

Repeatability and reproducibility of facebow transfer using an earpiece facebow in edentulous patients

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ABSTRACT

Facebow record has shown questionable results with respect to its effect on outcome of complete denture and also its reliability while transferring the record. The purpose of this study was to observe the repeatability and reproducibility of facebow transfer using an earpiece facebow in edentulous patients. 10 patients with completely edentulous maxilla, undergoing treatment for complete denture were included in this study. The maxillary wax occlusal rims after the adjustments were duplicated to low fusing impression compound. 3 points were marked on the facial surface of the rims: right molar region, left molar region and in the midline. An adjustable platform was fitted onto the lower member of the articulator. Facebow transfer was performed using earpiece facebow by three observers: A, B and C; where observer A performed the procedure thrice and observers B and C performed it once each. Measurements were made between the three marked points and the adjustable platform on the articulator using a digital Vernier caliper. The p value was found to be insignificant in both intra-observer and inter-observer comparison with respect to all three markings. In intra-observer comparison range of deviation amongst all three markings was found to be in between 3.07 and 4.04 mm; and in inter-observer comparison it was found to be between 3.33 and 3.47 mm. Within the limitations of the study, Facebow transfer using an earpiece facebow in edentulous patients was found to be a reproducible and repeatable procedure

Keywords:

Earpiece facebow, Facebow transfer, Reliability.

1. Introduction

Dental prostheses are widely fabricated for partially dentulous as well as edentulous patients. Factors responsible for support differ in natural teeth and removable dental prosthesis. The supporting structures include periodontal ligaments surrounding the teeth and oral mucosa in edentulous region, showing different compressibility and resiliency which affect the overall outcome of the prosthesis. One of the most important requirements for successful complete denture prosthesis is establishing a good occlusal harmony between the teeth and mandibular movements so it allows better distribution of masticatory forces and improves efficiency and stability of denture.

One of the steps introduced in fabricating the complete denture has been facebow transfer. The facebow mounting serves to transfer the definite three-dimensional relationship between the maxillary dental arch and the starting position of the paths of mandibular movement [1]. Orientation of the occlusal plane has effect on the eccentric condylar inclinations. Elevation of the occlusal plane decreases the condylar readings while lowering the occlusal plane increases them and consequently can produce some serious cuspal inclination disharmonies [1].

The use of facebow has been debatable either by its effect on outcome of complete denture prosthesis or by its difficulty in reproducibility. It has not been possible to arrive at a definitive conclusion regarding reliability of the facebow transfer especially in edentulous patients and it is desirable to know this since the expenditure of clinical time would be of waste if the subsequent transfer procedure would result in gross errors. It is necessary to re-address the question of whether an arbitrary face-bow is reliable in orientation of maxillary position onto an articulator in

edentulous patients. The purpose of this study was to observe the repeatability and reproducibility of facebow transfer using an earpiece facebow in edentulous patients.

2. Materials and methods:

10 patients with completely edentulous maxilla who visited to Department of Prosthodontics, Crown & Bridge and Implantology, Rural Dental College & Hospital, Loni were chosen for the study. These patients included ones who were advised with treatment option of removable complete denture and were willing to participate in this study. The treatment was carried out in conventional manner starting with making of the primary impression. At the step of the Jaw relation, orientation relation was recorded using an arbitrary facebow. For the study purpose, the maxillary wax occlusal rims after the adjustments were duplicated to avoid any distortion during the transfer procedure. Silicon mold was prepared individually for each occlusal rim. Low fusing impression compound was softened and allowed to harden in the mold to obtain a duplicated rim. 5 maxillary casts were duplicated for each patient for mounting on to the articulator after each facebow transfer. For evaluation of transferred relation of maxilla on the articulator 3 reference points were marked on the facial surface of the rims: right molar region, left molar region and in the midline (Fig.1). An adjustable platform was fitted onto the lower member of the articulator. For facebow transfer procedure an earpiece facebow was used. The procedure was performed by three observers: A, B and C; where observer A performed the procedure thrice and observers B and C performed it once each. The rim along with the cast was mounted on a semi adjustable articulator after each facebow transfer. In total there were 50 facebow transfers done, 5 for each patient. The variance in the transferred position of the maxilla on the articulator was done by calculating the distance between the three marked points and the adjustable platform on the articulator using a digital Vernier caliper (Fig. 2). Comparison was carried out between the measurements obtained by observer A, which served as intra-observer variance and between the measurements of average values by observer A, values by observer B and values by observer C, which gave us inter-observer variance. Statistical analysis software namely SYSTAT version 12 (made by Crane's software, Bangalore) a licensed copy was used to analyse the data.

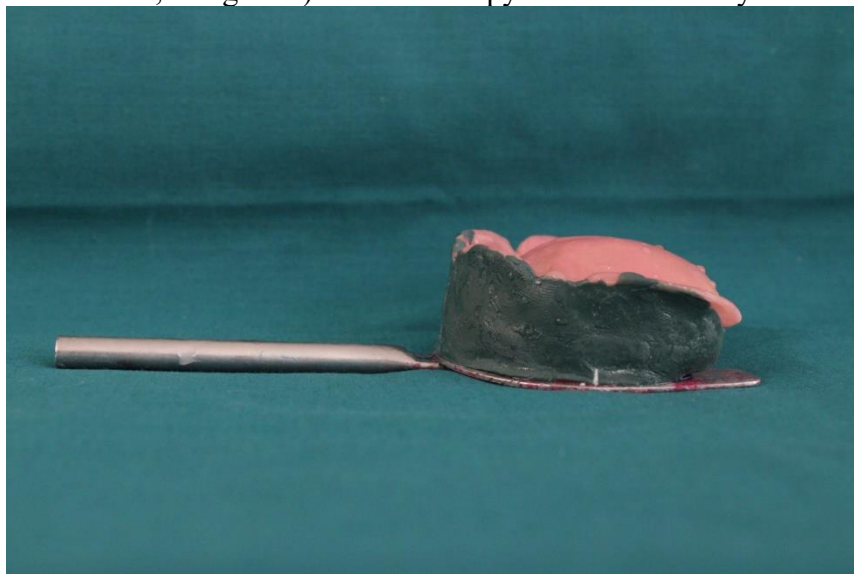


Figure 1: Record base and occlusal rim attached to the bite fork with the markings on it.

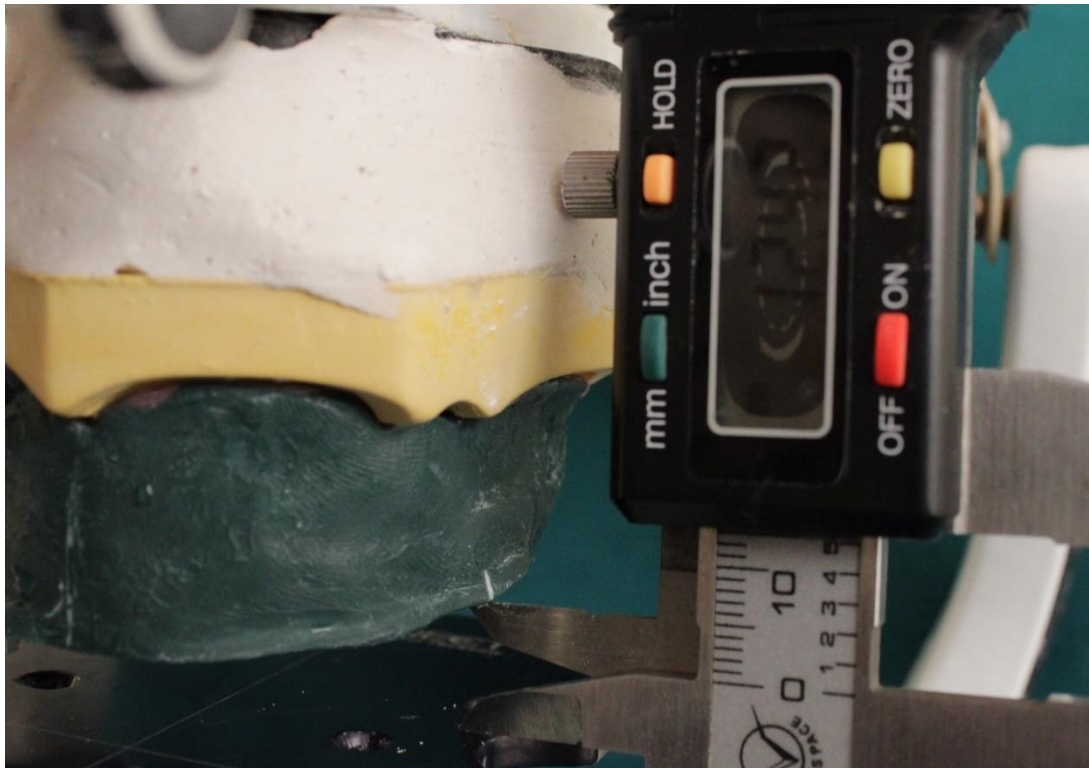


Fig. 2: Measuring distance between points and adjustable platform.

3.Results:

One-way ANOVA test was performed for both Intra-observer variance and Inter-observer variance with respect to all three points. The findings were insignificant for right molar point (p value= 0.439 for intra-observer variance and $p= 0.775$ for inter-observer variance), left molar point (p value= 0.289 for intra-observer variance and $p= 0.763$ for inter-observer variance) and midline (p value= 0.214 for intra-observer variance and $p=0.581$ for inter-observer variance)(Graph 1 and 2). A subsequent multiple pair-wise comparisons were carried out using Post Hoc Test- Bonferroni which also proved to be insignificant. Reliability statistics was done using Cronbach's scale, which resulted in Cronbach's Alpha greater than 0.7 at all three points for both intra-observer and inter-observer variance thus finding the procedure to be reliable. Maximum and minimum values were calculated so as to see the range of variance in values at all three markings. On intra-observer comparison, range of deviation amongst all three markings was found to be in between 3.07 and 4.04 mm; and in inter-observer comparison it was found to be between 3.33 and 3.47 mm.

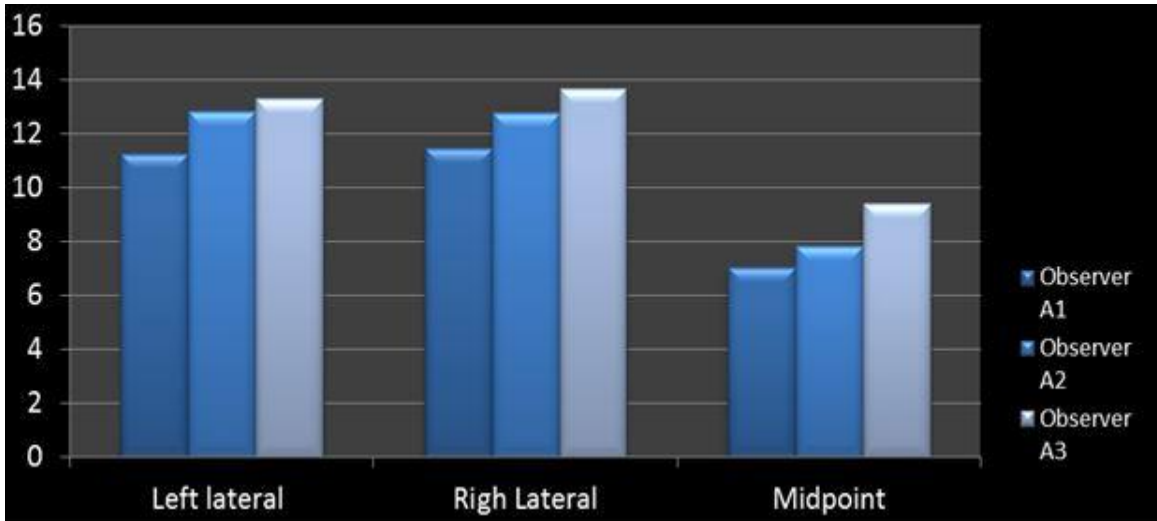


Figure 3: Graphical representation of mean values by Observer A measured thrice (A1, A2 and A3) at all three points.

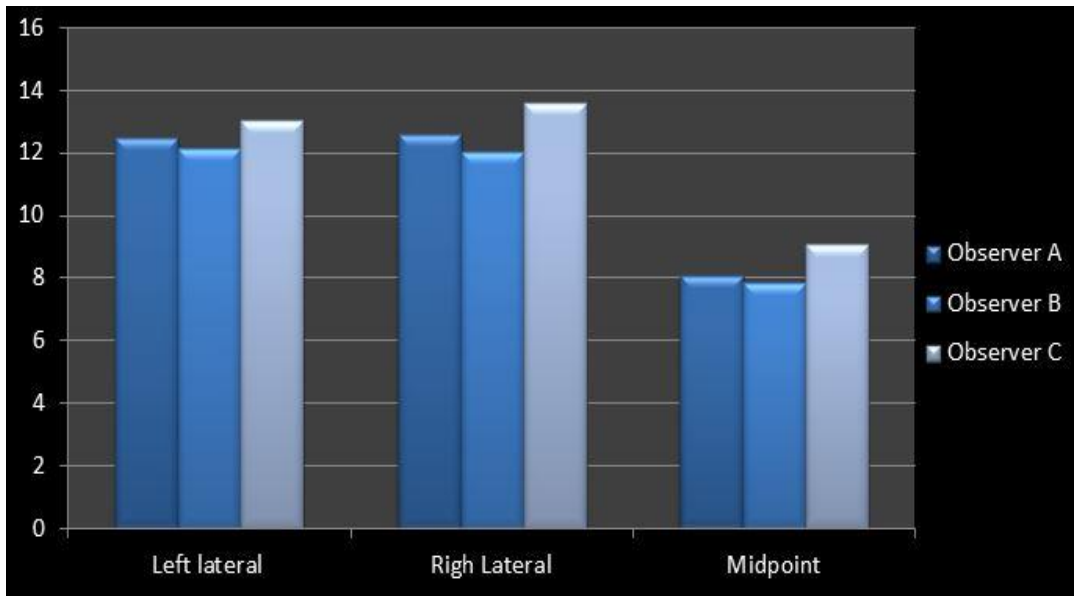


Figure 4: Graphical representation of mean values by Observer A (Average of A1, A2 and A3), Observer B and Observer C measured at all three points.

4.Discussion:

The use of facebow transfer has not proven to be indispensable so to achieve better outcome of complete denture. In 2013 Cunha et al reported in his study that a simplified method which eliminated the facebow transfer for complete denture fabrication can restore masticatory function as well as that of the conventional protocol which makes use of facebow [2]. Farias Neto in his review had suggested that simpler approaches for the construction of complete dentures may present acceptable results [3]. Dr. Yohn K in 2016 concluded in his article that there was no evidence to suggest that using a face bow transfer improved the results of complete dentures thus questioning the use of facebow in edentulous patients [4].

Various authors also studied for the reproducibility of the instrument [5-8]. Gold and Setchell and Yanus et al concluded that facebow is an accurate procedure and facebow transfer records are reproducible whereas Brecker in his study commented that facebow transfer cannot be easily duplicated on the same subject [8]. Bowley et al reported that the facebow transfer record is accompanied by inherent errors in adjusting the instrument to the patient and then in setting the instrument to the articulator [6]. Ahler in 2018 drew out various conclusions in favor of reliability and validity of the Facebow transfer [9].

The present study evaluated both, reproducibility (Inter-observer) i.e the closeness of the agreement between independent values obtained with the same facebow transfer on the identical subject but by different observers and repeatability (Intra-observer) which denotes the closeness of the agreement between independent results obtained with the same facebow transfer on the identical subject by the same observer. The results showed there were clear differences seen with both the Intra-Observer and Inter-Observer measurements at the three points marked on the occlusal rims.

The anterior reference adjustments showed no significant effect on variance obtained in transfer of facebow record in various studies [6-7]. Choi in his study mentioned, either palpation of Orbitale or 43mm point vertical to incisors as reference points might have effect on consistency of record. In this study the nasion relator was used for anterior reference adjustment which could be easily adjusted and might contribute to insignificant results.

In the study by Bowley et al, where the effect of setting of anterior or posterior facebow assembly components was evaluated, it showed significant error in setting the posterior assembly component in relation to marked transverse hinge axis resulting in gross error in anterior-posterior and supero-inferior direction. The use of earpiece facebow avoids the room of error in this study.

During each transfer procedure for same patient, the same bitefork and occlusal rim assembly was used to eliminate potential error during the attachment of rim to bitefork as mentioned in previous study [8].

We found range of variance to be between 3.07 and 4.04mm in intra-observer comparison and between 3.33 and 3.47 mm in inter-observer comparison. A previously reported study showed average vertical error as high as 4.3mm by one dentist and an average of ± 1.2 mm vertical error at all three reference teeth while another study gave the largest variation in superior-inferior direction of 1.7mm [7,8]. The variability obtained was insignificant in the present study thus making the facebow transfer a reliable procedure. These results were consistent with the studies carried out by Choi et al and Ahlers et al. However, study by Bamber et al had given poor reproducibility of the facebow transfer [5]. These studies did not include the repeatability of the transfer procedure and were carried out on dentate subjects.

Various reasons could be attributed to the differences seen which include facebow records being made without any assistance by the operator, operator's fatigue, locking earbow in position and aligning of the nasion relator assembly. These factors contributing to degree of error in a facebow transfer were also reported in previous studies by Bamber et al and Gold and Setchell. Bowley et al referred to mounting errors of 0.5mm and can also considered one of factors in the present study.

A very recent systematic review by Prakash P et al evaluated the use facebow transfer for complete denture fabrication to improve patient acceptance [10]. On extensive search 7 randomised clinical trials were included in the study. Authors concluded use of facebow transfer in complete denture resulted in similar clinical efficiency and patient acceptability than complete

denture fabrication without facebow transfer and more comprehensive studies need to be carried out to bring any change in clinical practice.

The results were statistically insignificant thus making the facebow transfer a repeatable and reproducible procedure. The variance seen in present study is more than the previous studies and one of the reasons could be the realeff effect offered by resilient oral mucosa in edentulous patients. Ideally, soft tissue should be bound to underlying cortical bone, containing a resilient layer of sub mucosa and should be covered by keratinized mucosa. This resilient submucosa permits moderate compressibility and its fatty and glandular structure and provides the “hydraulic cushion” similar to palm of hand and sole of foot. This “realeff” phenomenon can mask the inaccuracies produce during the recording of maxillomandibular relationship and produce a likeness of correct clinical outcome of the prosthesis [11,12].

Facebow procedure has shown the reliability however its application and outcome at clinical level is uncertain. Further randomised clinical trials need to be conducted to assess for the outcome of prosthesis without using facebow transfer in terms of occlusal disharmony, masticatory efficiency and patient acceptability.

5.Conclusion:

Within the limitations of the study, Facebow transfer using an earpiece facebow in edentulous patients was found to be a reproducible and repeatable procedure.

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