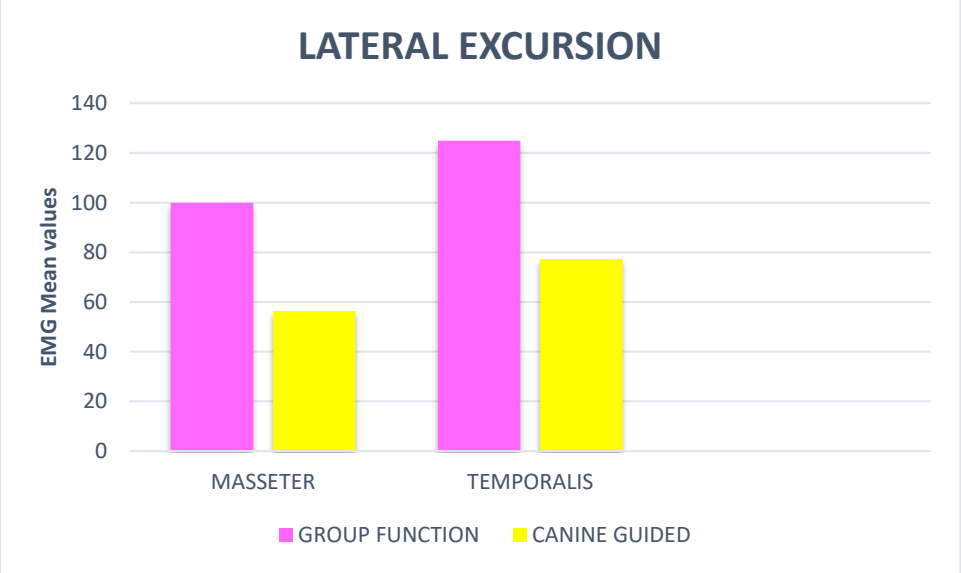


Fig-4 Comparison of Group function and Canine guided occlusion during Lateral excursion of Masseter and Temporalis.



DISCUSSION

Craniomandibular function is based on the complex and interrelated components comprising the biomechanics and morphology of the muscles, joints, teeth, and the neuromuscular system. The major reason for dentistry to deal with masticatory muscle function is the significance of these muscles in the natural function and the functional disorders of the craniomandibular system. There is a definitive association between the occlusion and the outcome of the action of the masticatory muscles that is the functional jaw movements.

Anterior guidance is essential for the harmonious functional relationship with the masticatory system. An understanding of the mechanical principles governing the anterior guidance can minimize trauma to the stomatognathic system.

Schuyler (1963)[59] defined incisal guidance as the influence on the mandibular movements guided by the contacting surfaces of the maxillary and mandibular anterior teeth.

According to **Angelo D' Amico(1961)[3]** a desirable horizontal overlap of maxillary incisors and canines is important to prevent the attrition of opposing premolars and molars as they can help to avoid the horizontal vector forces to the periodontium .

Stuart and Stallard (1969)[60] also observed this phenomenon and therefore developed anterior guidance as part of the gnathological concept in mutually protected articulation. According to the philosophy of gnathology, the anterior teeth

protect the posterior teeth in eccentric movements of the mandible and the posterior teeth should protect the anterior teeth in maximum intercuspation, known as mutually protected articulation.

Canine protection and group function have been used for classification of occlusal contact patterns in lateral excursions in natural dentition.

According to **Robert Crum et al (1972)[16]**, "the success or failure of a prosthodontic restoration depends upon the integration of proper proprioceptive feedback and motor responses. Accordingly anterior teeth are much more sensitive than posterior teeth. So retaining anterior teeth as abutment for the prosthesis assumes a greater importance".

The present study was conducted to find out which of these two types of occlusion generated through fabrication of four unit fixed partial dentures using canine as an abutment leads to decreased elevator muscle activity during clenching and lateral excursions using Electromyography. According to the predetermined selection criteria 10 partially edentulous patients were selected for this study. Though usually fixed partial dentures are fabricated in group function occlusion, a deviation from the customary occlusion that is incorporating canine protected occlusion cannot be taken into account until it is proved through many studies. Ours is one such attempt.

The study of electrical activity of the muscles was first introduced by Erb to provide information regarding the functioning of its motor units. Electromyography was a sensitive tool widely used by R.E. Moyers in 1949 to analyze the behavior of the masticatory muscles in patients with craniomandibular disorders.

Y.Yamada et al (1985)[31] analyzed the utilization of electromyograms in clinical dentistry. It is a machine used for real time neurophysiologic data acquisition and analysis system with a versatile hardware and software combination. It permits the analysis of jaw reflexes and generation of a hard copy output in 31/2 minutes.

Electromyography (**EMG**) is a technique for evaluating and recording the electrical activity produced by skeletal muscles. EMG is performed using an **electromyograph** to produce a record called an **electromyogram**. An electromyograph detects the electric potential generated by muscle cells, when these cells are electrically or neurologically activated.

The basic functional entity of the muscles is the motor unit which is comprised of the motoneuron, its axon and the muscle fibers innervated by branches of the axon. This muscle fiber contracts when the action potentials of the motor nerve supplying it reaches a depolarization threshold. The depolarization generates an electromagnetic field which is measured as a very small voltage known as EMG.

ELECTRODE:

In EMG, an electrode is an electric conductor that conveys the electric current from the biological myoelectric source to the electronic amplifier. There are two kinds of EMG, they are;

1. Non-invasive or Surface electrodes
2. Invasive or Needle electrodes

Surface EMG assesses muscle function by recording muscle activity from the surface above the muscle on the skin. Invasive electrodes collect the EMG from within the muscle and penetrate the skin surface.

MOTOR UNIT ACTION POTENTIAL:

A motor unit is defined as one motor neuron and all of the muscle fibers it innervates. When a motor unit fires, the impulse (called an action potential) is carried down the motor neuron to the muscle. The area where the nerve contacts the muscle is called the neuromuscular junction, or the motor end plate. After the action potential is transmitted across the neuromuscular junction, an action potential is generated in all of the innervated muscle fibers of that particular motor unit. The sum of all this electrical activity is called as a motor unit action potential (MUAP). This electro physiologic activity from the multiple motor units is the signal typically evaluated during an EMG.

Amplitude is measured from the base line to the maximum height observed in the wave and represented by microvolts. Duration is measured from the distance between consecutive corresponding points of the wave.

The present study was concerned with the surface electrodes, as only the superficial muscles (Temporalis and Masseter) were taken for EMG study.

In this study surface electrodes were employed to determine the elevator muscle activity. Though surface and needle electrodes can be used to find out the muscle dynamics, Surface electrodes records the global activity of the muscles. They

are convenient and painless and are sufficient enough for evaluation of superficial muscles.

Surface Electrodes

They are generally two small plates made of silver/silver chloride which were placed over the muscles using key guidelines for masseter and temporalis, (Stephen W. H. Yuen et al 1990)[61]. A ground electrode was placed onto the forehead of the patients. Electrodes were attached to the skin by an electrode gel and adhesive tape.

EMG study was done during maximum voluntary clenching and lateral excursion of the mandible towards the restored side in two different occlusions in the masseter and temporalis muscles.

"Because isometric bite forces vary from individual to individual, and from time to time in a single individual, measurements were made through maximum voluntary isometric contractions (clenches)". (Stephen W. H. Yuen et al 1990)[61].

Vittasalo and Komi (1975)[62] also showed that maximum voluntary isometric contractions might be the best way to standardize the test situations.

Comparison was made between the mean values and standard deviation of EMG values between the group function and canine guided occlusion during clenching and lateral excursion of masseter and temporalis muscles.

In group function occlusion the mean EMG value for masseter muscle during clenching was 415.60 ± 20.48, whereas for canine guided occlusion it was 418.80 ± 26.63. The mean difference between the two types of occlusion was 3.20 and this difference was found to be statistically not significant with the P value of 0.767. For temporalis muscle, the mean EMG value in group function occlusion during clenching was 332.90 ± 36.47, whereas for canine guided occlusion it was 339.70 ± 37.17. The mean difference between the two types of occlusion was 6.80 and this difference was found to be statistically not significant with the P value of 0.685.

In group function the mean EMG value for masseter muscle during lateral excursion was 100.00 ± 27.94, whereas for canine guided occlusion it was 56.40 ± 5.27. The mean difference between the two types of occlusion was 43.60 and this difference was found to be statistically significant with the P value of < 0.001. For temporalis muscle, the mean EMG value in group function occlusion during lateral excursion was 124.90 ± 26.31, whereas for canine guided occlusion it was 77.20 ± 9.57. The mean difference between the two types of occlusion was 47.70 and this difference was found to be statistically significant with the P value of < 0.001.

The results revealed that the EMG values recorded during laterotrusion was significantly less in case of patient in whom fixed partial dentures were restored using canine protected occlusion when compared to those in whom fixed partial dentures were restored with group function occlusion. The elevator muscle (Masseter & Temporalis) activities was nearly the same in both the occlusal schemes during clenching.

This result of this study can be correlated from the following authors.

Arturo Manns et al (1987)[33] stated in his study that the reduction in the elevator muscle activity was greater in canine protected occlusion as the pressure is concentrated in a small periodontal surface area.

U. C. Belser et al (1985)[30] put forward that canine guided occlusion do not significantly alter muscle activity during mastication but it significantly reduces the muscle activity during parafunctional clenching.

Ronald J. Shupe et al (1984)[28] tried to create canine protected occlusion in a maxillary occlusal splint using heat cured acrylic resin in maxillary teeth. The splint had a minimal palatal coverage and a minimal increase in vertical dimension of occlusion. Results revealed that the forces generated to the posterior teeth were reduced.

Keith E. Thayer (1981)[25] used metal canine risers which were bonded to the lingual surface of maxillary canine teeth without any tooth preparation. After two years of follow up it was proved to be beneficial in eliminating the bruxism and clenching habits.

Gary Robert Goldstein (1979)[20] found out that the teeth of mouths having canine protected occlusion had lower mean periodontal disease index scores than in those with progressive disclusion or with group function occlusion.

Moller (1981)[63] suggested that jaw muscle activity is dependent on the number of occlusal contacts.

Van Steenberghe and De Vries (1978)[64] showed that an increase in the number of teeth that come into contact on both sides of the arch results in an increase of the force that can be developed between the jaws.

Williamson and Lundquist (1993)[26] observed a reduction in EMG activity of the temporal and masseter muscles in patients with canine guidance when compared to with group function occlusion. These investigators concluded that only with appropriate anterior guidance could the EMG activity of the muscles be reduced.

Ronald J Shupe et al (1984)[28] also looked at EMG activity of the masticatory muscles. They compared the effects of flat canine guidance, group function, and steep canine guidance on the EMG activity of the masseter and temporal muscles. They found less EMG activity with steep canine guidance, supporting the findings of Williamson and Lundquist.

According to **Gar S. Graham et al (1988)[35]** study the EMG activity of the masseter and anterior part of the temporal muscles was reduced with canine protected occlusion and first molar guidance during lateral excursive movement and excursive position clenching.

According to **Jemt et al, (2004)[50]** in a case series crossover study of 5 individuals treated with a maxillary implant-supported FPD and opposing mandibular dentition, observed that lateral displacement and total displacement of mandible was greater with group function occlusion than with canine-protected occlusion.

A.C. Akoren et al (1995)[43] observed that canine guidance compared with group function occlusion caused a greater electromyographic activity reduction of anterior temporal muscle during laterotrusive sliding while the teeth were in contact.

N.Okano et al (2007)[51] stated that the EMG activity in the anterior temporalis significantly increased in the simulated group function and the simulated bilateral balanced occlusion compared with the simulated cuspid guided occlusion.

D'Amico (1961)[3] stated that canine protection favors the vertical chewing pattern and prevents the wear of teeth.

Ash and Ramjford (1996)[65] observed that a steep canine rise on Michigan splint can reduce the EMG activity of masseter and temporalis muscles.

Murray (2001)[66] explained a technique for the provision of canine riser restoration, which deliberately altered the cuspal inclines in canine teeth to provide canine protected occlusion. He believed that these restorations may help to control excessive loading, limit the tooth wear, and assist in management of Temporomandibular joint disorders.

Jiang, Su et al (2010)[67] conducted a study to evaluate the clinical treatment effect on bruxism using group functional occlusal splint and canine guided occlusal splint. The successful rate of treatment of bruxism was 83.33% in canine guided occlusion and 79.1% with functional splint.

According to Henke and Friedrich (1999)[68] the canine guided occlusion decreased the lateral stresses on posterior teeth and is preferred over group function occlusion for restoring and altering the anterior guidance.

Goldstein (1979)[20] found the relationship of canine-protected occlusion to periodontal index. The teeth of mouth having canine-protected occlusion had significantly lower mean periodontal indices.

SUMMARY AND CONCLUSION

This study has been formulated to evaluate the Electromyographic activity of elevator muscles (Masseter & Temporalis) in lateral guidance with group function and canine guided occlusion in patients who required restoration of canine and posterior teeth.

For each of the 10 patients, two fixed partial dentures were fabricated one with group function occlusion, the other with canine guided occlusal schemes. The basic principles and recording procedures has been discussed. The obtained results were subjected to statistical analysis.

From the analysis, following conclusions were drawn:

- Highly significant reduction of EMG activity of elevator muscles (Masseter and Temporalis) was observed during lateral excursion in Canine guided occlusion when compared to that of Group function occlusion.
- EMG activity of elevator muscles was nearly the same during clenching in both the type of occlusal schemes.
- When an entire occlusion is to be restored, reestablishment with canine guided occlusion is preferred when remaining canines are present with good periodontal support.
- The EMG values obtained in this study can be taken as base line data for future studies.

"When bone and muscle war, muscle never loses" (**Harry Sicher). "**When teeth and muscle war, muscle never loses" (**Peter. E. Dawson)[69].**

From the above statements, it clearly shows that masticatory muscles play a predominant role in stomatognathic system. So it is mandatory to follow this guideline and not overlook the factor. At the same time any step taken which involves this muscle must be cautious.

Technology remains useless unless used. To conclude, further studies in the same outlook will serve the purpose of adding one more feather to the dental realm.

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From

Dr. S.Elavarasan BDS

Post Graduate Student (Second Year) - MDS

Department of Prosthodontics& Crown and Bridge,

Tamil Nadu Government Dental College and Hospital

Chennai- 600003

To

The Director ,

Institute of Neurology

Madras Medical College and Hospital

Chennai

Through proper channel,

Sub:- Request for permission to evaluate Electromyographic activity of Masseter and Temporalis

Respected Sir,

I Dr.S.ElavarasanIInd year post graduate, Dept of Prosthodontics, TNGDC&H, Chennai, am planning to do a thesis titled " **Evaluation of Elevator Muscle Activity Using EMG In Patients Restored With Fixed Partial Denture With Group Function And Canine Guided Occlusion".** My thesis required surface Electromyographic evaluation of Masseter and temporalis in patients restored with Fixed partial denture.It would be of immense help if you could let me make use of Electromyographic unit. Sir please consider my request and help me in proceeding with my thesis.

Thanking you,

Yours sincerely,

Station: Chennai

Date: 20.6.2016

DIRECTOR
INSTITUTE OF NEUROLOGY
MADRAS MEDICAL COLLEGE
GOVT. GEN. HOSPITAL, CHENNAI

Forwarded to the Respected Director of Neurology Sir please help my PG Dr. Elavarasan

22/6/16

Dr. C.SABARIGIRINATHAN
M.D.S., M.Sc., M.B.A., P.hd.,
Professor and HOD
Dept. of Prosthodontics
Tamilnadu Govt. Dental College & Hospital
Chennai - 600 003.

TAMIL NADU GOVERNMENT DENTAL COLLEGE & HOSPITAL, CHENNAI – 3.
TELEPHONE : 044-253403343
FAX: 044- 25300681

Ref No: R. C. NO: 0420/DE/2016 date : 09-08-2016

Sub: IEC review of the research proposals,

Title of the work: Evaluation of Elevator Muscle Activity Using Electromyography In Patients Restored With Fixed Partial Denture With Group Function Occlusion And Canine Guided Occlusion.

Principal Investigator: Dr. S.Elavarasan
III yr PG student.

Department : Department of Prosthodontics
Tamil Nadu Govt. Dental College & Hospital , Chennai-3

Thank you for submitting your research proposal , which was considered at the Institutional Ethics Committee meeting held on the 01.07. 2016, at TN Govt. Dental College and the documents related to the study referred above were discussed and the modifications done as suggested and reported to us through your letter dated 08-08-2016 have been reviewed. The decision of the members of the committee , the secretary and the Chairperson IEC of TN Govt. Dental College is here under:

Approved	Approved and advised to proceed with the study
Approved with suggestions	----------
Revision	----------

The principal investigators and their team are advised to adhere to the guide lines given below:

1. You should get detailed informed consent from the patients / participants and maintain confidentiality.
2. You should carry out the work without affecting regular work and without extra expenditure to the Institution or the Government.
3. You should inform the IEC, in case of any change of study procedure, site, and investigating guide.
4. You should not deviate from the area of work for which you have applied for ethical clearance.
5. You should inform the IEC immediately in case of any adverse events or serious adverse reactions. You should abide to the rules and regulations of the institution(s) .
6. You should complete the work within specific period and if any extension of time is required, you should apply for permission again to do the work.
7. You should submit the summary of the work to the ethical committee every 3 months and on completion of the work.
8. You should not claim any kind of funds from the institution for doing the work or on completion/ or for any kind of compensations.
9. The members of the IEC have the right to monitor the work without prior intimation.
10. Your work should be carried out under the direct supervision of the guide/ Professor.
11. The investigator and Guide should each declare that no plagiarism is involved, in this whole study and enclose the undertaking in dissertation/ thesis.

MEMBER SECRETARY,
INSTITUTIONAL ETHICS COMMITTEE
Tamil Nadu Govt. Dental College & Hospital
Chennai

CHAIR PERSON
INSTITUTIONAL ETHICS COMMITTEE
Tamil Nadu Govt. Dental College & Hospital
Chennai

Forward to
Dr. S. Elavarasan - PG
13/8/16

PARTICIPANT INFORMATION SHEET

Investigator: Dr.S.Elavarasan

Guide: Prof .Dr.K.VINAYAGAVEL, M.D.S.,

Title of the study: EVALUATION OF ELEVATOR MUSCLE ACTIVITY USING ELECTROMYOGRAPHY IN PATIENTS RESTORED WITH FIXED PARTIAL DENTURE IN GROUP FUNCTION OCCLUSION AND CANINE GUIDED OCCLUSION

Name of the research institution: Tamilnadu Government Dental College & Hospital, Chennai.

Purpose of the study: To find out the elevator (masseter, temporalis) muscle activity using EMG with the help of surface electrodes will be done after restoration with fixed partial dentures in group function occlusion and canine guided occlusion.

Procedure: **The following examination/investigation will be done for you.**

- Intra oral examination. Routine examination will be done using mouth mirror and probe. Upper and lower diagnostic impression will be made.
- IOPA radiographs will be taken.
- For protection from X-rays, Lead Apron & Thyroid collars will be used.
- Local anaesthesia will be given. Tooth preparation will be done followed by impression will be made and temporary FPD will be cemented.
- Two sets of FPD will be fabricated, one with group function occlusion and another with canine guided occlusion. Surface Electromyography study will be done in one week interval.

Risks of participation:

Risks :patient may be allergic to local anaesthesia ,test dose will be given to rule out allergic reactions.

To prevent Iatrogenic pulp exposure diagnostic IOPA will taken and protocols for biomechanical tooth preparation will be followed.

For protection from X-rays, Lead Apron & Thyroid collars will be used.

Confidentiality: The privacy of the patients in the research will be maintained throughout the study. In the event of any publication or presentation resulting from the research, no personally identifiable information will be shared.

Participant's rights: Taking part in the study is voluntary. You are free to decide whether to participate in the study or to withdraw at any time. Your decision will not result in any loss of benefits to which you are otherwise entitled. The results of this study will be intimated to you at the end of the study period or during the study if anything is found abnormal which may aid in the management or treatment.

Compensation: NIL

ஆராய்ச்சி பற்றிய தகவல் படிவம்

1) தசை மின்னியக்க பதிவியல் கருவியை பயன்படுத்தி நிலையான பகுதி செயற்கை பல் பொருத்தப்பட்ட நோயாளிகளின் தாடை ஏற்றுத்தசைகளின் செயல்பாட்டினை குழு செயல்பாட்டு கடி பொருத்தத்திலும், கோரைப்பல் வழிகாட்டி கடி பொருத்தத்திலும் உயிரி அளவீடு மூலமாக மதிப்பிடும் ஆய்வு.

2) இந்த ஆராய்ச்சி செய்யும்பொருட்டு தமிழ்நாடு அரசு பல் மருத்துவமனை மற்றும் மருத்துவக் கல்லூரிக்கு வரும் நோயாளிகள் தேர்வு செய்யப்படுகிறார்கள்.

3) இந்த ஆராய்ச்சியின் நோக்கம் இரண்டு விதமான கடிபொருத்தத்திற்கும் தாடை ஏற்றுத் தசையின் மின்னியக்கவியலுக்குமான தொடர்பை கண்டறிய உள்ளது.

4) நோயாளி பற்றிய குறிப்புகள் பிறர் அறியா வண்ணம் ஆராய்ச்சி முடியும்வரை இரகசியமாக பாதுகாக்கப்படும். அதை வெளியிடும் நேரத்தில் எந்த நோயாளியின் தனி அடையாளங்களும் வெளியிட வாய்ப்பு கிடையாது.

5) இந்த ஆராய்ச்சியில் பங்குபெறுவது நோயாளியின் தனிப்பட்ட முடிவு மற்றும் நோயாளிகள் இந்த ஆராய்ச்சியில் இருந்து எப்பொழுது வேண்டுமானாலும் விலகிக்கொள்ளலாம். நோயாளியின் இந்த முடிவு அவருக்கோ அல்லது ஆராய்ச்சியாளருக்கோ எந்தவித பாதிப்பும் ஏற்படாது என்பதை தெரியப்படுத்துகிறோம்.

6) இந்த ஆராய்ச்சியில் முடிவுகள் நோயாளிகளுக்கு ஆராய்ச்சி முடியும் தருவாயிலோ அல்லது இடையிலோ தெரிவிக்கப்படும். ஆராய்ச்சியின்பொழுது ஏதும் பின்விளைவுகள் ஏற்பட்டால் அதை சரிசெய்ய தகுந்த உதவிகள் அல்லது தேவையான சிகிச்சைகள் உடனடியாக மேற்கொள்ளப்படும்.

நோயாளியின் பெயர் கையொப்பம்/ கைரேகை

முதன்மை ஆய்வாளர்
தமிழ்நாடு அரசு பல் மருத்துவக் கல்லூரி,
சென்னை-600 003.

INFORMED CONSENT FORM

STUDY TITLE:

"**EVALUATION OF ELEVATOR MUSCLE ACTIVITY USING ELECTROMYOGRAPHY IN PATIENTS RESTORED WITH FIXED PARTIAL DENTURE IN GROUP FUNCTION OCCLUSION AND CANINE GUIDED OCCLUSION**"

Name:

O.P.No:

Address:

S. No:

Age / Sex:

Tel. no:

I, _____ age _____ years exercising my free power of choice, hereby give my consent to be included as a participant in the study "Evaluation Of Elevator Muscle Activity Using EMG In Patients Restored With Fixed Partial Denture In Group Function Occlusion And Canine Guided Occlusion"

I agree to the following:

- I have been informed to my satisfaction about the purpose of the study and study procedures including investigations to monitor and safeguard my body function.
- I agree to undergo the procedure involved in the study process.
- I have informed the doctor about all medications I have taken in the recent past and those I am currently taking.
- I agree to cooperate fully throughout the study period.
- I hereby give permission to use my medical records for research purpose. I am told that the investigating doctor and institution will keep my identity confidential.

Name of the patient Signature / Thumb impression

Name of the investigator Signature

Date

ஆராய்ச்சி ஒப்புதல் படிவம்

தசை மின்னியக்க பதிவியல் கருவியை பயன்படுத்தி நிலையான பகுதி செயற்கை பல் பொருத்தப்பட்ட நோயாளிகளின் தாடை ஏற்றுத்தசைகளின் செயல்பாட்டினை குழு செயல்பாட்டு கடி பொருத்தத்திலும், கோரைப்பல் வழிகாட்டி கடி பொருத்தத்திலும் உயிரி அளவீடு மூலமாக மதிப்பிடும் ஆய்வு.

இந்த ஆராய்ச்சி செய்யும் பொருட்டு தமிழ்நாடு அரசு பல் மருத்துவமனை மற்றும் மருத்துவக் கல்லூரிக்கு வரும் நோயாளிகள் தேர்வு செய்யப்படுகிறார்கள்.

பெயர்: வயது பால்:

ஆராய்ச்சி சேர்க்கை எண்: புற நோயாளி எண்:

நான் என் சுய நினைவுடன் மற்றும் முழு சுதந்திரத்துடனும் இந்த மருத்துவ ஆராய்ச்சியில் சேர்ந்துகொள்ள ஒப்புதல் அளிக்கிறேன். கீழ் காணப்படும் நிபந்தனைகளுக்கு ஒப்புதல் அளிக்கிறேன். இந்த ஆராய்ச்சியின் நோக்கமும் அதன் சிகிச்சை முறைகளும் எனக்கு திருப்தி அளிக்கும் வகையில் அறிவுறுத்தப்பட்டது.

நான் மருத்துவ சிகிச்சை முறைக்கு முழுமையாக ஒத்துழைத்து ஏதேனும் அசாதாரண நோய் அறிகுறிகள் ஏற்பட்டால் உடனடியாக என் மருத்துவருக்கு தெரிவிக்க ஒப்புக்கொள்கிறேன்.

என் மருத்துவ குறிப்பேடுகளை மருத்துவ ஆராய்ச்சியில் பயன்படுத்த சம்மதிக்கிறேன். இந்த ஆராய்ச்சி மையமும், ஆராய்ச்சியாளரும் என் அடையாளத்தை ரகசியமாக வைத்திருப்பதாக அறிகிறேன்.

நோயாளியின் பெயர் கையொப்பம் தேதி

ஆராய்ச்சியாளர் பெயர் கையொப்பம் தேதி

MASTER CHART

GROUP FUNCTION OCCLUSION

S.No	EMG VALUES OF MASSETER MUSCLE ACTIVITY		EMG VALUES OF TEMPORALIS MUSCLE ACTIVITY	
	MAXIMUM VOLUNTARY CLENCHING	LATERAL EXCURSION	MAXIMUM VOLUNTARY CLENCHING	LATERAL EXCURSION
1	422	74	310	167
2	445	71	385	96
3	388	79	280	98
4	396	134	295	137
5	398	82	345	95
6	415	128	346	138
7	402	69	289	101
8	438	138	352	141
9	410	119	361	154
10	442	106	366	122

CANINE GUIDED OCCLUSION

S.No	EMG VALUES OF MASSETER MUSCLE ACTIVITY		EMG VALUES OF TEMPORALIS MUSCLE ACTIVITY	
	MAXIMUM VOLUNTARY CLENCHING	LATERAL EXCURSION	MAXIMUM VOLUNTARY CLENCHING	LATERAL EXCURSION
1	431	56	290	90
2	438	50	370	70
3	398	54	302	72
4	421	61	319	76
5	364	58	323	62
6	419	63	390	74
7	409	50	310	72
8	420	65	339	93
9	421	52	396	85
10	467	55	358	78