

Evaluation of Alternative Dispositives to the Face-Bow For Mounting Casts in Semi-Adjustable Articulator

Avaliação de Dispositivo Alternativo ao Arco Facial Para Montagem de Modelos em Articulador Semi Ajustável

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RESUMO

Objective. The aim of this study was to evaluate an alternative technique to face-bow for mounting casts in semi-adjustable articulators. **Material and methods.** Nine students from the 8th and 10th periods of the Federal University of Goiás, aged over 18 years and whom presented complete natural dentition were included in the study. The four cast maxillaries of each subject were mounted in a single semi-adjustable articulator, using one of the following mounting techniques: face-bow, universal mounting jig of 0°, of 15° or universal mounting jig of 20°. On each side of the articulator three points were defined: one in the articulator (A, in the condylar region) and two in the cast (B and

C). Images were obtained on each side of the articulator. Using Image J software, "the angle" " β " formed by the intersection of the line segments AB/BC was acquired. The level of significance was set at $\alpha = 0.05$. **Results.** Only the universal mounting jig of 15 degrees was not significantly different to the face-bow. Whereas, the universal jigs of zero and 20 degrees, showed differences to the face-bow and the 15° universal jig ($p < 0.05$). **Conclusions.** The universal mounting jig could represent an alternative to the face-bow and might encourage the use of a semi-adjustable articulator, which has been shown to be indispensable in a large number of clinical situations.

KEYWORDS: Dental articulator, dental technicians, Prosthesis.

INTRODUCTION

The face-bow is traditionally associated with the use of a semi-adjustable articulator, which is important for diagnosis, planning and treatment of the dental archs, including the fabrication of the occlusal plate and the treatment of patients with temporomandibular disorders^{1,2}. Face-bows are calliper-like instruments that serve to record the spatial relationship between the maxillary dental arch and anatomic reference point(s), and transfer this relationship to an articulator^{1,3}. There is literature evidence that prosthetics made in articulator mounting casts used with a face-bow show more occlusal contacts and result in less intraoral adjustment⁴.

In accordance with Carlsson⁵, to achieve a higher levels of evidence-based care, it is necessary to improve and critically inspect opinions and clinical methods current used which may not have sufficient evidence for their preservation. This problem is prominent due to only 8% of dental treatments being supported by randomised controlled clinical trials³.

Face-bows are one example of a widely used device whose clinical relevance has rarely been questioned^{6,7}. Their usefulness has been discussed in some studies, such as by Logan⁸ and Lazarri⁹, who considered them indispensable, and by Craddock and Symmons¹⁰ and Stansberry¹¹ who considered them unnecessary. In practice, the clinical importance of the use of face-bows in making removable partial prosthesis, total prosthesis and other kinds of indirect prosthodontic restorative treatment,

has been discussed^{3-5,11,12}.

The purpose of the face-bow transfer in prosthodontic restorative treatment is to record the relationship of the maxilla to the hinge axis, and establish the same relationship between a maxillary cast and the mechanical hinge of an articulator. If the maxillary cast is positioned without the correct maxilla-hinge axis relationship, arcs of movement that differ from those of the patient can occur in the articulator. An occlusion that is restored to simulate the casts may result in interceptive and deflective tooth contacts in the hinge closing movements, if there are subsequent changes in the vertical dimension of occlusion¹³.

For many dentists, articulators with a face-bow are complicated instruments to use, absorb much clinical time and give an unsatisfactory final result due to the restoration made in this instrument when adjusted to adapt to a patient's functional occlusion. The universal jig is an alternative instrument to the face-bow. The universal jig consists of a device, with different angles, that gives support to the maxillary cast during mounting in the semi-adjustable articulator. Its defining advantage is the fact that it is not necessary to manipulate the patient. This results in the minimisation of the clinical time spent with the patient and can help the patient-dentist relationship. Therefore, it is necessary to evaluate in a thoroughly established setting, the safety of clinical application of these new instruments.

Considering the necessity to offer a wide range of treatments, the conventional relation between cost and benefit of a

treatment may have to be re-evaluated in an effort to minimise the operational time, cost of materials and adequate quality control. The possibility of substituting the face-bow with a simpler dispositive could represent important advantages, particularly from the point of view of public health and in education, where students may be motivated to use semi-adjustable articulators, which are fundamentally important instruments in dental clinical practice^{5,12,14}.

Therefore, we undertook a study to evaluate whether an alternative technique of mounting casts in semi-adjustable articulators, utilising three universal mounting jigs with different angles (0, 15 and 20 degrees) would produce significantly different results when compared to face-bow mounting.

MATERIALS AND METHODS

Materials

Table 1 shows the equipment tested in this study.

Table 1. Equipment used

Equipment's	Manufacturer
Jig universal - 0° e 20°	Dentflex Indústria e Comercio Ltda, Ribeirão Preto, SP, Brazil.
Jig universal - 15°	
Standard Professional Face-bow	
Semi-adjustable articulator (Model 4000)	Bio-art, São Carlos, SP, Brazil.

Methods

The sample population consisted of students from 8^o and 10^o period of the Federal University of Goiás, College of Dentistry, all aged over 18 years. After a preliminary examination, patients were excluded if they did not present complete natural dentition. The study protocol and consent form were approved by the local Ethics in Research Committee (Federal University of Goiás, Proc. 084/2010). All subjects who met the criteria and accepted the conditions of the study gave informed consent.

Firstly, an impression was taken of the maxillary arch using an anatomical stock tray and the addition of silicone rubber (HidroXtrem, Vigodent-Coltene SA, RJ, Brazil). Of the thirteen students selected, nine presented casts in which the maxillaries were stable on a surface plane. Each subject was moulded twice and from each mould we obtained two casts (stone plaster type IV, Herostone, Vigodent SA, RJ, Brazil).

The four maxillary casts from each subject were randomly assigned and mounted in a single semi-adjustable articulator arcon model (Articulador 4000 Bio-art. São Carlos, SP, Brazil), according to one of the following mounting techniques: face-bow, universal mounting jig of 0°, universal mounting jig of 15° or universal mounting jig of 20°.

For the mounting casts with face-bow, the transfer fork was covered with thermoplastic impression material (Impression Compound, Kerr Manufacturing Company California, USA), in the regions of the maxillary canines and first molars, and pressed into position on the maxillary teeth. After checking the im-

pression of the tooth cusps, the transfer fork was readapted on the maxillary teeth and the face-bow was mounted and locked in position. The intercondylar distance (small, medium or large) was also registered. The Bennett angle was set to 15 degrees, and the condylar inclination was adjusted to 30 degrees. After these adjustments one maxillary cast was transferred from the face-bow to the articulator and fixed with stone plaster type IV (Herostone, Vigodent SA, RJ, Brazil).

The others three casts were mounted arbitrarily with help of a universal jig (Fig. 1) with one of three angles (0, 15 or 20 degrees) (Table 1). Each cast was mounted with one of these jigs in the same articulator that had been adjusted to a Bennett angle of 15 degrees, condylar inclination of 30 degrees and medium intercondylar distance. For positioning the maxillary cast, the dental median line was aligned with the universal jig median line (LM) and incisal central incisive aligned with the medium transversal line (LT2) (Fig. 1). Each cast was then fixed with stone plaster type IV (Herostone Vigodent SA, RJ, Brazil).

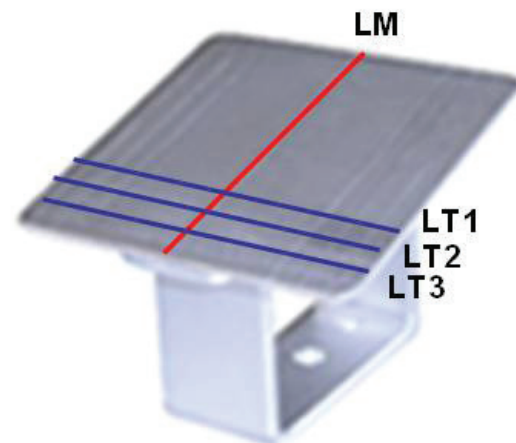


Figure 1. Equipment of the universal mounting jig

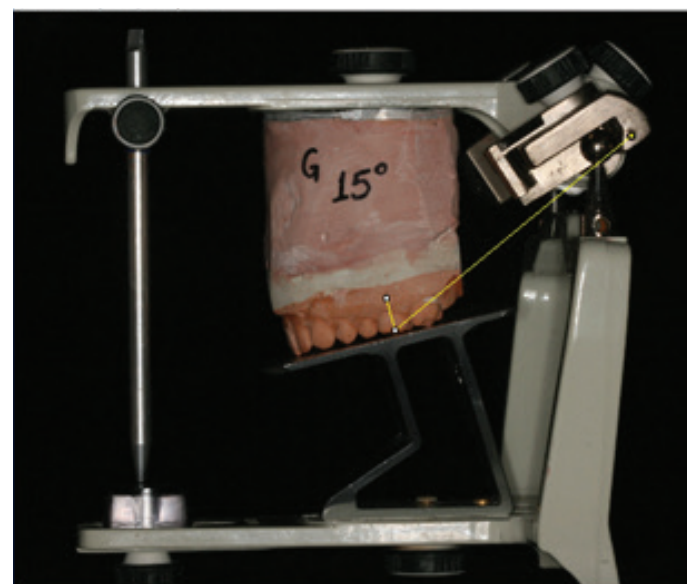


Figure 2. Picture captured in the Image J software, representing the angle β .

Image analysis and processing

On each side of the articulator, three points were defined: one in the articulator (A, in the condylar region) and two in the cast (B and C). Point B was positioned at the first lower molar buccal groove (intercuspal region) and C at the midpoint of the first molar (mesiodistal) and 1 cm above the intercuspal region (Fig. 2). Using a digital camera (Rebel XTi, Canon, Inc., Tokyo, Japan) positioned parallel to the floor, at a standard distance of 1.15 m, articulating images were obtained on each side of the articulator. Using the Image J software (National Institute of Mental Health, Bethesda, Maryland USA), the angle " β " formed by the intersection of the line segments AB and BC was calculated. The angle " β " on both sides of the cast was recorded three times for each cast mounted to obtain the medium.

The data of " β " angle for the four groups (universal jig of 0, 15 and 20 degrees, and face-bow) were compared statistically using SPSS software (v15.0, Chicago, USA). The Friedman test was used to determine any statistical significant difference between the four groups. The level of significance was set at $\alpha = 0.05$.

RESULTS

Table 2 shows the results of this study.

The Friedman test (Table 2) showed that only the 15 degree universal mounting jig was not significantly different from the face-bow. On the other hand, the universal jigs of 0 and 20 degrees, showed differences between themselves and to the face-bow and the 15° universal jig ($p < 0.05$).

Table 2. Friedman test for data of the " β " angle.

Mounting technique	n	Median	Standard Deviation
Face bow ^A	18	66,97	3,88
Universal jig 0 degree ^B	18	61,50	2,51
Universal jig 15 degree ^A	18	65,25	2,21
Universal jig 20 degree ^C	18	72,82	2,61

$p < .05$

Letters equals indicate absence of statistic difference.

DISCUSSION

The definition of the angle β was a simply metric, but effective for comparison of the antero-posterior inclination of the maxillary cast, in relation to a fixed point on the articulator.

According to Preston¹⁵, variations in maxillary cast orientation on the articulator, compared with the orientation of the patient's transverse horizontal axis, would result in occlusal discrepancies due to deviations in the arcs of closure. Thus, the purpose of the face-bow is to record and transfer the relationship of the jaws axis to the articulator, so that the maxillary cast may be oriented in the same relationship to the opening of the articulator⁷.

However, in the study of Shodadai *et al.*³, which evaluated the benefit of using an arbitrary face-bow for the fabrication of a stabilisation appliance, it was concluded that the use of an arbitrary face-bow does not yield a clinically relevant improve-

ment with regard to the number of occlusal contacts or the chair side adjustment time. Similar results were founded with regard to the fabrication of complete dentures. Both professionals and patients were satisfied with their complete dentures, concluded that a face-bow may not be a necessary instrument in complete denture fabrication, because even with your use the aim of transferring the accurate jaw-to-joint relationships cannot be achieved, in order to provide good complete dentures, without occlusal adjustment^{12,16,17}. (WANG *et al.*,¹⁶; KAWAI *et al.*,¹²; ELLINGER¹⁷)

According to Yanus *et al.*⁷, several possible factors can contribute to the lack of benefit in using a face-bow and inaccuracies found in face-bow recordings and cast mounting including: a) failure to locate the arbitrary hinge-axis point or failure to locate the same place at each recording session, b) failure of the subjects to properly place the ear pieces of the face-bow in the external auditory meatus, c) failure to seat the maxillary teeth properly in the occlusal index, and d) error occurring during measurement procedures.

Thus, techniques of more simple cast mounting have been reported as alternatives to the face-bow. Different universal mounting jigs are available, but until now, there has been no analysis to define what angle of these mounting jigs is similar to the face-bow. In the present study, the mounting jig of 15 degrees showed behaviour similar to the face-bow in the cast mounting of subjects with complete natural dentition.

The aim was to analyse the mounting jigs available on the market from different makers together with the semi-adjustable articulator used most often. It should be noted that the 15 degree mounting jig was from the same maker as the articulator, and that might be represented by the results. The results seem to indicate that the inclination of the universal mounting jig is not the unique factor that can influence the value of angle β , it can be seen that the small difference between the angles of 15° and 20°, of only five degrees, can result in a statistically significant difference themselves.

Caution must be taken in attempting to extrapolate these results for partial edentulous patients. In patients with complete denture, or in fully dentured patients, it is possible to guarantee the stabilisation of the cast the in mounting jig. However, in arches with partial lose, stabilisation might not be possible, depending of the extent and location of the lose.

The present results, gained in patients with full denture, confirms the findings of Wang *et al.*¹⁶, which compared the mounting jig and face-bow in complete denture fabrication. Even though the mounting jigs analysed in both studies were not the same, this data suggest the possibility of substitution of the face-bow in complete denture patients, as well as fully denture patients.

In the literature, many researchers consider the face-bow indispensable^{8,9}. However, the fact should be considered that many procedures have been arrived upon without any evidence-based care and we should perhaps question whether some dogmas presents in oral rehabilitation may need scientific support⁵.

The results of present study support the use of simplified techniques, which are easier to master and eliminate the additional chair time required for face-bow registration, thus eliminating patient discomfort, as the presence of the patient is not

necessary in this step¹⁸. The simplification and demystification of mounting on an articulator can stimulate their use, which in a lot of clinical situation is indispensable. Thus, educators should consider these findings when designing curricula for prosthodontics training¹².

Because of the possible limitations of this pilot study, we recommend a more detailed investigation on the importance, or not, of face-bows and universal mounting jigs, including evaluation of occlusal contacts.

CONCLUSION

Inside of the levels of clinical relevance defined in this study, it can be concluded that the universal 15° degree mounting jig showed statistically equal results to that of face-bow, in relation to the position of the superior cast in fully dentured patients.

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RESUMO

Objetivo. O objetivo deste estudo foi avaliar uma técnica alternativa ao arco facial para montagem de modelos em articuladores semi-ajustáveis. **Material e métodos.** Nove estudantes do 8º e 10º períodos da Faculdade de Odontologia da Universidade Federal de Goiás, com mais de 18 anos e que apresentou dentição natural completa foram incluídos no estudo. Quatro modelos do arco superior de cada sujeito foram montados em um único articulador semi-ajustável, usando uma das seguintes técnicas de montagem: arco facial, plano de camper de 0º, 15º ou 20º. Em cada lado do articulador foram definidos três pontos: um no articulador (A, na região do côndilo) e dois no modelo

(B e C). As imagens foram obtidas em cada um dos lados do articulador. Usando o software Image J, o "β" ângulo formado pela intersecção dos segmentos de linha AB / BC foi adquirido. O nível de significância foi estabelecido em $\alpha = 0,05$. **Resultados.** Apenas o plano de camper de 15º, não foi significativamente diferente do arco facial. Enquanto que, os plano de camper de zero e 20º, mostraram diferenças para o arco facial e o plano de 15º ($p < 0,05$). **Conclusões.** O plano de camper pode representar uma alternativa para o arco facial e pode encorajar o uso de um articulador semi-ajustável, o qual tem sido mostrado ser indispensável num grande número de situações clínicas.

PALAVRAS-CHAVE: Articulador dental, técnicas dentais, prótese.

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