COMPARATIVE EVALUATION OF OCCLUSAL CONTACTS IN THREE UNIT FIXED PARTIAL DENTURE PROSTHESIS FABRICATED WITH & WITHOUT FACEBOW TRANSFER –IN VIVO STUDY

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Abstract

The utility of facebow might reduce the occurrence of occlusal interferences in fabrication of three unit fixed prosthesis. There is a lack of data regarding the clinical usefulness of facebow in fixed prosthesis fabrication.

The purpose of this clinical trial was to study and compare the occlusal interferences in three unit fixed prosthesis fabricated with and without facebow transfer.

15 participants satisfying predefined inclusion and exclusion criteria were selected in this clinical trial. For each participant, 2 pair of three unit fixed prosthesis were fabricated. Prosthesis were fabricated one with and other without facebow transfer. The treatment involved single operator and single technician to minimize the error if any. After fabrication, the prosthesis were evaluated on the basis of the occlusal contacts and interferences of the three unit fixed prosthesis using a 40um articulating paper. The prosthesis with better occlusal contacts was cemented and the results were evaluated using chi square test.

Nine out of 15 three unit fixed partial denture prosthesis fabricated using facebow transfer had reduced incidence of occlusal interferences. 6 out of 15 prosthesis fabricated without facebow transfer had reduced incidence of occlusal interferences. The results were evaluated using chi square test which was highly significant. (P>1), the three unit fixed prosthesis fabricated with facebow transfer had reduced no. of occlusal interferences.

Taking into consideration of the complex and multiphase study design of the study with a finite number of participants and one specific arbitrary face-bow, the following result could be drawn as there is significant difference in three unit fixed partial denture prosthesis fabricated by the use of the arbitrary face-bow compared to a mean setting as compared to three unit fixed partial denture prosthesis fabricated without facebow transfer. The three unit fixed partial denture prosthesis fabricated with facebow transfer yields a better prosthesis and minimizes the harmful occlusal interferences as compared to the three unit fixed prosthesis fabricated without facebow transfer.

Evidence based dentistry is needed to asses and abolish the unnecessary steps in clinical dentistry. Facebow is one such step which has been questioned for long by many clinicians and there is lack if clinical trials with its use in fixed prosthodontics. This study is to evaluated the importance of use of facebow transfer in fabrication of three unit fixed prosthesis.

Keywords: fixed partial dentures, Face-bow, Occlusal adjustment, occlusal interferences, Randomized controlled trial.

INTRODUCTION

Construction of well fitted indirect restorations that are well adapted by patient's masticatory system is desired by both the dentist and the dental technician during the prosthodontic treatment.1 With the continuous progress in awareness about healthcare it is utmost important to recognize and banish unimportant diagnostic measures and ineffective therapeutic interventions. It has been evaluated that only 8% of dental treatments are backed by randomized controlled clinical trials and majority of clinically relevant questions are based on uncontrolled observations, recommendations from respected authorities

or personal beliefs. Clinical relevance of facebow has not been judged often due to its origin back to the end of the 19th century.2 For replicating of the spatial relationship of the maxillary arch to some anatomic reference point to an articulator, facebow is used, as it orients the dental cast to the opening axis of the articulator; customarily the anatomic references are the mandibular transverse horizontal axis and one other selected anterior reference point.3 This procedure ensures that the maxillary cast relates to the condylar assemblies of the articulator in the same manner as that of the patients maxillae relate to the terminal hinge axis of their condyles.4 Most common errors occurring in prosthodontics is said to be due to inaccuracy in mounting of the maxillary casts. When maxillary casts are mounted using facebow, it is believed that it coincides with the patients arbitrary hinge axis and the rotation axis corresponds closely to the true hinge axis as compared to the mean value settings. Therefore, to minimize occlusal errors, maxilla should be related to the arbitrary hinge axis using facebow.5,6

Ideally occlusal contacts in all posterior teeth are uniformly distributed and they should contact simultaneously. Clinically uneven pressure distribution on occluding teeth is due to nonuniform contacts created due to cuspal interferences.7

Inorder to achieve maximum occlusal contacts and minimal intraoral adjustments, restorations or splints should be made on casts mounted using facebow.2 Disruptive forces on the proprioreceptors of the stomatological system can be caused by occlusal interferences of just a few microns which result bruxism clenching or grinding leading to functional disorder the temporomandibular joint. It is important to detect and avoid factors that can result such functional disorders.8

Deflective occlusal contacts are tooth contacts that interrupt the normal closure of the mandible and cause deflection either mechanically or by activating the musculature which avoids such deflective contacts.9 Tooth contacts can be identified qualitatively and quantitatively. Qualitative methods involve the use of marking papers, shim stocks, occlusal waxes, silicone impressions or combinations of these materials to identify tooth contacts and the inference are recorded by the number and location of contacts requiring the investigator to make decisions about the nature of the tooth contacts.10

Making of facebow record is recommended by almost all literature of the prosthodontics but its use is questioned by dental practitioners since long time.4 A number of clinical trials have been carried out on utility of facebow in fabrication of complete denture and occlusal splint have suggested that facebow transfer hardly makes any difference. The data regarding use of facebow in fixed prosthodontics is not significantly present and the same inference cannot be applied for tooth-based fixed partial dentures as the impressions, jaw relation and periodontal tissues cannot be compared to denture base. With rising awareness about evidence based dental practice it is important to identify and eliminate such unnecessary diagnostic procedures and ineffective therapeutic interventions.1-6 This study is conducted to explore whether the use of facebow brings any benefit in patients requiring three unit fixed prosthesis.

Current scientific randomised clinical trials suggests simpler approaches for the construction of complete dentures and occlusal splints may lead to acceptable prosthesis fabrication, but no clinical study has investigated its use in fixed and removable partial dentures.1

Hence, the aim of this in vivo study is to evaluate and compare the occlusal contacts in three unit fixed partial denture prosthesis fabricated with facebow transfer & without facebow transfer.

Material and Methods

A total of 15patients, referred to the department of prosthodontics who present with unilateral single posterior missing teeth in any one quadrant of maxillary or mandibular arch [Class I cases] with the opposing teeth vital and unrestored maintaining healthy periodontium with loss of single posterior tooth within 1 year from date of reporting were selected for the study. The abutment teeth could be root canal treated or vital. Age range of the participants was 22–58 years. Patients with History/clinical evidence of bruxism ,Temporomandibular Symptoms ,Neuromuscular problems , Malocclusion and Cases requiring alteration of vertical dimension were excluded

Institutional ethical clearance was obtained for the study. Informed consent from the participants was recorded. The objectives were to evaluate occlusal contacts in three unit fixed prosthesis with facebow transfer and without facebow transfer . To compare the occlusal contacts in three unit fixed prosthesis with and without facebow transfer.

Figure 1: Intraoral pictures of patient

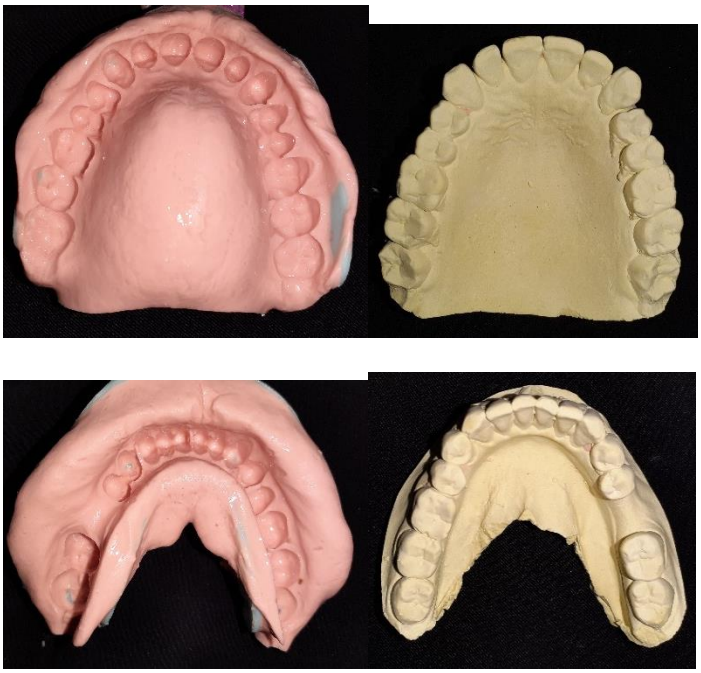


Figure 2: Diagnostic casts for waxup

Figure 3: Intraoral tooth preparation of the abutment teeth

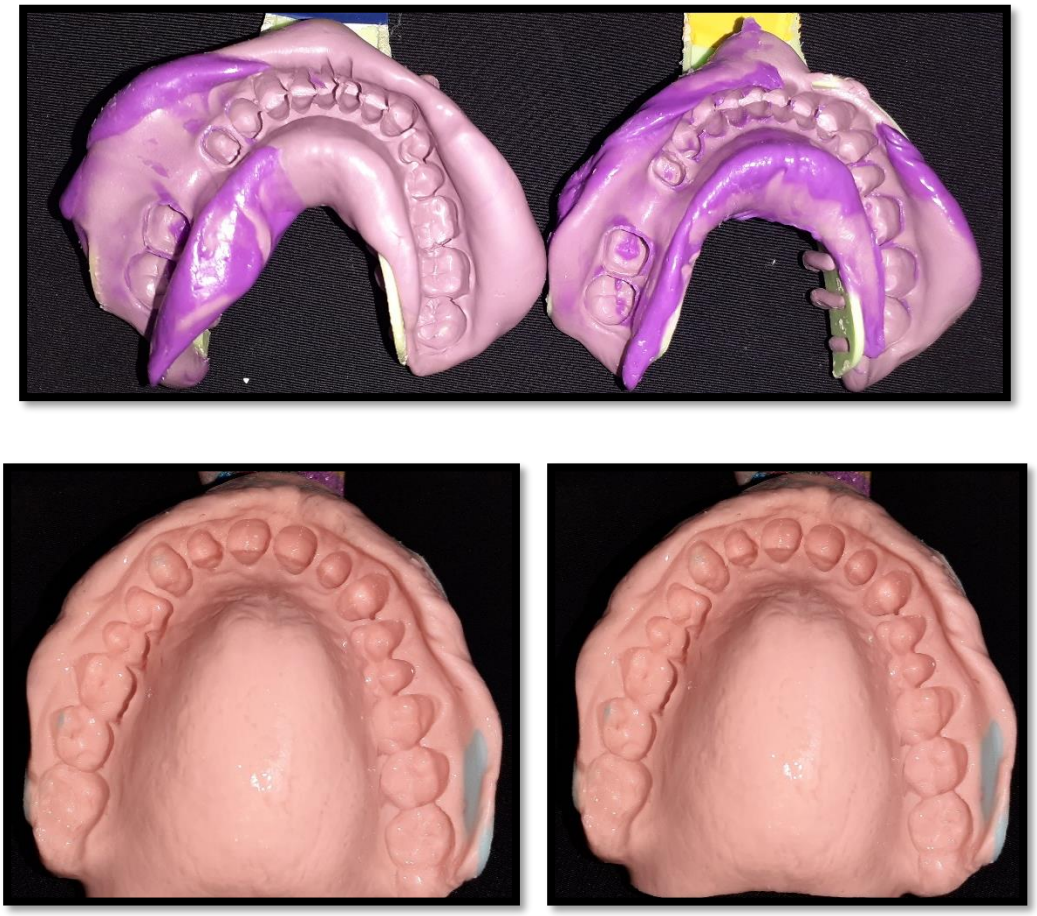


Figure 4: Two sets of impression

Figure 5: Facebow transfer onto Hanau Wide vue articulator

Figure 6: Occlusal contacts marked intraorally using articulating paper

Figure 7: Marked occlusal contacts in centric and in eccentric contacts

A detailed case history and clinical examination was recorded including intra oral peri apical radiographs of abutment teeth. Preoperative clinical photographs were taken.(fig1) .Pre-operative preliminary maxillary and mandibular impressions were made using Alginate Impression Material (Imprint dust free). The impressions were poured with Dental stone (Kalabhai, India) for diagnostic cast.(fig2) . Three unit waxup on diagnostic cast was made for the fabrication of temporary. Abutment teeth were prepared for full-metal three unit fixed denture prosthesis using standard tooth preparation burs. (Shofu Inc. Kyoto)(fig3) . After tooth preparation gingival retraction was done with chemico mechanical technique using SURE-Cord Knitted Retraction Cord non-impregnated (Sure-endo) and Prevest Denpro Hemostal Gel 25% Aluminium Chloride. Bite registration was done using Aluwax bite registration material (MAARCE Palghar, MPA Mumbai, India). Two sets of maxillary and mandibular final impressions were made in two stage technique in a stock tray with addition silicone Putty Soft (Express XT 3M ESPE) and Express XT Light Body (3M ESPE).(fig 4) Then two pairs of casts were made for each participant. Provisional temporization made from Protemp (3M ESPE) using pouring technique was cemented using Prime Dental Templute - Eugenol Free Temp Luting Cement. Both impressions were poured with Dental die stone ((Kalabhai, India) for fabrication of master cast.

Master cast were trimmed and pindexed and die pins were inserted. Base were made using base former and die cutting was done. One pair of master cast was mounted into semi adjustable Articulator HANAU Widevue (Whip mix, USA) using facebow (Whip mix, USA) setting and intraoral bite registration in maximum intercuspal position (fig 5) and the other pair of master cast was mounted into semi adjustable Articulator HANAU Widevue (Whip mix, USA)in mean settings and intraoral bite registration in maximum intercuspal position.[5] The wax patterns fabricated on both the articulators were sprued, invested with phosphate bonded investment material in the same casting ring followed by burnout and casting. After recovery, finishing of both the three unit full-metal prosthesis was done using metal finishing kit (DFS Finishing Kit). Both the three-unit full metal prosthesis were tried intraorally.(fig6)

PROCEDURE TO EVALUATE OCCLUSAL CONTACT

Articulating papers are the most frequently used qualitative indicators to locate the occlusal contacts intraorally.11 The occlusal contacts between the restoration and the opposing teeth were checked using articulating paper about 40micron thick. (Bausch Arti Check; Dr. Jean Bausch GmbH and Co.) Adjustments in the centric occlusal position were done with the patient in upright position. The articulation paper sized to an adequate length to cover the teeth that were marked and mounted in articulating forceps. The teeth will be dried to ensure accurate markings. Two different colors of articulating paper were used (red and blue).12 Red markings indicate the static occlusion and blue indicate the contacts in excursive movements. The patient's dynamic occlusion was marked first with blue articulating paper by asking the patient to make different excursive movements. The patient's static occlusal contacts (MIP) were marked with red articulating paper by asking the patient to tap his/her teeth into maximum intercuspal position. This 'dynamic-static' order was to produce a clear presentation of the occlusion. 13The characteristic marking was observed as a central area that is devoid of the colorant and surrounded by a peripheral rim of the dye. This region is called "target" or "iris" owing to their appearance, and it denotes the exact contact point.11The number and distribution of occlusal contacts in static and dynamic occlusion were evaluated depending on the individual occlusion concepts of the participants in order to identify the premature occlusal contacts.(fig 7) The prosthesis with ideal occlusal contacts were polished and cemented using permanent cement GC Gold Label Luting & Lining Cement (GC CORPORATION TOKYO, JAPAN)

RESULT

The results obtained are tabulated into binary system for statistical analysis which states 0 as absence of interferences and 1 as presence of interferences in 30 samples as two three unit fixed prosthesis were fabricated per patient.

Table 1: Interference in prosthesis fabricated with and without facebow for each sample

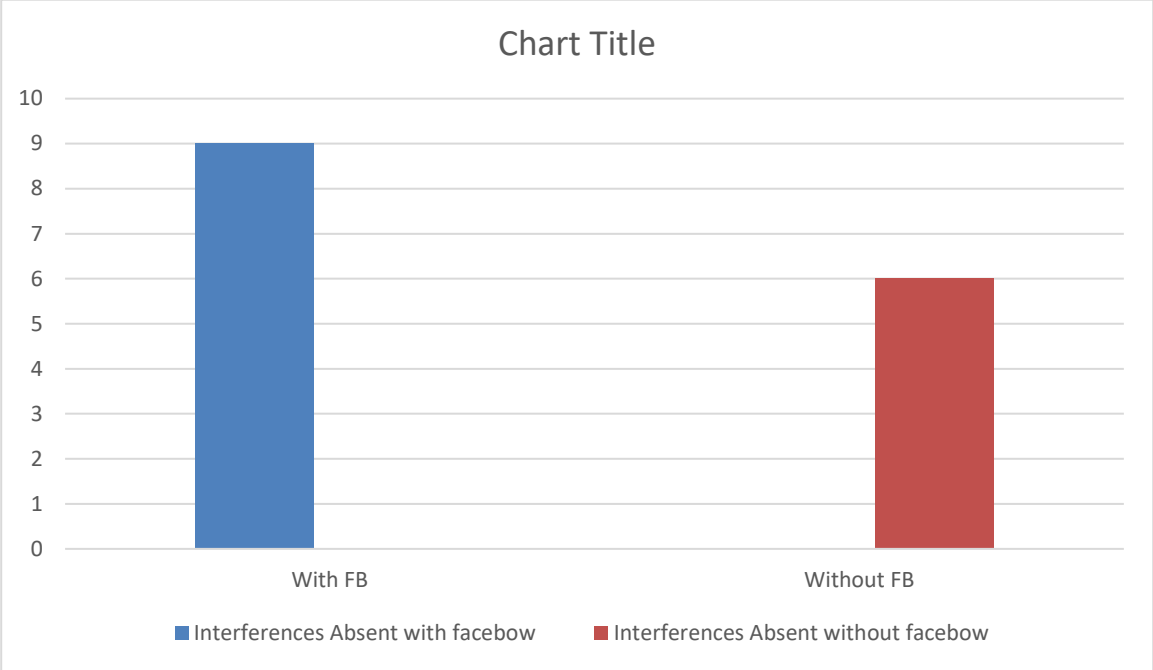
Sample no.	With facebow interferences	Without facebow
1	0	1
2	1	0
3	0	1
4	0	1
5	0	1
6	1	0
7	0	1
8	0	1
9	0	1
10	1	0
11	1	0
12	0	1
13	1	0
14	0	1
15	1	0

According to the observation, result of the study is that 9 out of the 15 three unit fixed prosthesis fabricated with facebow transfer showed absence of interferences and 6 out of 15 three unit fixed prosthesis fabricated without use of facebow transfer showed absence of interferences.

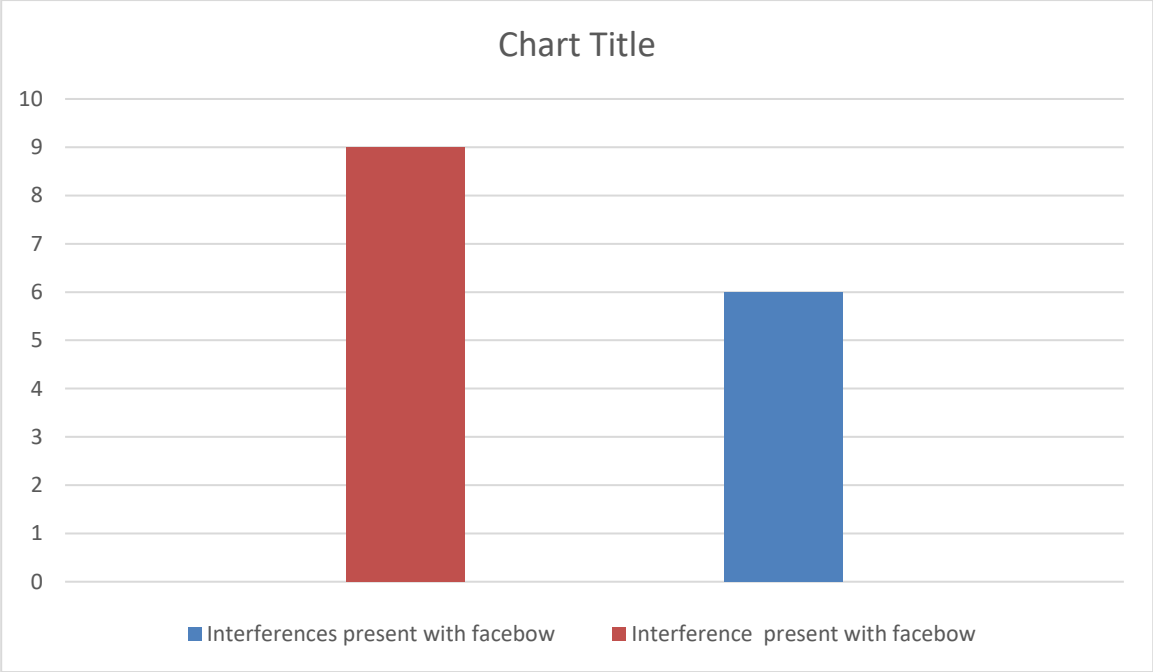
Table 2: Chi square test result in prosthesis fabricated with facebow versus prosthesis fabricated without facebow for each sample

			Without face bow		Total	Chi square	P value
			Interferences absent	Interferences present			
With Face bow	Interferences Absent	Count	0	9	9	15.000	**<0.001**
		%	0.0%	100.0%	60.0%		
	Interferences Present	Count	6	0	6		
		%	100.0%	0.0%	40.0%		
Total		Count	6	9	15		
		%	100.0%	100.0%	100.0%		

Graph 1- Comparsion of interference being absent in prosthesis fabricated with and without facebow for each sample.



Graph 2- Comparsion of interference being present in prosthesis fabricated with and without facebow for each sample.



The data was statistically analyzed using chi square test. Significance of difference in occlusal interference as a result of occlusal equilibration was analyzed in three unit fixed prosthesis fabricated with and without facebow. For statistical evaluations, $P < 0.05$ was considered statistically significant and $P < 0.001$ was considered highly statistically significant. The three unit fixed partial denture prosthesis fabricated with facebow transfer yields a better prosthesis and minimizes the harmful occlusal interferences as compared to prosthesis fabricated without facebow transfer.

Even occlusal contacts are important for uniform distribution of forces along the periodontal ligament and for the proper

maintenance of harmony among the stomatognathic system. Studies claim that occlusal interferences lead to pathological effects resulting in TMDs.

Mandibular movements from centric occlusion to mandibular rest position are characterized by condylar rotation and anterior-inferior translation of the condyle-disc complex around a transverse horizontal hinge axis for recording of true hinge axis, the mounting of cast using facebow would ensure maxillary cast teeth to glide against the mandibular teeth without interferences intraorally. So prosthesis fabricated without use of facebow lead to introduction of interferences for which prosthesis need to be occlusally adjusted.

Factors that influence this result after using facebow are: correct recording of the vertical dimension at occlusion after making the centric relation using interocclusal recording material; recording of path of rotation and axis of condyle on mandibular movements and use of semiadjustable Hanau widevue articulator for transferring these records.

There are few studies that assess the advantage of using face-bow, as the only variable in two groups, in fabrication of complete denture and occlusal splints but there is lack of studies regarding its use in fixed prosthodontics and removable partial dentures. It has been believed that the prosthesis made using face-bow produces predictable functional and aesthetic restorations as compared to the casts mounted arbitrarily by the technician. The mean setting was chosen as a control group for mounting casts onto the articulator. Based on literature, casts mounted arbitrarily did not affect the outcome of the prosthesis2,4,5,1. The main goal of this study was the assessment of occlusal contacts clinically. Previous studies suggest some shortcomings with the use of articulating paper such as reproducibility of markings due to saliva and moisture which affects its accuracy. While using the articulating paper there is no connection between force applied and area marked.

Discussion

The outcome of this study were assessed using occlusal points that were present in Groups 1 and 2 and statistical difference is present in the number of clinical contacts. The total quantity of clinical uneven occlusal contacts decreased with the use of facebow. Patients have to adapt due to the change within the stomatognathic system to the new centric relation occlusion. In group 1 (facebow setting) the three unit fixed prosthesis showed absence of interefernces as compared to the prosthesis fabricated without the use of facebow i.e 9 out of 15 prosthesis fabricated with fabebow has better clinical outcome

In group 2 (mean setting) when prosthesis was fixed it had interferences present in both centric and eccentric occlusion in most of the cases

This study is supported by Zapad Z Z and Rijec Z who studied variance in the mean spatial condylar shift between facebow transfer and without facebow transfer using average mounting and concluded it to be 0.1 – 0.2 mm, which can be considered a physiological variation of condylar shift of normal temporomandibular joints among asymptomatic subjects with normal occlusion.14,15 Ahlers O, Edelhoff D& Jakstat H also concluded that cast transfer done using facebow had a better reliability as compared to that mounted using average mean value.16

Qualitative analysis was done using articulating paper of 40μm in centric and in eccentric contacts as an indicator for intereferences. Arbitrary face-bow was used as they are easy to use and readily available as compared to kinematic facebow for recording the arbitrary hinge axis. The magnitude of difference is clinically evident in this study. The difference is not solely dependent upon the facebow as the only variable as there are many other factors playing key role in prosthesis fabrication including error in mounting, error due to bite registration material, error in facebow transfer expansion by plaster technician error and lastly unavoidable casting error.

The utility of a face-bow for prosthesis fabrication has been questioned for long time in the literature. Some have opinion that facebow should not be used because its time consuming nature for making records16. The results of our study did not focus on the location of high points but mere the presence or absence of interferences.

For further scope of studies, a comparative study should be made by utilizating facebow as the variable to the control group using a better occlusal indication along with force distribution. Further research is, needed to evaluate use of face-bow in fabrication of multiunit fixed partial dentures as tooth-based fixed partial dentures has other factors such as impressions, jaw relation, and periodontal tissues.

CONCLUSION

Within limitations of this in vivo study and considering the complex multistep study design, limited number of participants and referring to one specific arbitrary face-bow, the following conclusion could be drawn:

In the 15 samples of three unit fixed prosthesis fabricated with facebow, interferences were absent in 9 samples as the facebow orients the maxillary cast to the articulator in the same spatial craniomandibular relationship as present in the patient.

In the 15 samples of three unit fixed prosthesis fabricated without facebow interferences were absent in 6 samples i.e there were higher incidence of occlusal interferences being present when maxillary casts were mounted arbitrarily without use of the facebow transfer.

This study concludes that, there is substantial difference by the use of the arbitrary facebow compared to a mean setting without facebow transfer when three unit fixed prosthesis is fabricated. The three unit fixed partial denture prosthesis fabricated with facebow transfer yields a better prosthesis and minimizes the harmful occlusal interferences.

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