

## Review Article

# Face-bow transfer in prosthodontics: a systematic review of the literature

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**SUMMARY** An extensive search for randomised controlled clinical trials was accomplished to compare dental prostheses and occlusal splints constructed with or without face-bow transfer, and question whether face-bow transfer may present better clinical results than simpler approaches. Studies were identified by searching electronic databases (PubMed/MEDLINE, Latin American and Caribbean Literature on the Health Science, and Brazilian Bibliography of Dentistry). The keywords 'dental articulator', 'semi-adjustable articulator', 'face-bow', 'jaw relation record' and 'occlusal splint therapy' were used. The minimum inclusion requirements were (i) randomised controlled trials with patients of any age, (ii) comparison between dental prostheses or occlusal splints constructed with or without face-bow transfer and (iii) assessment of clinician's time, number of occlusal

contacts, patient satisfaction or masticatory function. The search resulted in the identification of 8779 articles. Subsequently, 8763 articles were excluded on the basis of title and abstract. By the end of the search phase, eight randomised controlled trials were considered eligible. Current scientific evidence suggests that face-bow transfer is not imperative to achieve better clinical results in prosthodontics. Randomised clinical trials suggest that simpler approaches for the construction of complete dentures and occlusal splints may present acceptable results, while no clinical study has investigated its use in fixed and removable partial dentures.

**KEYWORDS:** face-bow, dental articulator, complete denture, prosthodontics, occlusal splint

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## Introduction

During prosthodontic treatment, it is important for both the dentist and the dental technician to construct indirect restorations that are well fitted in patient's masticatory system in a minimum amount of time and effort. The face-bow has been regarded as an indispensable accessory of semi-adjustable articulators for transferring the maxillary cast. When the face-bow is used, maxillary and mandibular casts are mounted in relation to the temporomandibular joints and in close proximity to the condylar hinge axis. This may result in more accurate occlusal contacts in centric and eccentric positions. Brotman (1) used applied

mathematics to show that occlusal errors are introduced when the patient's condylar hinge axis is not properly located. Most prosthodontic textbooks have stated that a face-bow record is necessary for orienting the maxillary cast to the articulator for all types of prosthetic work (2). A survey of forty-three U.S. dental schools conducted in 2001 to determine the curricular structure, teaching philosophies and techniques used in pre-clinical complete denture courses revealed that the face-bow is used by 84% of the schools (3). In Ireland and United Kingdom, 10 of the 12 dental schools surveyed on the undergraduate teaching of fixed partial dentures required the use of a face-bow to mount the maxillary cast within the articulator (4).

However, it has never been scientifically documented that the most sophisticated and complicated methods for jaw relation recording and construction of dental prostheses lead to better clinical results. Kawai *et al.* (5), compared the quality of 122 conventional complete dentures fabricated with traditional or simplified techniques. No difference was found for patient overall satisfaction and prosthodontists' ratings of denture quality. In 1991, the Scandinavian Society for Prosthetic Dentistry (SSPD) presented a consensus publication stating that a face-bow is not necessary and recommended simple methods in jaw recording for all types of prosthodontic work (2).

As the value of the face-bow remains questionable, the purpose of this study was to accomplish an extensive search for randomised controlled clinical trials comparing dental prostheses and occlusal splints constructed with or without face-bow transfer. The research hypothesis was that the construction of dental prostheses and occlusal splints with face-bow transfer may present better clinical results than simpler approaches.

## Materials and methods

### *Information sources*

Studies were identified by searching electronic databases. The keywords 'dental articulator', 'semi-adjustable articulator', 'face-bow', 'jaw relation record' and 'occlusal splint therapy' were used. No limits were applied for language. This search was applied to PubMed/MEDLINE, LILACS (Latin American and Caribbean Literature on the Health Science) and BBD (Brazilian Bibliography of Dentistry). Additional references from citations within the articles were obtained, and current textbooks were also used. Papers dated between 1950 and 2013 were selected. The last search was run on 8 March 2013.

### *Inclusion and exclusion criteria*

The minimum inclusion requirements were (i) randomised controlled trials with patients of any age, (ii) comparison between dental prostheses or occlusal splints constructed with or without face-bow transfer and (iii) assessment of clinician's time, number of

occlusal contacts, patient satisfaction or masticatory function. Clinical reports, reviews and short communications were excluded.

### *Review methods*

All reports identified by the search were printed and independently analysed once by each of the two reviewers on the basis of title, keywords and abstract (when available) to check if the study was likely to be relevant. Full reports of all relevant papers and all papers that could not be classified were obtained. In cases of disagreement, a third reviewer was consulted to achieve consensus. The reviewers were not blinded as to authors, journals, date of publication, financial support or results. The inclusion criteria were applied, data assessed and then independently extracted by two reviewers. Consensus was sought in cases of discrepancy.

## Results

The search resulted in the identification of 8779 studies. Subsequently, 8763 articles were excluded on the basis of title and abstract mostly because they did not investigate the use of the face-bow and were laboratory studies or review articles. Two studies identified by the hand search were excluded because they were master thesis. The full texts of 14 studies were screened. During full-text screening, six articles were excluded because they did not meet the inclusion criteria for assessment of clinician time, number of occlusal contacts, patient satisfaction or masticatory function. By the end of the search phase, eight randomised controlled trials were considered eligible (5–12). Their data were the basis of this review (Table 1). Figure 1 is a flow chart of studies assessed and excluded at various stages of the review. Of the seven studies regarding complete denture construction, three studies presented no difference between simpler and complex approaches, while four studies presented better results for the simpler approach without the face-bow. One study investigated the use of the face-bow in occlusal splints, but no difference was found regarding the number of occlusal contacts and the time needed for chairside occlusal adjustment. No clinical study was found regarding fixed and removable partial dentures.

**Table 1.** Randomised clinical trials evaluating the influence of face-bow transfer on prosthodontic work

Author	Study design	Outcomes	Results
Ellinger <i>et al.</i> (6)	Complete denture Single-blinded study <i>n</i> = 64 Age: <65 years Inclusion criteria: patients edentulous for a period of at least 1 year Exclusion criteria: not mentioned	Coincidence of centric relation with centric occlusion, denture stability, denture retention, condition of the supporting tissues	No difference
Shodadai <i>et al.</i> (7)	Occlusal splint <i>n</i> = 20 Age: not mentioned Inclusion criteria: adult patients with a complete natural dentition who had been diagnosed with dental attrition because of nocturnal bruxism Exclusion criteria: not mentioned	Number of intraoral occlusal contacts and the time needed for chairside occlusal adjustment	No difference
Nascimento <i>et al.</i> (8)	Complete denture Double-blinded study <i>n</i> = 5 (crossover design) Age: not mentioned Inclusion criteria: not mentioned Exclusion criteria: not mentioned	Number of occlusal contacts and patient satisfaction	Better patient satisfaction and greater number of occlusal contacts in centric relation and left lateral movement without the face-bow
Kawai <i>et al.</i> (5)	Complete denture Single-blinded study <i>n</i> = 122 Age range: 45–75 years Inclusion criteria: subjects were eligible if they were aged between 45 and 75 years, edentulous, had significant problems with at least one of their existing dentures, possessed an adequate understanding of written and spoken French and were able to understand and respond to a test questionnaire Exclusion criteria: symptoms of temporomandibular disorders, xerostomia, oro-facial motor disorders, severe oral manifestations of systematic disease or psychological or psychiatric conditions that could influence their response to treatment	Patient satisfaction regarding overall satisfaction, comfort, stability, aesthetics, ability to speak, ease of cleaning and ability to chew soft white bread, hard cheese, raw carrot, sausage, steak, raw apple and lettuce (VAS)	No difference
Heydecke <i>et al.</i> (9)	Complete denture Single-blinded study <i>n</i> = 22 (crossover design) Age range: 50–85 years Inclusion criteria: patients requiring a new set of dentures and able to read and respond to a written questionnaire in German Exclusion criteria: symptoms of temporomandibular disorders, xerostomia, oro-facial motor disorders, severe oral manifestations of systematic diseases or psychological or psychiatric conditions that could influence their response to treatment	Patient satisfaction regarding aesthetic appearance, ability to chew, ability to speak and retention (VAS)	The ability to chew in general and to masticate carrots, hard sausage, steak and raw apple was significantly better without the face-bow

(continued)

**Table 1.** (continued)

Author	Study design	Outcomes	Results
Heydecke <i>et al.</i> (10)	Complete denture Single-blinded study <i>n</i> = 20 (crossover design) Age range: 50–85 years. Inclusion criteria: patients requiring a new set of dentures and able to read and respond to a written questionnaire in German Exclusion criteria: symptoms of temporomandibular disorders, xerostomia, oro-facial motor disorders, severe oral manifestations of systematic diseases or psychological or psychiatric conditions that could influence their response to treatment	General satisfaction, comfort, ability to speak, denture stability, aesthetics, ease of cleaning and ability to chew (VAS)	Patients rated their general satisfaction, denture stability and aesthetic appearance significantly better without the face-bow
Kawai <i>et al.</i> (11)	Complete denture Single-blinded study <i>n</i> = 122 Age: 45–75 years Inclusion criteria: significant problems with at least one of their existing dentures, possessed an adequate understanding of written and spoken French and were able to understand and respond to a test questionnaire Exclusion criteria: symptoms of temporomandibular disorders, xerostomia, oro-facial motor disorders, severe oral manifestations of systematic disease or psychological or psychiatric conditions that could influence their response to treatment	Production cost and clinician's labour time	Mean total cost was significantly greater and clinicians spent 90 min longer on clinical care with the face-bow
Cunha <i>et al.</i> (12)	Complete denture Single-blinded study <i>n</i> = 42 Age: >45 years Inclusion criteria: complete edentulism for at least 1 year, desire to receive a pair of new conventional complete dentures, mental receptiveness and good understanding of spoken Portuguese Exclusion criteria: disorders of the masticatory system disorders, pathological changes of residual ridges and debilitating systemic diseases	Masticatory performance (colorimetric method) and chewing ability	No difference for masticatory performance; better masticatory ability without the face-bow

## Discussion

The results of this study did not support the research hypothesis that the construction of dental prostheses and occlusal splints with face-bow transfer may present better clinical results than simpler approaches. Of the seven studies identified regarding complete denture construction, three studies presented better results when the dentures were constructed without

face-bow transfer, while four studies presented no difference. One study regarding occlusal splint therapy was identified, but no difference was found. No clinical trials were identified regarding the construction of removable partial dentures or fixed prosthodontics.

A classical longitudinal series of randomised clinical trials initiated in 1969 investigated if clinical differences exist in dentures made using two different techniques (6, 13–16). The sample was composed by 64

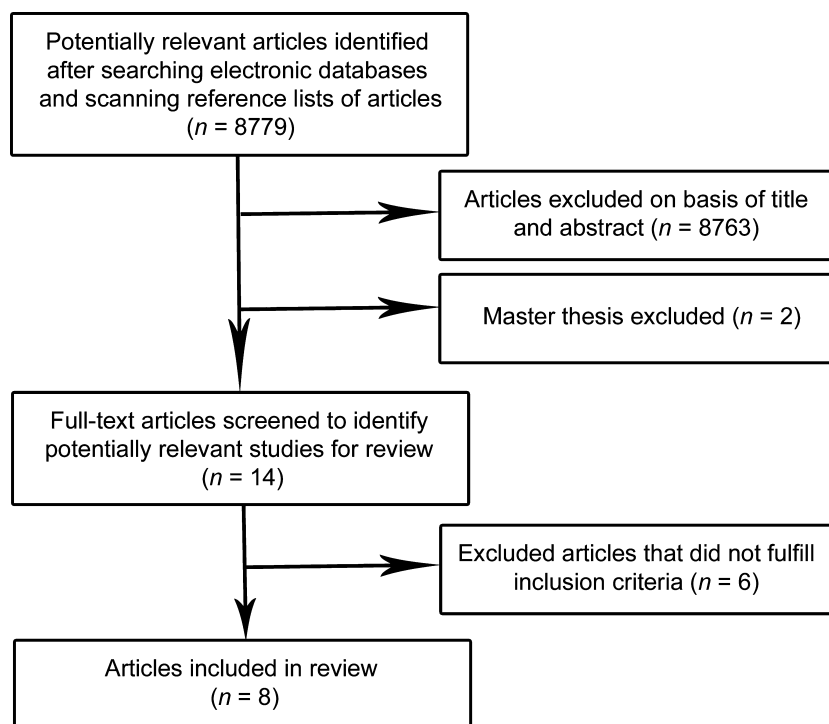


Fig. 1. Studies assessed and excluded at various stages of the review.

edentulous patients divided into two groups. The variables investigated were denture quality (6), residual ridge resorption (14,15) and microscopic status of the oral mucosa (16). The 'complex' technique involved location of the true hinge axis for a face-bow transfer to mount the upper cast on a semi-adjustable articulator. The lower cast was mounted in centric relation. Eccentric records were made. The denture teeth were arranged and adjusted to a fully balanced occlusion. The standard technique involved no face-bow transfer. All dentures were constructed by five experienced prosthodontists. Ellinger *et al.* (6), evaluated denture quality at the initial placement appointment and five yearly recall visits. No difference was found for coincidence of centric relation with centric occlusion, denture stability, denture retention and condition of the supporting tissues. Furthermore, no difference was found for ridge resorption (14, 15) and mucosal status (16).

Kawai *et al.* (5) conducted a randomised clinical trial with 122 patients randomly allocated into two groups according to a classical or a simplified technique for the construction of complete dentures. In the classical protocol, dentures were made following preliminary impression, final impression with a custom tray and

border moulding with impression compound, occlusal registration, face-bow transfer, try-in, delivery and adjustments. In the simplified technique, a single impression with a stock tray and alginate was used, while no face-bow transfer was accomplished. All dentures were constructed by two experienced prosthodontists. Patients' ratings on a 100-mm visual analogue scale (VAS) for overall satisfaction, comfort, stability, aesthetics, ability to speak, ease of cleaning, and ability to chew soft white bread, hard cheese, raw carrot, sausage, steak, raw apple and lettuce were evaluated at 3 and 6 months post-insertion. The quality of the dentures was assessed by one prosthodontist. No significant difference in patient satisfaction or in the perceived quality of conventional dentures produced with classical or simplified techniques was found. Multiple regression analysis revealed no effect of potential confounders (age, gender, diagnostic classification, edentulous period and treating prosthodontist) on general satisfaction. A similar protocol was adopted by Cunha *et al.* (12) in a randomised clinical trial with 42 subjects. The authors reported no impairment in masticatory performance and patient's satisfaction regarding masticatory function after 3 months. Furthermore, Kawai *et al.* (11) compared the laboratorial

costs and clinician's labour time between both methods. The simplified technique decreased laboratorial costs and clinicians time (90 min less). However, this reduction was influenced by both the single impression and the maxillomandibular recording.

In the studies conducted by Heydecke's group (9, 10), the influence of face-bow transfer and occlusal concept on general satisfaction, comfort, ability to speak, stability, aesthetics, ease of cleaning and ability to chew was evaluated. Twenty subjects wore two sets of complete dentures for equal periods of 3 months. One set was constructed with individualised condylar inclination recorded using a face-bow and extraoral tracings, and teeth arranged in balanced occlusion. The other set was made using a simplified method without face-bow transfer and canine/first pre-molar guidance. Dentures were constructed by three prosthodontists and a dental technician. VAS measures for general satisfaction, stability and aesthetics were significantly better for the simplified method. No difference was found for ability to speak, comfort, ability to chew and the ease of cleaning the dentures (9). Furthermore, chewing ability was rated more favourably with the simplified method for carrots, hard sausage, steak and raw apple (10). At the end of the study, patients were asked to choose one set of dentures. Five subjects preferred the complex method, 12 preferred the simplified method and three patients had no preference (9).

A potential limitation of the studies evaluating the clinical benefits of face-bow transfer in complete denture is the involvement of other variables. Of the seven studies identified, the simplified method also included a single impression or a different occlusal concept in six of them. Only the study of Nascimento *et al.* (8), investigated exclusively the influence of face-bow transfer in the construction of complete dentures. The authors reported that a balanced occlusion was achieved even without face-bow transfer and could be an alternative to obtain adequate complete dentures. However, that study presented a limited sample of five subjects (crossover design) and 10 days of follow-up. Furthermore, in all clinical trials included in this systematic review, dentures were constructed by experienced clinicians or prosthodontists. The question is whether undergraduate students may achieve similar results using the simplified method. If so, should we shorten the time devoted for the teaching of face-bow transfer and enhance the

practice of more critical procedures? More studies are necessary to test the clinical results of simplified methods when conducted by undergraduate students.

A randomised clinical trial was conducted to evaluate the influence of face-bow transfer on the number of intraoral occlusal contacts and the time needed for chairside occlusal adjustment of occlusal splints (7). The sample consisted of 20 fully dentate adult patients diagnosed with bruxism. For each patient, two occlusal splints made of acrylic resin were constructed successively by the same experienced dental technician using the same articulator. One of the occlusal splints was constructed by transferring the upper dental cast to the articulator with the face-bow, while the other occlusal splint was constructed by arbitrarily mounting the maxillary cast with the help of a flat occlusal plane indicator. Bennett angle was set to 15°, and condylar inclination was adjusted to 45°. The two splints were inserted and adjusted in random order. Clinical outcomes did not differ between the two occlusal splints. The authors suggested a combination of factors to explain why patients may not benefit from face-bow transfer: change (usually increase) of the occlusal vertical dimension after making the centric relation interocclusal record; lack of evidence for pure condylar rotation and the existence of a condylar hinge axis on mandibular opening; unpredictable and variable condylar movements on mandibular opening; use of rigid hinge axis articulators; and the presence of temporomandibular pain.

To summarise, the results of this systematic review suggest that there is no scientific evidence to support the use of the face-bow during the construction of complete dentures and occlusal splints. Randomised clinical trials have shown that simpler approaches for the construction of complete dentures and occlusal splints may present similar results to more complex techniques. Furthermore, there is a lack of clinical studies evaluating the use of the face-bow in fixed prosthodontics and removable partial dentures. It has been argued that the face-bow is essential for producing consistently predictable aesthetic restorations, because the casts must be oriented on the technician's bench in the same horizontal plane as the crowns will be when they are placed in the patient's mouth. More studies are necessary to clarify the importance of face-bow transfer, because simpler approaches may facilitate the access to prosthodontic services and influence undergraduate dental curriculum.

## Conclusion

Current scientific evidence suggests that face-bow transfer is not imperative to achieve better clinical results in prosthodontics. Randomised clinical trials suggest that simpler approaches for the construction of complete dentures and occlusal splints may present acceptable results, while no clinical study has investigated its use in fixed and removable partial dentures.

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