

COMPARATIVE EVALUATION OF THE ACCURACY OF TWO METHODS OF OCCLUSAL REGISTRATION INVOLVING TERMINAL ABUTMENTS – AN INVIVO STUDY

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ABSTRACT

Purpose of the study was to evaluate the accuracy of interocclusal records made in the terminal abutment region by two recording techniques.

Ten partially edentulous patients planned for replacement of missing mandibular molars with fixed partial denture were selected. For each patient three sets of articulations were made.

Articulation I - Pre operative casts: *Preoperative maxillary and mandibular casts mounted in an articulator. Measurements were made from the deepest part of the marginal gingiva in the maxillary and mandibular teeth using a travelling microscope.*

Articulation II - Inter occlusal record with centric stop: *Complete crown preparation was done for both mesial and distal abutments, preserving the centric stop in the distal abutment. Casts obtained were articulated using an inter occlusal record. Measurements between the maxillary and mandibular casts measured at the same area as the preoperative cast.*

Articulation III – Inter occlusal record without a centric stop: *The centric stop retained was reduced to complete the preparation and a third set of cast articulated with another inter occlusal record. Measurements between the maxillary and mandibular casts measured at the same area as the preoperative cast.*

The values obtained were statically analyzed.

Within the limitations of the study, presence of inter occlusal record in both the techniques showed an increase in vertical discrepancy.

Clinical Implication: Making interocclusal records with vertical stop shows increased vertical discrepancy.

Key Word: *Interocclusal records, centric stop, distal abutment, terminal abutment.*

INTRODUCTION

Accurate transfer of casts to the articulator is very critical in fabricating a restoration without occlusal errors. For the opposing casts to be held in a stable and

reproducible manner, a tripod of vertical support and satisfied horizontal stability between the two casts are required. Interocclusal records are the means whereby the inter arch relationships are transferred from the mouth to the articulator^{1,2}.

In spite of accurate records, problems exist in transferring the working cast to the articulator. Improper seating of condyles in the fossa, eccentric closure by the patient due to loss of proprioception, muscular action, tissue changes within the joint, mandibular position influenced by occlusal contacts are the factors that contribute to mounting errors.³ When the restoration involves the terminal tooth, then an interocclusal record becomes necessary. A unilateral record

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is sufficient in those instances where a posterior section of one side of an arch alone is being restored.²

Though various techniques^{4,5,6} have been introduced to make accurate inter occlusal records in the distal abutment regions, none of them proved to be the most accurate. The purpose of the study was to compare the accuracy of inter occlusal records made in the terminal abutment tooth by two methods of recording technique, with centric stop and without centric stop using polyvinylsiloxane as the recording material.

METHODOLOGY

Ten partially edentulous patients who reported to the Department of Prosthodontics, Rajah Muthiah Dental College and Hospital, Annamalai University, Tamil Nadu, India for replacement of teeth were selected. The patients were explained about the different treatment options and only those interested in fixed partial dentures were selected for the study after their consent. Selection was done based on the following criteria:

- i. One or two missing posterior teeth in the mandibular arch.
- ii. The posterior abutment tooth, should be the terminal tooth (no teeth posterior to it).
- iii. Braly's classification class I & II (3)
- iv. Angle class I molar relationship.
- v. No history of TMJ dysfunction or myofascial pain syndrome, crepitus facial muscle pain, or limitation of mandibular movement

For each patient three sets of articulations were made.

Articulation I - Pre operative casts (reference group):

Maxillary and mandibular preoperative impressions were made with polyvinyl siloxane impression material (Aquasil, Dentsply). Preoperative maxillary and mandibular casts were mounted in an articulator in the maximum intercuspal position. Measurements were made from the deepest part of marginal gingiva of the proposed mesial and distal abutments, to their respective opposing teeth using a travelling microscope. The values obtained were used as the guideline measurement for that particular patient.

Articulation II - Inter occlusal record with centric stop:

The occlusal contacts in the patient were recorded using an articulating paper (Arti- fol) 8 microns thick (Fig 1). The cusp of the terminal abutment tooth that was in contact with the opposing tooth was considered as the centric stop. Complete crown preparations were done for both the mesial and distal abutments, preserving the centric stop in the distal abutment (Fig 2). Casts obtained were articulated using an inter occlusal record. The inter occlusal record was obtained using polyvinyl siloxane bite registration material (Bitrex, Equinox). The patient was guided to the maximum intercuspal position and the bite registration material was injected between the prepared teeth. Measurements between the maxillary and mandibular casts measured at the same area as preoperative cast.

Articulation III - Inter occlusal record without a centric stop:

The centric stop retained was reduced to complete the preparation (Fig 3) and a third set of cast articulated with another inter occlusal record. Measurements between the maxillary and mandibular casts measured at the same area as preoperative cast.

Measurement phase:

The articulated maxillary and mandibular cast were measured at three different areas (Fig 4).

Distance A-B: The distance between the gingival zenith of the terminal abutment tooth (A) to the gingival zenith of opposing tooth (B).

Distance C-D: The distance between the superior most portion of edentulous ridge (C) to the gingival zenith of the corresponding opposing tooth (D).

Distance E-F: The distance between the gingival zenith of mesial abutment tooth (E) to the gingival zenith of opposing tooth (F).

The measurements were made using a travelling microscope with the sensitivity of .001mm. This procedure was carried out for all ten patients. The average for the distance A-B, C-D, E-F, of all ten patients was calculated and statically analyzed.

RESULTS

The articulated casts were measured at three different points. The distance A-B was on terminal abutment teeth, the distance C-D was at edentulous area, the distance E-F was at mesial abutment tooth. These three measurements were carried out for all the three mounted maxillary and mandibular casts - reference group (Articulation I), with centric stop plus Interocclusal records (Articulation II), without centric stop plus Interocclusal records (Articulation III). The values obtained for each group are tabulated in Table No. 1, 2, 3 & statistical analysis are tabulated in Table No. 4, 5 & 6.

TABLE 1: VALUES OBTAINED FOR 10 PATIENTS BELONGING TO GROUP I IN MILLIMETERS

Articulation I			
S. No.	A-B	C-D	E-F
1	8.88	6.20	8.58
2	11.2	6.13	10.7
3	11.6	6.06	7.08
4	8.68	4.75	6.09
5	1.32	7.06	12.6
6	10.7	3.83	6.61
7	9.82	7.80	6.54
8	11.6	8.53	11.9
9	11.4	3.82	6.64
10	10.9	8.85	9.60
	10.6	5.79	8.64

TABLE 2: VALUES OBTAINED FOR 10 PATIENTS BELONGING TO GROUP II IN MILLIMETERS

Articulation II			
S. No.	Mesial Abutment	Edentulous space	Distal Abutment
1	9.60	11.2	9.27
2	11.8	7.66	11.9
3	8.37	6.08	8.04
4	12.2	5.32	8.15
5	14.2	11.3	16.1
6	11.6	5.90	8.45
7	13.9	10.4	10.3
8	12.7	11.0	11.4
9	11.8	5.90	8.50
10	11.2	9.52	10.1
	11.8	8.43	10.2

TABLE 3: VALUES OBTAINED FOR 10 PATIENTS BELONGING TO GROUP III IN MILLIMETERS

Articulation III			
S. No.	Mesial Abutment	Edentulous space	Distal Abutment
1	6.95	10.7	8.28
2	10.9	5.71	11.3
3	6.66	7.22	8.13
4	11.2	5.96	7.00
5	15.5	9.89	15.9
6	11.2	5.43	8.76
7	15.7	9.92	5.75
8	11.7	6.58	11.4
9	11.2	5.56	8.77
10	10.8	8.57	10.1
	11.2	7.56	9.54

Statistical Analysis

TABLE 4: READINGS ON DISTANCE A-B BY ANNOVA REPEATED MEASURE ANALYSIS

Distance A-B	Mean	SD	F-ratio	P-value
Group I	8.64	2.43	6.735	.007
Group II	10.2	2.48		
Group III	9.54	2.85		

TABLE 5: READINGS ON DISTANCE C-D BY ANNOVA REPEATED MEASURE ANALYSIS

Distance C-D	Mean	SD	F-ratio	P-value
Group I	6.30	1.80		
Group II	8.43	2.50	8.397	.003
Group III	7.56	2.05		

TABLE 6: READINGS ON DISTANCE E-F BY ANNOVA REPEATED MEASURE ANALYSIS

Distance E-F	Mean	SD	F-ratio	P-value
Group I	10.6	1.09		
Group II	11.8	1.87	1.421	.267
Group III	11.2	2.94		

Table 4 shows that for distance A-B, the average interocclusal space by Group I was found to be 8.64mm with standard deviation of 2.43mm, average interocclusal space for Group II was found to be 10.2mm with



Fig 1: Shows identified Centric stop



Fig 2: Preparation of terminal abutment with centric stop



Fig 3: Preparation of terminal abutment by removing centric stop



Fig 4: Measuring points for the statistics

standard deviation of 2.48mm, and average interocclusal space for Group III was found to be 9.54mm with standard deviation of 2.85mm.

Table 5 shows that, for distance C-D, the average interocclusal space by Group I was found to be 6.30 mm with standard deviation of 1.80 mm, average interocclusal space for Group II was found to be 8.43mm with standard deviation of 2.50mm, and average interocclusal space for Group III was found to be 7.56 mm with standard deviation of 2.05mm.

Table 6 shows that, for distance-F, the average interocclusal space for Group I was found to be 10.61mm with standard deviation of 1.09mm, average interocclusal space for Group II was found to be 11.8mm with standard deviation of 1.87mm, and average interocclusal space for Group III was found to be 11.2mm with standard deviation of 2.94mm.

The results obtained to compare three methods by ANNOVA repeated measure infers significant result, this confirms that all three methods differs in assessing interocclusal space.

Bonferroni multiple comparison test infers Group I differs with Group II in distance A-B, and distance C-D. There was no significant difference between three groups in distance E-F.

DISCUSSION

Prosthetic rehabilitations frequently require an interocclusal record to fabricate a successful restoration. The ideal combination of material and technique for making interocclusal records allow the placement of indirectly made restorations in the patient's mouth without additional occlusal adjustments. In situation where the terminal tooth in the dental arch is used as distal abutment, an interocclusal record is of immense importance. An inaccurate transfer of such interocclusal records result in improper mounting of the casts in the articulator with concomitant treatment errors.⁵

The accuracy of an interocclusal record⁶, is influenced by the material properties, the recording technique, the accuracy with which the recording materials fit on the working cast, and the reliability of the mandibular position which is influenced by the occlusal contacts, muscular action or tissue changes within the Temporomandibular joints.

Various authors have described different techniques of making accurate Interocclusal records particularly in situations when the distal most tooth is used as an abutment. but none of the techniques has been compared or analysed for its accuracy.

A method by Christensen⁷ has been selected for the study, to verify the accuracy of interocclusal record, as it is less time consuming & can be done along with routine clinical procedures. The other methods of making records has some clinical inconvenience like, (i) Yuji sato's method⁷ is the modification of Christensen, but it needs additional time to build up composite cone whereas (ii) Adams technique⁴ needs bite registration tray to make interocclusal records and (iii) Postol technique⁸ is a time consuming procedure to fabricate a resin coping and resin registration material is not dimensionally stable compared to other bite registration materials.

Christensens preserved a cusp which is in maximum occlusal contact as vertical stop to make the record. Yuji sato did a modification in christensens method, in situation where the maximum occlusal contact is not on the cusp tip, thereby its on the slope of the cusp, in that case he build up composite cone to provide stability for the vertical stop. Adam prepared shallow groove on the abutment tooth to stabilize the record. Postol fabricated a resin coping on terminal abutment tooth to transfer the record with accurate vertical dimension.

Choice of material is another important factor to transfer the record to the articulator. Plaster, modeling compound, wax, acrylic resin, and elastomers are materials commonly used for making records. To select an ideal material, the desirable properties of recording material with their merits and demerits has to be thoroughly evaluated.⁸ Among the various recording materials, elastomer was selected as, it has a brief working time with good elastic properties, minimum resistance to closure, can be stored for relatively long time, the most dimensionally stable and accurate with minimal vertical discrepancy.^{11,12}

The device used for measuring vertical discrepancy is travelling microscope.¹³ Measurements were made on three positions in a imaginary vertical plane, in three regions of mesial abutment, edentulous space

and distal abutment, similar to Muller, as he measured in his study in three regions of anterior, premolar and molar region.¹⁴

When the results were compared the distance A-B, measured in Articulation II & III 10.2 & 9.53mm respectively were found to be greater than the distance A-B, of the reference group (Articulation I, 8.64mm). The distance C-D measured in Articulation II & III, 8.42 & 7.58mm respectively were found to be greater than distance C-D of reference group (5.78mm). The distance E-F measured in Articulation II & III, 11.8 & 11.1mm respectively were found to be greater than distance E-F, of reference Articulation I (10.6mm).

The results showed that the presence of interocclusal records has increased vertical dimension in all three positions. Between the Articulations, the records made in the absence of centric stop was found to be in close approximation to the reference group (Articulation I).

The statistical analysis showed that the values obtained at the distal abutment (distance A-B) and in the edentulous space (distance C-D) was statically significant, when comparing with Articulation I models with Articulation II models. The values obtained for distance A-B and C-D showed no significance, when compared between Articulation I & III and between the Articulations i.e., Articulation II versus Articulation III. The values obtained for distance E-F showed no statically significant difference when comparing Articulation I, either Articulation II or Articulation III, and between the Articulation II & Articulation III.

The inaccuracies or change in measurements may be attributed to anyone of the following reasons,

- i) Repositioning the record on cast could be a source of discrepancy, probably because imprints of occlusal pits and fissures cannot accurately be repositioned onto occlusal surface of casts, which do not reproduce complete surface detail.³
- ii) The mounting error can happen with every mounting. Breeding reported that, a mounting error of approximately .05mm can occur when casts are hand articulated.¹⁰

- iii) The physiologic variation of mandibular position is influenced by occlusal contacts, muscular action or tissue changes within joints.¹⁵
- iv) The compressive force exerted on elastomeric material while making records, it has been reported in literature that elastomeric material become distorted as a result of compressive forces.¹⁶

CONCLUSION

Within the limitations of the present study, the following conclusions can be drawn: a) Presence of Interocclusal records results in an increase in vertical discrepancy. b) Presence of centric stop was found to cause greater discrepancy than without centric stop. Further studies has to be continued with more number of samples & with techniques to limit control of interocclusal materials to flow over the centric stop.

REFERENCES

- 1 Freilich, Principles for selection interocclusal records for articulation of dentate and partially dentate casts. *J Prosthet Dent* 1991; 68: 361-67.
- 2 Squier RS. Jaw Relation records for fixed prosthodontics. *DCCNA* 2004; 28: 471-86.
- 3 Vergos VK, Tripodakis AP: Evaluation of vertical accuracy of Interocclusal records. *Int J Prosthodont* 2003; 16: 365-68.
- 4 Adams HF: A technique for quadrant interocclusal records. *J Prosthet Dent* 1982; 47: 44-46.
- 5 Douglass GD: The cast restoration – why is it high? *J Prosthet Dent* 1975; 34: 491-95.
- 6 Berman MH: Accurate interocclusal records. *J Prosthet Dent* 1960; 10: 620-30.
- 7 Christensen LC, Preserving a cenric stop for Interocclusal re-cords. *J Prosthet Dent* 1983; 50: 558-60.
- 8 Postol: Interocclusal registration at the vertical dimension of occlusion using acrylic resin copings. *J Prosthet Dent* 1982; 48: 39-43.
- 9 Yuuji S: creating a vertical stop for Interocclusal records. *J Prosthet Dent* 2000; 83: 582-85.
- 10 Breeding, DMD: Accuracy of three interocclusal recording materials used to mount a working cast. *J Prosthet Dent* 1994; 71: 265-70.
- 11 Lassila V, McCabe JF: Properties of interocclusal registration material. *J Prosthet Dent* 1985; 53: 100-104.
- 12 Lassila Comparison of five interocclusal recording materials. *J Prosthet Dent* 1986; 55: 215-18.
- 13 Karthikeyan, Comparative evaluation of dimensional stability of three types of interocclusal recording materials: An in vitro study, *JIPS* 2007; 7: 24-27.
- 14 Millstein, DMD, MS, Differential accuracy of elastomeric recording materials and associated weight change, *J Prosthet Dent* 1994; 71: 400-03.
- 15 Berry DC, Singh BP: Daily variations in occlusal contact. *J Prosthet Dent* 1983; 50: 386-91.
- 16 Breeding: Compression resistance of four interocclusal recording materials. *J Prosthet Dent* 1992; 68: 876-78.