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# Mandibular Hader bar attachment overdenture wearers: A five-year longitudinal clinical evaluation by electromyographic analysis



*Aparna S. Barabde*[a,*], *Shailesh M. Barabde*[b], *Ashish Bhagat*[a], *Amar Thakare*[a]

[a] *Department of Prosthetic Dentistry, V.Y.W.S. Dental College & Hospital, Amravati, India*
[b] *P.D.M. Medical College, Amravati, India*

*Keywords:*
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E.M.G. analysis
Coping & attachment

A B S T R A C T

*Introduction:* Electromyography is used to evaluate the muscle activity of temporalis and masseter muscles in a comparative clinical research on effectiveness of masticatory cycle by conventional overdenture and use of overdenture with Hader bar attachment for five years established on a scientific level and is first of its kind.

*Aim:* The purpose of this study is to determine the response of co-ordination of stomatognathic system and the functional status of long-term overdenture use, which can be recorded in EMG.

*Material and Methods:* Ten patients were treated with maxillary conventional complete denture and mandibular overdenture. Electrical activity of masseter and temporal muscles were obtained in 3 groups. (Gp. I) After insertion of conventional overdenture with copings; (Gp. II) Overdenture with Hader bar attachment and (Gp.III) five years of use of overdenture with Hader bar attachment.

*Results and conclusion:* The mean and standard deviation for all the patients showed an increase in muscular activity of temporalis and masseter muscles after long-term rehabilitation ($x = 0.405$; 0.407 and $s = 0.0668$; 0.1344 respectively, $p = 0.0042$ and 0.0074 which is $<0.05$). This study concludes that overdenture with Hader bar system, after five years of function provide a sound justification for a viable alternative treatment modality to provide overdenture with attachment service to patients.

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## 1. Introduction

The Prosthodontic management of the edentulous patient has long been a major challenge for a Prosthodontist. Patients exhibit difficulties in adapting to complete conventional dentures and have limited benefits in masticatory performance with an atrophied mandible. The bar and clip system is one of the most effective mode of retention & support for overdenture. In late 1960, Hader bar & rider system was developed by Swiss dental laboratory technician Hader H.[1] It is available as castable plastic patterns (with a diameter of approximately 1.8 mm and length of 50 mm) and metal clips or sleeves. These are waxed to the abutment copings & the entire assembly is cast as one single unit in the desired metal. The bar splints the abutments and help retain the overlying denture. EDS bar by English, Donnel & Staublin in 1992 is a

* *Corresponding author*. DR Barabde Dental Clinic, Badnera Road, Rajkamal SQ, Amravati 444 602, India. Tel.: +91 8888854054, +91 9890213696.
E-mail address: draparnabarabde@yahoo.com (A.S. Barabde).

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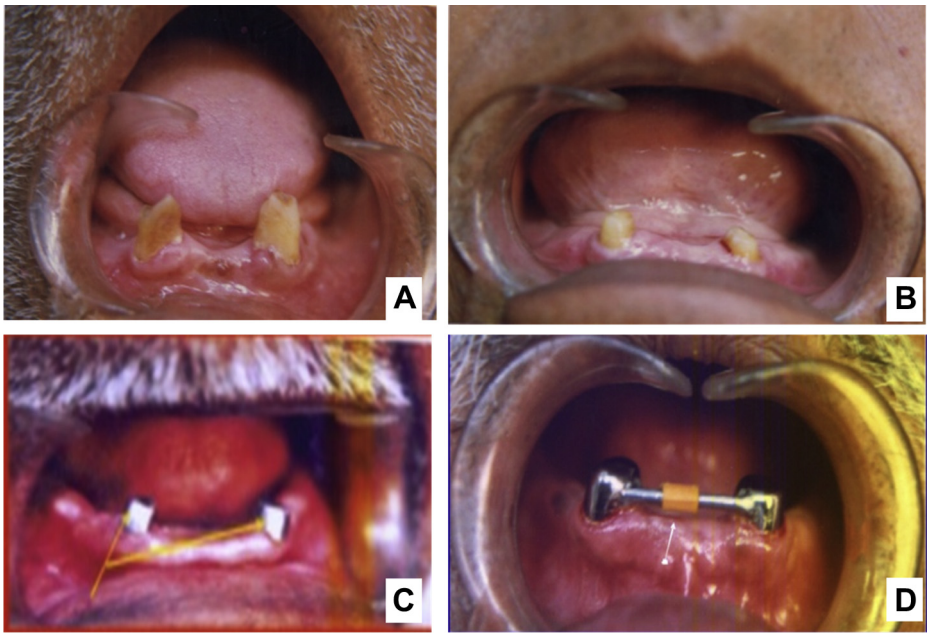



**Fig. 1 – A – Abutment selection. B – Abutment preparation. C – Cemented Ni–Cr alloy copings. D – Attachment with overlaid clip: intra-oral view.**

modified Hader bar which is also the most effective system for overdenture.

The difference in muscle activity between conventional overdenture and overdenture with attachment determines the functional status of the attachment system.[2] This requires additional investigation, which is essential to a complete understanding of correlation of mechanical advantages and functional efficiency of masticatory system.[3] Two types of ovderdentures are in current use: the type which rests on domed or thimble shaped endodontically treated or modified teeth and the type which is supported by retentive attachments.[4] Many types of attachments have been introduced to the profession to augment retention and stability in conventional ovderdentures. A question that becomes obvious that do these attachments provide sound justification for extra effort required to provide long-term overdenture service with attachment to patients? Or Are these attachments functionally more efficient over conventional measures?

This necessitates basic research to determine the functional status of these attachments over the conventional overdenture service. In the present study, subjects who underwent conventional and Hader bar overdenture attachment treatment were re-evaluated after five years and compared. Sensory stimulation of periodontal receptors and resultant discharge of afferent impulses to brain elicit a precise coordinated neuromuscular reflex response.[5] To study the oral function in individual subject by nervous regulation of difference in activity produced by overdenture with coping and overdenture with attachment is being compared in the present study by qualitative electromyographic evaluation of the pattern of activity in elevator muscles of mastication on occurrence of tooth contact during exertion of force on hard foodstuff.[2] "Preservation in preventive Prosthodontics can and should begin before a patient ever loses a tooth that is our ideal".

## 2. Aims and objectives

The aim of the present study is to compare the initial measures of oral functional efficiency in Hader bar attachment overdenture with data obtained after five years under the null hypothesis that they would be similar. Conventional overdenture with Hader bar attachment was compared.

To study the electrical activity of masseter and temporalis muscles in minimum contraction and maximum contraction on chewing force on working and balancing sides and recordings are obtained in three phases. Phase-I on placement of conventional overdenture with copings. Phase-II overdenture with Hader bar attachment. Phase-III after Hader bar attachment service for five years. The purpose of the study is to determine whether the use of attachment in mandibular overdenture provide functional advantage over conventional mandibular overdenture by electromyographic means.[2] EMG activity test of patient with complete denture, overdenture and natural teeth was carried out by Rissin L., et al. Similarly Sposetti V.J. et al. On overdenture wearers before and after placement of Zest-anchor Stud-type of attachment, which concluded that the muscle activity increased after the placement of attachment.[6] Considering the review this study with tissue bar attachment system is the first of its kind.

## 3. Material & methods

Average muscle action potential values are obtained for the three groups as follows:

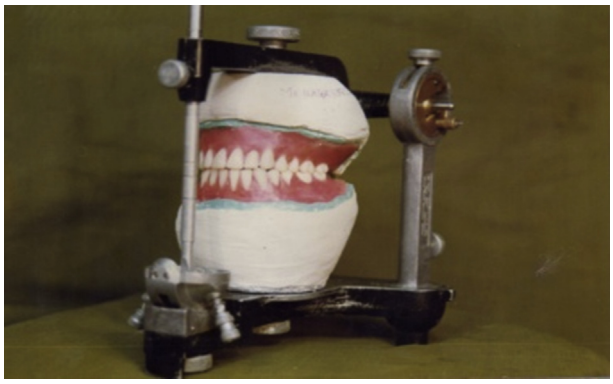


**Fig. 2 – Waxed up denture in balanced occlusion.**

Group I – Conventional overdenture with copings.
Group II – Conventional overdenture with Hader bar attachment system.
Group III – Overdenture with attachment system after 5 years of use.

For convenience the materials and method in details is being divided into the following headings:

### 3.1. *Criteria for patient selection*

Total ten patients, 9 male & 1 female, with firm retained mandibular canines placed at right angle to sagittal plane and no other teeth present ranged in the age group from 45 to 55 years were selected from the OPD of GDCH, Nagpur. Satisfactory general health, normal ridge relationship, positive attitude towards overall health care was ensured.

### 3.2. *Clinical Assessment*

#### 3.2.1. *Abutment selection*

Mandibular Canines are favored because of their strategic arch position, anterior location (Fig. 1A), role in sensory input, bone support and also as they are last teeth to be lost.[7]

Selection of Hader bar type attachment system is based on its advantages i.e. better cross-arch apical stress to abutment teeth and the stress breaking effect.[8]

After a thorough clinical assessment of the patients; fabrication of complete maxillary denture and conventional mandibular overdenture was done which included following specific standardized technique.

#### 3.2.2. *Protocol for abutment preparation, attachment placement and fabrication of dentures*

i. Modification of canines to a favorable crown-to-root ratio and intentional root canal treatment was carried out (Fig. 1B).
ii. Displacement wash final impression by custom made tray using twin-technique with rubber-base impression material was made.
iii. The cast thus obtained is duplicated and thin cast copings were fabricated in nickel–chromium alloy after which they were cemented with zinc–phosphate cement in patient's mouth (Fig. 1C).
iv. Individually tailored dentures were processed with fiber-reinforced heat cure acrylic resin and occlusal harmonization procedure was undertaken (Fig. 2).

#### 3.2.3. *Determination of muscle activity for conventional overdenture*

First EMG recording is thus obtained on conventional overdenture (Gp. I) (Fig. 3A, Tables 1 and 2).

#### 3.2.4. *Fabrication and placement of bar-clip attachment system in the patient's mouth and its placement in the same lower denture after removal of copings from lower canines to standardize the recordings*

i. The fabrication and placement of Hader bar system for the same mandibular overdenture is carried out meticulously. The height of abutment & prospective bar is determined in accordance to the available vertical space, which should be sufficient to give adequate clearance & sufficient bulk for the fabrication of subsequent complete denture. This also provides for favorable arrangement of teeth & oral hygiene measures.
ii. Abutments are prepared in height with improved crown-root ratio, the parallelism and taper (3–5°) is rechecked and corrected. With the wax pattern on abutments in place, the available vertical and horizontal space is re-evaluated. The selection of the proposed Hader bar having round cross-section & diameter of 1.5–2 mm is cut to the desired length and waxed to wax pattern for copings on canines (the previous metal copings are removed for fabrication of attachment system).
iii. The resin bar pattern is kept parallel to edentulous ridge. At least 1.5–2 mm of space was provided between the under surface of the bar & mucosa to allow for oral hygiene procedures.
iv. The bar is placed over the crest of ridge or slightly lingually in a straight horizontal alignment and almost perpendicular to the line bisecting the angle formed by the posterior alveolar ridges.
v. Thus cast bar with copings is cemented onto abutments (Fig. 1D).
vi. The fabrication of bar-retained and supported denture is carried out following conventional steps. Prefabricated retentive clips are incorporated onto the fitting surface of the denture during processing of denture. The resilient plastic sleeve is placed on the horizontal bar and the denture with retentive clip is secured in the patient's mouth.

#### 3.2.5. *Determination of muscle activity on placement of Hader bar attachment*

Second EMG recording is obtained on placement of the attachment system (Group II) (Fig. 3B, Tables 3 and 4).

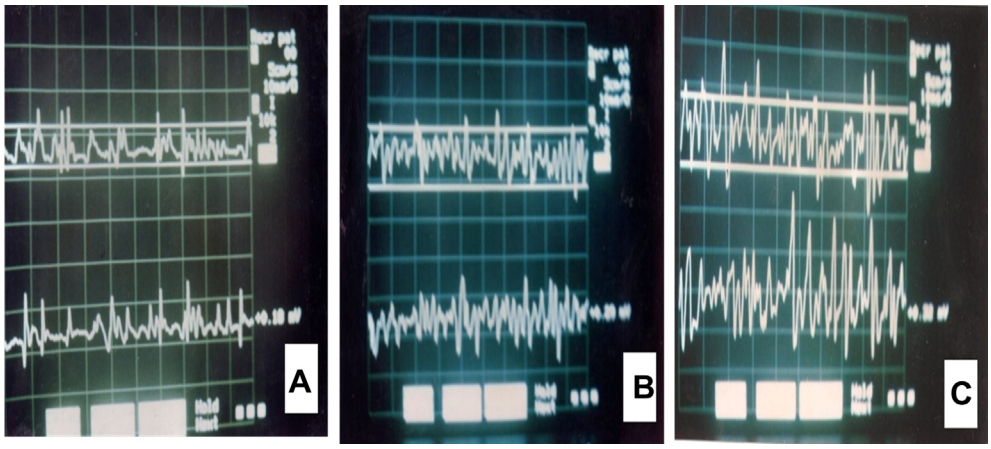



**Fig. 3 – A – EMG reading of masseter muscle immediately after conventional over denture placement. B – EMG activity of masseter muscle after placement of Hader bar attachment. C – EMG activity of masseter muscle after 5 years of placement of Hader bar attachment.**

**Table 1 – EMG recordings of average muscle action potentials for Group I (conventional overdenture with copings) for masseter.**

| Case no. | EMG recordings of average muscle action potentials for Group I (conventional overdenture with copings) | | | | | |
|---|---|---|---|---|---|---|
| | Masseter muscle | | | | | |
| | Chewing side | | | Balancing side | | |
| | Min. contraction | | Max. contraction | Min. contraction | | Max. contraction |
| | Amplitude | Duration | Amplitude | Amplitude | Duration | Amplitude |
| | C1 | C2 | C3 | C4 | C5 | C6 |
| 1. | 0.15 | 4.3 | 0.30 | 0.16 | 4.3 | 0.30 |
| 2. | 0.19 | 5.6 | 0.34 | 0.20 | 4.6 | 0.32 |
| 3. | 0.15 | 5.5 | 0.38 | 0.16 | 4.0 | 0.28 |
| 4. | 0.16 | 5.2 | 0.23 | 0.09 | 3.6 | 0.17 |
| 5. | 0.19 | 6.1 | 0.22 | 0.11 | 3.9 | 0.22 |
| 6. | 0.12 | 5.2 | 0.12 | 0.11 | 5.2 | 0.18 |
| 7. | 0.20 | 6.0 | 0.34 | 0.20 | 4.6 | 0.27 |
| 8. | 0.17 | 5.3 | 0.22 | 0.13 | 5.3 | 0.23 |
| 9. | 0.16 | 5.8 | 0.30 | 0.21 | 4.0 | 0.36 |
| 10. | 0.19 | 4.6 | 0.29 | 0.18 | 6.1 | 0.26 |

**Table 2 – EMG recordings of average muscle action potentials for Group I (conventional overdenture with copings) for temporalis.**

| Case no. | Emg recordings of average muscle action potentials for Group I (conventional overdenture with copings) | | | | | |
|---|---|---|---|---|---|---|
| | Temporalis muscle | | | | | |
| | Chewing side | | | Balancing side | | |
| | Min. contraction | | Max. Contraction | Min. contraction | | Max. contraction |
| | Amplitude | Duration | Amplitude | Amplitude | Duration | Amplitude |
| | C7 | C8 | C9 | C10 | C11 | C12 |
| 1. | 0.10 | 4.8 | 0.34 | 0.10 | 3.6 | 0.41 |
| 2. | 0.16 | 6.1 | 0.28 | 0.16 | 5.2 | 0.32 |
| 3. | 0.15 | 5.1 | 0.32 | 0.12 | 3.8 | 0.28 |
| 4. | 0.10 | 5.2 | 0.16 | 0.10 | 4.9 | 0.20 |
| 5. | 1.08 | 3.6 | 0.12 | 0.15 | 4.3 | 0.26 |
| 6. | 0.13 | 3.6 | 0.14 | 0.12 | 5.2 | 0.20 |
| 7. | 0.20 | 5.2 | 0.20 | 0.17 | 5.8 | 0.18 |
| 8. | 0.15 | 5.8 | 0.16 | 0.15 | 4.8 | 0.18 |
| 9. | 0.16 | 4.6 | 0.26 | 0.16 | 4.0 | 0.19 |
| 10. | 0.15 | 5.0 | 0.16 | 0.18 | 5.3 | 0.28 |

**Table 3 – EMG recordings of average muscle action potentials for Group II (overdenture with Hader bar attachment) for Masseter.**

| Case no. | EMG recordings of average muscle action potentials for Group II (overdenture with Hader bar attachment) | | | | | |
|---|---|---|---|---|---|---|
| | Masseter muscle | | | | | |
| | Chewing side | | | Balancing side | | |
| | Min. contraction | | Max. contraction | Min. contraction | | Max. contraction |
| | Amplitude | Duration | Amplitude | Amplitude | Duration | Amplitude |
| | C13 | C14 | C15 | C16 | C17 | C18 |
| 1. | 0.14 | 5.2 | 0.42 | 0.16 | 6.8 | 0.40 |
| 2. | 0.18 | 6.3 | 0.36 | 0.22 | 4.7 | 0.36 |
| 3. | 0.36 | 4.6 | 0.33 | 0.15 | 3.5 | 0.37 |
| 4. | 0.19 | 4.8 | 0.38 | 0.16 | 5.6 | 0.18 |
| 5. | 0.18 | 5.2 | 0.11 | 0.12 | 6.0 | 0.14 |
| 6. | 0.32 | 5.6 | 0.30 | 0.25 | 4.8 | 0.64 |
| 7. | 0.24 | 5.8 | 0.35 | 0.18 | 5.6 | 0.19 |
| 8. | 0.19 | 6.0 | 0.29 | 0.13 | 5.1 | 0.18 |
| 9. | 0.27 | 5.4 | 0.46 | 0.18 | 5.2 | 0.28 |
| 10. | 0.20 | 4.9 | 0.31 | 0.17 | 6.6 | 0.28 |

**Table 4 – EMG recordings of average muscle action potentials for Group II (overdenture with Hader bar attachment) for temporalis.**

| Case no. | EMG recordings of average muscle action potentials for Group II (overdenture with Hader bar attachment) | | | | | |
|---|---|---|---|---|---|---|
| | Temporalis muscle | | | | | |
| | Chewing side | | | Balancing side | | |
| | Min. contraction | | Max. contraction | Min. contraction | | Max. contraction |
| | Amplitude | Duration | Amplitude | Amplitude | Duration | Amplitude |
| | C19 | C20 | C21 | C22 | C23 | C24 |
| 1. | 0.14 | 5.8 | 0.42 | 0.16 | 5.2 | 0.42 |
| 2. | 0.18 | 5.2 | 0.34 | 0.18 | 4.8 | 0.38 |
| 3. | 0.13 | 3.2 | 0.20 | 0.09 | 3.2 | 0.16 |
| 4. | 0.14 | 4.8 | 0.42 | 0.16 | 5.0 | 0.30 |
| 5. | 0.10 | 3.8 | 0.26 | 0.17 | 4.8 | 0.46 |
| 6. | 0.14 | 5.6 | 0.32 | 0.18 | 5.2 | 0.22 |
| 7. | 0.21 | 4.8 | 0.27 | 0.15 | 5.6 | 0.40 |
| 8. | 0.18 | 6.2 | 0.76 | 0.22 | 5.6 | 0.28 |
| 9. | 0.16 | 5.8 | 0.38 | 0.23 | 5.2 | 0.52 |
| 10. | 0.13 | 5.2 | 0.20 | 0.20 | 4.6 | 0.20 |

**Table 5 – EMG recordings of average muscle action potentials for Group III (5 year use of Hader bar attachment system) for masseter.**

| Case no. | EMG recordings of average muscle action potentials for Group III (5year use of Hader bar attachment system) | | | | | |
|---|---|---|---|---|---|---|
| | Masseter muscle | | | | | |
| | Chewing side | | | Balancing side | | |
| | Min. contraction | | Max. contraction | Min. contraction | | Max. contraction |
| | Amplitude | Duration | Amplitude | Amplitude | Duration | Amplitude |
| | C25 | C26 | C27 | C28 | C29 | C30 |
| 1. | 0.18 | 4.2 | 0.32 | 0.20 | 4.8 | 0.34 |
| 2. | 0.29 | 4.6 | 0.36 | 0.12 | 5.6 | 0.34 |
| 3. | 0.18 | 5.3 | 0.38 | 0.32 | 4.3 | 0.42 |
| 4. | 0.20 | 4.6 | 0.32 | 0.18 | 6.8 | 0.40 |
| 5. | 0.16 | 6.6 | 0.44 | 0.12 | 4.8 | 0.36 |
| 6. | 0.34 | 6.0 | 0.42 | 0.24 | 4.8 | 0.68 |
| 7. | 0.28 | 6.2 | 0.51 | 0.16 | 5.2 | 0.34 |
| 8. | 0.22 | 4.4 | 0.46 | 0.13 | 5.0 | 0.32 |
| 9. | 0.36 | 6.5 | 0.48 | 0.20 | 3.9 | 0.42 |
| 10. | 0.32 | 6.2 | 0.36 | 0.18 | 4.8 | 0.38 |

#### 3.2.6. *Once treated, each patient's information was updated regularly according to the frequency of recall visits*

Hygiene problems, necessity of retention clip activation, repairs, replacement and renewals were dealt with meticulously. On regular maintenance after care and patient's appreciation of treatment for about five years.

#### 3.2.7. *Determination of muscle activity after five years of long-term use of overdenture with attachment*

Third EMG Recording was obtained after five years of regular use of overdenture with attachment **(Group III)**. (Fig. 3C, Tables 5 and 6). Comparison of all the recordings is made.

Neuromatic – 2000 CEM-EMG machine with concentric needle electrodes was selected and recording for temporalis and masseter muscle were obtained one at a time on working and balancing sides, following standard recordings in supine position of patient.

## 4. Discussion

Mastication is one of the main functions of the stomatognathic system. Increased interest for overdenture on natural retained teeth in Indian population is continuing to gain momentum. With the increase in their predictability, has come an increase in their scope. The theoretical rationale for Hader bar attachment overdenture prosthesis consisted in obvious

**Table 6 – EMG recordings of average muscle action potentials for Group III (5 year use of Hader bar attachment system).**

| Case no. | EMG recordings of average muscle action potentials for Group III (5year use of Hader bar attachment system) | | | | | |
|---|---|---|---|---|---|---|
| | Temporalis muscle | | | | | |
| | Chewing side | | | Balancing side | | |
| | Min. contraction | | Max. contraction | Min. contraction | | Max. contraction |
| | Amplitude | Duration | Amplitude | Amplitude | Duration | Amplitude |
| | C31 | C32 | C33 | C34 | C35 | C36 |
| 1. | 0.18 | 6.2 | 0.32 | 0.17 | 4.6 | 0.32 |
| 2. | 0.15 | 6.2 | 0.28 | 0.12 | 4.2 | 0.36 |
| 3. | 0.19 | 3.3 | 0.46 | 0.08 | 3.0 | 0.38 |
| 4. | 0.26 | 5.6 | 0.36 | 0.25 | 4.6 | 0.37 |
| 5. | 0.13 | 3.8 | 0.42 | 0.10 | 3.8 | 0.72 |
| 6. | 0.20 | 6.2 | 0.31 | 0.20 | 4.0 | 0.65 |
| 7. | 0.15 | 4.6 | 0.48 | 0.17 | 4.2 | 0.48 |
| 8. | 0.10 | 4.8 | 0.58 | 0.10 | 4.4 | 0.34 |
| 9. | 0.17 | 6.0 | 0.64 | 0.18 | 4.0 | 0.47 |
| 10. | 0.20 | 5.8 | 0.22 | 0.20 | 4.6 | 0.36 |

**Abbreviations**:
**Group I (C 1–C 12)**: C1 = Average amplitude on minimum contraction on chewing side for masseter muscle for Group I. C2 = Average duration on minimum contraction on chewing side for masseter muscle for Group I. C3 = Average amplitude on maximum contraction on chewing side for masseter muscle for Group I. C4 = Average amplitude on minimum contraction on balancing side for masseter muscle for Group I. C5 = Average duration on minimum contraction on balancing side for masseter muscle for Group I. C6 = Average amplitude on maximum contraction on balancing side for masseter muscle for Group I. C7 = Average amplitude on minimum contraction on chewing side for temporalis muscle for Group I. C8 = Average duration on minimum contraction on chewing side for temporalis muscle for Group I. C9 = Average amplitude on maximum contraction on chewing side for temporalis muscle for Group I. C10 = Average amplitude on minimum contraction on balancing side for temporalis muscle for Group I. C11 = Average duration on minimum contraction on balancing side for temporalis muscle for Group I. C12 = Average amplitude on maximum contraction on balancing side for temporalis muscle for Group I.
**Group II (C 13–C 24)**: C13 = Average amplitude on minimum contraction on chewing side for masseter muscle for Group II. C14 = Average duration on minimum contraction on chewing side for masseter muscle for Group II. C15 = Average amplitude on maximum contraction on chewing side for masseter muscle for Group II. C16 = Average amplitude on minimum contraction on balancing side for masseter muscle for Group II. C17 = Average duration on minimum contraction on balancing side for masseter muscle for Group II. C18 = Average amplitude on maximum contraction on balancing side for masseter muscle for Group II. C19 = Average amplitude on minimum contraction on chewing side for temporalis muscle for Group II. C20 = Average duration on minimum contraction on chewing side for temporalis muscle for Group II. C21 = Average amplitude on maximum contraction on chewing side for temporalis muscle for Group II. C22 = Average amplitude on minimum contraction on balancing side for temporalis muscle for Group II. C23 = Average duration on minimum contraction on balancing side for temporalis muscle for Group II. C24 = Average amplitude on maximum contraction on balancing side for temporalis muscle for Group II.
**Group III (C25–C36)**: C25 = Average amplitude on minimum contraction on chewing side for masseter muscle for Group III. C26 = Average duration on minimum contraction on chewing side for masseter muscle for Group III. C27 = Average amplitude on maximum contraction on chewing side for masseter muscle for Group III. C28 = Average amplitude on minimum contraction on balancing side for masseter muscle for Group III. C29 = Average duration on minimum contraction on balancing side for masseter muscle for Group III. C30 = Average amplitude on maximum contraction on balancing side for masseter muscle for Group III. C31 = Average amplitude on minimum contraction on chewing side for temporalis muscle for Group III. C32 = Average duration on minimum contraction on chewing side for temporalis muscle for Group III. C33 = Average amplitude on maximum contraction on chewing side for temporalis muscle for Group III. C34 = Average amplitude on minimum contraction on balancing side for temporalis muscle for Group III. C35 = Average duration on minimum contraction on balancing side for temporalis muscle for Group III. C36 = Average amplitude on maximum contraction on balancing side for temporalis muscle for Group III.

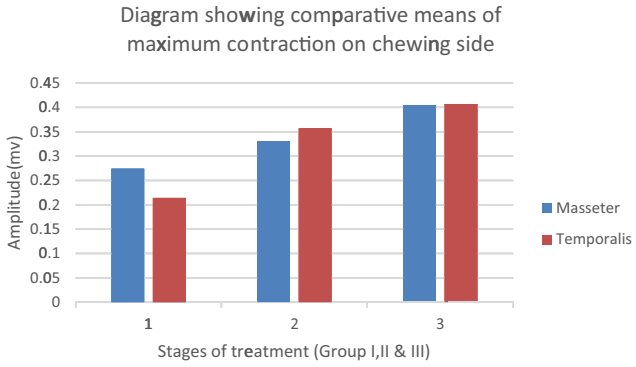



**Fig. 4 – Increase in EMG activity of average maximum contraction of masseter and temporalis muscles on chewing side.**

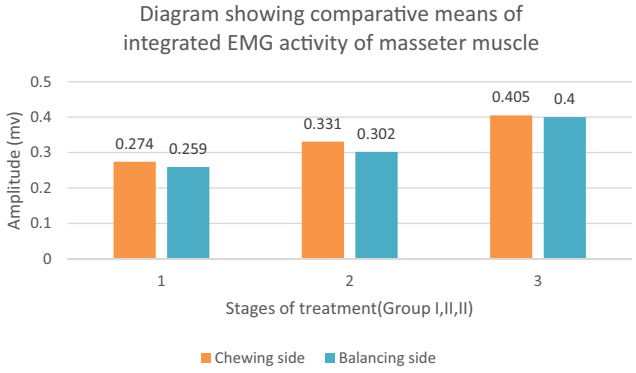



**Fig. 5 – Increase in integrated EMG activity of masseter muscle for avg. maximum contraction on chewing and balancing side.**

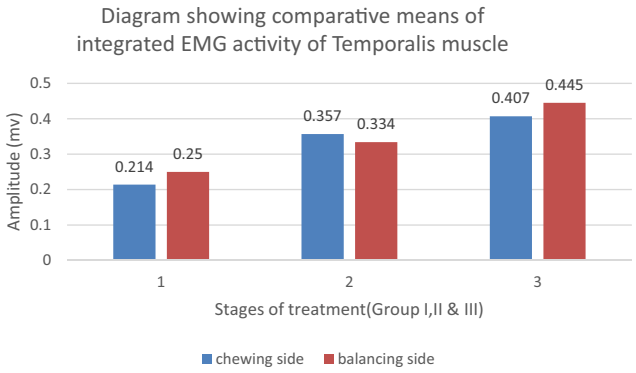



**Fig. 6 – Increase in integrated EMG activity of temporalis muscle for avg. maximum contraction on chewing and balancing side.**

need to preserve alveolar bone,[9] proprioception and periodontium protection, cross arch stability, retention, longevity,[10] biopsychosocial balance and functional mastication[11] in an expedient and in inexpensive way. Long evaluation periods are important to establish the treatment strategy to be justified in the long run.[9,12] In the present study, subjects who underwent two natural teeth retained overdenture-conventional and Hader bar overdenture were reevaluated after five years and compared.

The overdentures are evaluated bearing in mind the neurophysiologic background of reflexes evoked by sensory stimulation of stomatognathic system. The procedure was standardized by using same lower overdenture and same maxillary complete denture for all the three groups. This was adopted to eliminate any errors that could creep in due to two sets of lower dentures. Regular after care protocol, high maintenance and minor prosthetic revisions were persuaded over a five years period. Also the foodstuff was maintained the same i.e. equal in number and consistency, for all the evaluations. The advantages of giving overdenture in mandibular arch and retaining mandibular canines[13] were given due credit for consideration as a basis criteria for case selection. The selection of coping and Hader bar system and its fabrication in Nickel–chrome alloy were to incorporate the best advantages of the technique.

The bar joint system with the resilient plastic sleeve provides for rotational & combined movement to the overdenture. The overdenture is supported in parts by mucosal tissue of the ridges and thus maximum extension of

**Table 7 – ANOVA single factor analysis for C3, C15 and C27 for Group I, II and III.**

ANOVA: single factor

Summary

| Groups | Count | Sum | Average | Variance |
|---|---|---|---|---|
| Column 1 | 10 | 2.74 | 0.274 | 0.005893 |
| Column 2 | 10 | 3.31 | 0.331 | 0.008899 |
| Column 3 | 10 | 4.05 | 0.405 | 0.004472 |

ANOVA

| Source of variation | SS | df | MS | F | P-value | F crit |
|---|---|---|---|---|---|---|
| Between groups | 0.086287 | 2 | 0.043143 | 6.718595 | 0.004284 | 3.354131 |
| Within groups | 0.17338 | 27 | 0.006421 | | | |
| Total | 0.259667 | 29 | | | | |

**Table 8 – ANOVA single factor analysis for C9, C21 and C33 for Group I, II and III.**

ANOVA: single factor

Summary

| Groups | Count | Sum | Average | Variance |
|---|---|---|---|---|
| Column 1 | 10 | 2.14 | 0.214 | 0.006316 |
| Column 2 | 10 | 3.57 | 0.357 | 0.026534 |
| Column 3 | 10 | 4.07 | 0.407 | 0.01809 |

ANOVA

| SS | df | MS | F | P-value | F crit |
|---|---|---|---|---|---|
| 0.20066 | 2 | 0.10033 | 5.908716 | 0.00744 | 3.354131 |
| 0.45846 | 27 | 0.01698 | | | |
| 0.65912 | 29 | | | | |

**Table 9 – Single factor ANOVA analysis for C1, C13 & C25 for Group I, II & III.**

ANOVA: single factor

Summary

| Groups | Count | Sum | Average | Variance |
|---|---|---|---|---|
| Column 1 | 10 | 1.68 | 0.168 | 0.000618 |
| Column 2 | 10 | 2.27 | 0.227 | 0.004868 |
| Column 3 | 10 | 2.53 | 0.253 | 0.005423 |

ANOVA

| Source of variation | SS | df | MS | F | P-value | F crit |
|---|---|---|---|---|---|---|
| Between groups | 0.03794 | 2 | 0.01897 | 5.216847 | 0.012144 | 3.354131 |
| Within groups | 0.09818 | 27 | 0.003636 | | | |
| Total | 0.13612 | 29 | | | | |

overdenture borders. Attachment system provides shared distribution of occlusal force; retention against vertical dislodging force and distribution of occlusal forces between mucosa and bar joint. Rotational movement of the overdenture in the frontal & sagittal planes is permitted by the rotation of sleeves about the bar. The nylon sleeves and attached metal clip guide the movement of bar joint system eliminating any excessive undesirable movement against mucosal tissue.

The arrangement of teeth in balanced occlusion was provided to facilitate E.M.G, recording without interfering occlusal contact and to prevent false readings of muscle activity after placement of conventional overdenture.[14] Average amplitude on maximum contraction on chewing side showed a significant increase in EMG activity level ($p$-0.004284 and $p$-0.00744; $p < 0.05$) when compared with conventional overdenture placement against overdenture with Hader bar attachment and subsequent 5-year use of Hader bar attachment for both masseter and temporalis muscle respectively. Single factor ANOVA analysis was performed to evaluate the increase in muscle activity for both; masseter & temporalis muscle. The mean for amplitude of maximum contraction increased from 0.274 mv to 0.405 for Group I to Group III for masseter muscle, which is highly significant (Figs. 4 and 5; Table 7). For temporalis muscle, EMG activity increased from mean average maximum contraction of 0.214 mv–0.407 mv for Group I to Group III, which is also found to be statistically highly significant (Figs. 4 and 6; Table 8). The mean for average minimum contraction for masseter muscle was also found to be increased along with these findings (Tables 9 and 10).

**Table 10 – t-Test analysis for C1 & C25 for Group I & III.**

t-Test: two-sample assuming equal variances

| | Variable 1 | Variable 2 |
|---|---|---|
| Mean | 0.168 | 0.253 |
| Variance | 0.000618 | 0.005423 |
| Observations | 10 | 10 |
| Pooled variance | 0.003021 | |
| Hypothesized mean difference | 0 | |
| Df | 18 | |
| t Stat | −3.45828 | |
| P ($T \leq t$) one-tail | 0.001402 | |
| t Critical one-tail | 1.734064 | |
| P ($T \leq t$) two-tail | 0.002805 | |
| t Critical two-tail | 2.100922 | |

These findings are in agreement with the similar study by Sposetti VJ. et al 1986 where they found increase in masseter muscle activity after the patient gets accustomed to placement of attachment ($p < 0.02$). Hence it can be said that there was statistically significant difference in chewing effort as measured by the total electrical activity of the masseter and temporalis muscle after five years of service of Hader bar attachment as compared to initially on placement of attachment.[9,12] The present study confirms the exquisite sensitivity of sensory and reflex mechanisms of periodontal ligament into an unbelievably precise and rapid response.[8] The integration of the response in efficient functioning of stomatognathic system by increase in response elicited for Hader bar attachment on long-term use was evident by the study.

## 5. Conclusion

1) The Muscle activity is more after placement of attachment than conventional overdenture with copings.
2) There is a gradual improvement is muscle activity for all the three groups with maximum advantage seen for overdenture with attachment after 5 years of use.
3) Muscle activity after getting adapted to long-term overdenture use with attachment is better than before getting adapted to Hader bar attachment system. The difference between muscle activity on placement of conventional overdenture and after getting used to overdenture with attachment signifies improvement in chewing effort with attachment.

Within the limitations of the study results obtained indicate that oral rehabilitation with overdenture reestablishes and maintains health in the stomatognathic system. Furthermore, patient's appreciation for the two natural teeth retained mandibular overdenture even after five years is seen providing flexibility in planning treatment to meet the changing requirements. Further investigations with larger sample size and follow-up are still needed using the current protocol.

The study concludes that overdenture with Hader bar attachment when analyzed on a functional basis for long term provides a sound justification for this service to patients.

## Conflicts of interest

All authors have none to declare.

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