Alqalam Journal of Medical and Applied Sciences. 2025;8(3):1574-1578
https://doi.org/10.54361/ajmas.258344

Original article

The Impact of Semi-Adjustable Articulators with Facebow Transfer on the Clinical Efficacy of Complete Dentures

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Abstract
The incorporation of semi-adjustable articulators with facebows when producing complete dentures is one of the best innovations in dental technology. Loss of teeth is not uncommon in the elderly population and presents quite significantly with functional, esthetic, and psychological impacts. Complete dentures are the most practical means for replacing missing teeth, restoring oral function, and improving overall quality of life. Despite the best manufacturing procedures, it will always present difficulties to attain comfort and exactness. As such, sophisticated instruments like the semi-adjustable articulator and facebow are needed to raise the functional performance as well as clinical accuracy. This research aims to assess the effect of the utilization of a semi-adjustable articulator with facebow on the functionality of complete dentures, focusing on enhancing occlusal support and increasing the level of the wearer's comfort. The survey consisted of 40 respondents (22 women and 18 men), evenly divided between the technicians and the dentists, and with direct responses from the patients. The findings indicated good chewing stability in 93.34% of the patients with reduced difficulty in speech. Amongst the professionals, the semi-adjustable articulator was used regularly by 57.5% and the facebow by 42.5%. In addition, there were improved impression tray positioning accuracies with the instruments for 85% respondents and verification for increasing tooth arrangement for 80% respondents. In addition, there were reduced occlusal adjustments for 85% respondents and reduced TMJ pain-associated complaints for 82.5% respondents. The integration of semi-adjustable articulators with facebows significantly improves the precision and stability of complete dentures, aligning with previous studies that highlight their role in enhancing occlusal accuracy and reducing patient discomfort. Thereby enhancing patient comfort.
Keywords. Complete Dentures, Semi-Adjustable Articulator, Facebow Transfer, Occlusal Accuracy.

Introduction

Tooth loss is a common problem that significantly impacts a person's overall health, affecting functional, aesthetic, and psychological well-being. The absence of teeth directly impairs chewing efficiency, hindering proper digestion and nutrition [1]. Additionally, tooth loss can lead to speech difficulties, making it challenging to articulate certain sounds clearly [2]. Furthermore, the aesthetic consequences of missing teeth can diminish self-confidence, negatively impacting overall quality of life and social interactions [3]. For patients who have lost all their teeth, complete dentures remain the most common solution, effectively restoring lost oral functions.

Complete dentures are a preferred treatment due to their relatively low cost, ease of maintenance, and acceptable aesthetic results [4]. However, edentulous patients present unique anatomical and functional challenges, including significant alveolar ridge resorption and neuromuscular adaptation, making it essential to accurately determine jaw relationships and the position of the jaws relative to the skull base for successful treatment outcomes [5]. The fabrication of complete dentures involves multiple challenges, as prosthetic treatment must restore biological and mechanical harmony, along with masticatory function and aesthetics, in a complex clinical setting characterized by compromised supporting tissues. During oral rehabilitation, dentists must aim to establish an occlusion that minimizes residual ridge resorption in edentulous jaws, as unbalanced forces accelerate bone loss [5-8]. Although complete dentures provide an effective solution for many patients, achieving optimal results requires precise determination of jaw relationships and their position relative to the skull base.

Despite significant advancements in complete denture fabrication, challenges remain in improving the comfort, stability, and functional efficiency of these prostheses [4,9]. To ensure successful treatment outcomes, maxillary record bases must be accurately stabilized, aligning the patient's midline, incisal plane, and occlusal plane while ensuring proper coordination with the mandibular arch during occlusion [8,10]. Modern techniques, such as the semi-adjustable articulator and facebow, play a crucial role in recording clinical data related to jaw position relative to the skull base, enhancing the functional performance and occlusal balance of complete dentures [4,11,12]. The facebow transfer is particularly critical for accurately relating the maxillary cast to the hinge axis and Frankfort plane, facilitating a more physiological simulation of mandibular movements on the articulator [13-16]. This study aims to examine the effect of using the semi-adjustable articulator with facebow on complete dentures, focusing on improving occlusion, reducing

Received*: 01-06-2025 -* ***Accepted****: 26-07-2025 -* ***Published****: 01-08-2025*

chairside adjustment time, and achieving better functional jaw balance [12,17]. By investigating these techniques, this research seeks to provide practical evidence-based solutions that support clinicians and technicians in refining their skills and delivering more predictable and effective outcomes for patients [15,18].

Methods

Population and Sampling

The study population comprised prosthodontists, dental technicians employed in denture laboratories, and patients who had undergone complete denture rehabilitation using semi-adjustable articulators and facebow transfers. A purposive non-probability sampling technique was employed to recruit participants based on predefined inclusion criteria aligned with the study objectives. The final sample consisted of 40 clinical practitioners (prosthodontists and dental technicians) with documented hands-on experience in complete denture fabrication.

About 15 edentulous patients with prior experience using conventional complete dentures, subsequently rehabilitated with new prostheses fabricated using semi-adjustable articulators and facebow recordings. A structured, study-specific questionnaire was administered at Misrata Hospital of Oral and Dental Surgery and Kamal Clinic. The instrument assessed: Clinical practices: Prevalence of semi-adjustable articulator and facebow utilization in prosthetic workflows. Outcome measures: Perceived impact on denture quality, patient-reported comfort, and occlusal performance. Demographics: Professional experience (years), specialty, and institutional affiliation of practitioners. A total of 50 questionnaires were disseminated during February 2024, yielding 40 valid responses (80% response rate). Patient participants (*n* = 15) completed a separate questionnaire evaluating: Medical/dental history, Age, systemic health status, and prior prosthetic use. Prosthesis performance: Self-reported comfort, masticatory efficiency, speech adaptability, and denture stability, quantified via a 10-point Likert scale. A systematic review of peer-reviewed literature was conducted, focusing on evidence regarding the influence of semi-adjustable articulators and facebow transfers on the biomechanical accuracy and functional efficacy of complete dentures.

Statistical Analysis

Data processing and statistical analyses were performed using the following computational tools: Microsoft Excel (v16.0) for primary data curation. Python (v3.9) with dedicated libraries: *Pandas* and *NumPy* for dataset manipulation and numerical computation. *SciPy* for inferential statistics. *Matplotlib* and *Seaborn* for data visualization. Stats models for regression and variance analysis. Descriptive statistics were used to assess central tendency (mean, median) and dispersion (standard deviation, range). Normality was tested using the Shapiro-Wilk test. Bivariate analysis was performed using Pearson/Spearman correlation coefficients. Group comparisons were conducted using independent samples t-tests (for two groups) and one-way ANOVA (for multiple groups).

Results

Patient survey results indicated that 60% of participants did not suffer from chronic diseases, while 40% of them had chronic conditions, which may impact the quality of healthcare required for these patients, as shown in Table 1.

Table 1. Presents the prevalence of patients who depend on chronic diseases

Percentage	Repetition	Reply
40%	6	Yes
60%	9	No
100%	15	Totality

It was also found that 73.3% of patients had previously used dentures or dental prostheses, suggesting that the majority experienced advanced tooth loss or oral problems requiring prosthetic compensation. The proportion of those who had never used dentures was 26.7%, which might indicate early stages of tooth loss or good oral health per Table 2.

Table 2. Patient distribution according to the use of dentures or dental prosthesis in the past.

Percentage	Repetition	Replay
73.3%	11	Yes
26.7%	4	No
100%	15	Total

Regarding relining, 53.3% of patients reported having their dentures relined, reflecting a frequent need for denture adjustments, whereas 46.7% had not, either due to a lack of necessity or insufficient awareness per (Table 3).

Received*: 01-06-2025 -* ***Accepted****: 26-07-2025 -* ***Published****: 01-08-2025*

Table 3. Distribution of patients based on their previous experience with denture relining.

Percentage	Repetition	Replay
53.3%	8	yes
46.7%	7	no
100%	15	Total

Concerning denture comfort, most patients rated comfort between scores of 4-6, accounting for 66.66% of responses. Higher ratings (8-9) were less frequent at 13.33%, with no low ratings recorded, indicating acceptable patient satisfaction with comfort. In terms of ease of speech, no low ratings (1-3) were recorded. Instead, 80% of patients rated speech at moderate levels (4-7), with the highest frequency at rating 4 (33.33%), as mentioned in Figure 1.

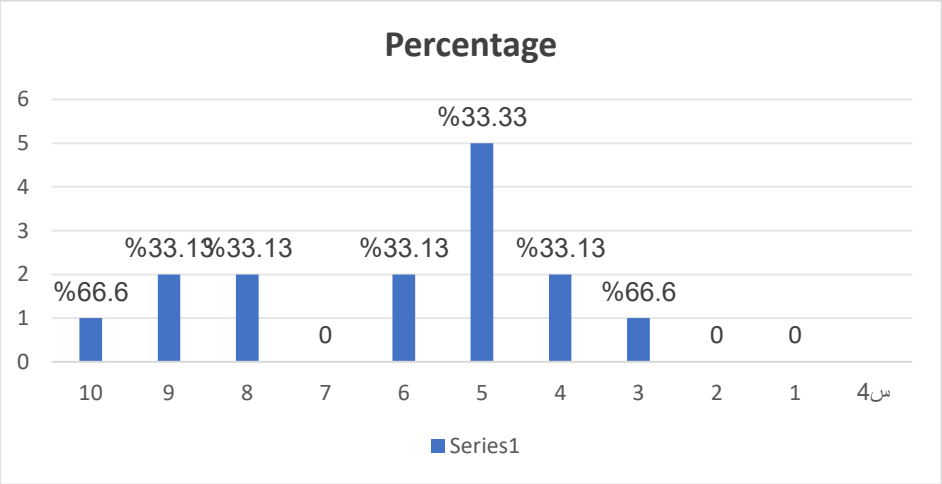

Figure 1. The distribution of patient evaluations for the comfort of complete dentures

For denture stability during mastication, 93.34% of patients reported scores ranging from moderate to high, with the highest frequency at rating 6 (26.66%), and high ratings (9-10) accounting for 33.33%. The average rating for stability during mastication was 7.20, followed by comfort at 6.13, and speech at 5.87. A strong correlation among the evaluations was observed, with the highest correlation between speech and stability (0.84), followed by comfort and speech (0.80), indicating an interrelationship among the functional qualities of the denture, as in Figure 3.

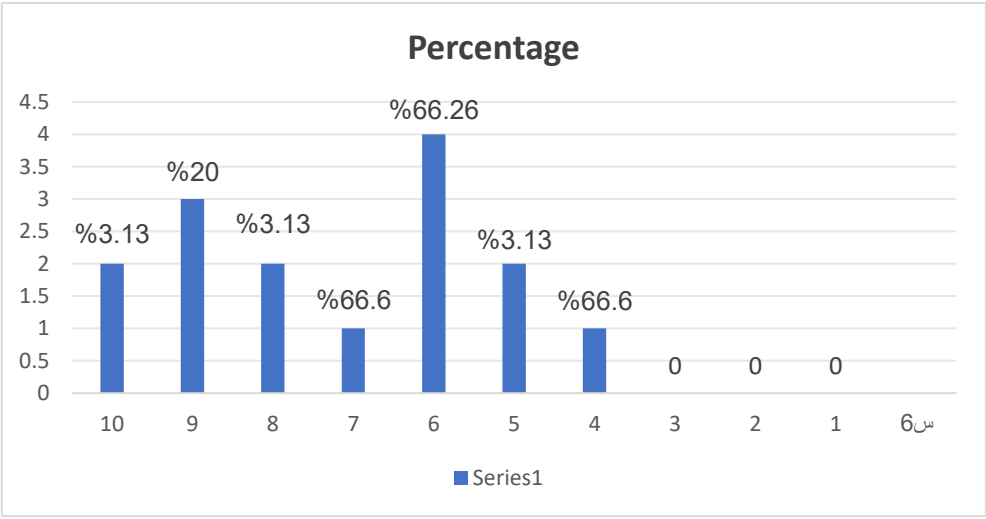

Figure 3. Patient Ratings on Denture Stability During Mastication

As for the survey results from dentists and technicians, it was found that females constituted 55% of the sample, while males accounted for 45%. The sample was equally distributed between Dentists and Dental Technicians, with 50% for each. Years of experience were predominantly concentrated between 1-5 years (60%), reflecting a substantial proportion of new professionals in the field (Table 4).

***Received**: 01-06-2025 - **Accepted**: 26-07-2025 - **Published**: 01-08-2025*

Table 4. Distribution of the Sample by Profession.

Percentage	Frequency	Carrier
50%	20	Dentists
50%	20	Dental Technicians
100%	40	Total

Furthermore, 57.5% of participants reported using a semi-adjustable articulator for mounting casts, while 42.5% did not. Only 42.5% used a facebow, suggesting it remains an uncommon practice. A significant 85% of participants indicated that using a semi-adjustable articulator with a facebow improves the accuracy of gypsum cast mounting, as in Table 5.

Table 5. Percentage of Participants with Prior Experience Using a Semi-Adjustable Articulator for Mounting Final Gypsum Casts.

Replay	Frequency	Percentage
Yes	23	57.5%
No	17	42.5%
Total	40	100%

Finally, 70% noted that patients perceived greater stability in their dentures, and 82.5% reported a reduction in temporomandibular joint complaints. The Shapiro-Wilk test was conducted to verify if the data followed a normal distribution. The results indicate that all variables follow a normal distribution, which permits the use of parametric tests in the analysis, as mentioned in Table 5.

Table 5: Shapiro-Wilk Test for Normality of Comfort, Speech, and Stability Evaluation Variables.

Result	P-value	Test Statistic	Variable
Data follows a normal distribution ($p > 0.05$)	0.1248	0.9077	Comfort Evaluation
	0.0605	0.8870	Speech Evaluation
	0.2555	0.9281	Stability Evaluation

Discussion

This study evaluated patient experiences with complete dentures and clinician practices regarding the use of semi-adjustable articulators with facebows. The findings reveal critical patterns in patient demographics, denture functionality, and clinical adoption of advanced techniques, offering actionable insights for improving edentulous care. 40% of patients had chronic conditions (Table 1), aligning with evidence that systemic health (e.g., diabetes, osteoporosis) accelerates residual ridge resorption and complicates denture stability [5]. This underscores the need for personalized treatment plans to mitigate biological challenges. 73.3% had previously used dentures (Table 2), suggesting a cohort with advanced edentulism. This correlates with studies linking prolonged tooth loss to irreversible alveolar bone loss, necessitating more sophisticated prosthetic solutions [11]. About 53.3% required relining (Table 3), highlighting the impact of residual ridge resorption on denture fit. This supports the imperative for techniques that minimize bone loss, such as balanced occlusion [8,19].

Comfort, Speech, and Stability: Moderate mean ratings (Comfort: 6.13; Speech: 5.87; Stability: 7.20) indicate suboptimal but acceptable function (Figure 1, 3). The absence of low scores (1–3) suggests baseline efficacy of conventional dentures. Strong Intervariable Correlations: Speech-Stability (*r* = 0.84) and Comfort-Speech (*r* = 0.80) (Figure 3) confirm that functional qualities are interdependent. Poor stability likely compromises speech and comfort, reinforcing the need for precise jaw relation records.

Underutilization of Evidence-Based Tools: Only 57.5% used semi-adjustable articulators, and 42.5% employed facebows (Table 5), despite 85% acknowledging their accuracy benefits. This gap mirrors global trends where time constraints and training gaps limit adoption [12]. Impact of Advanced Techniques: When utilized, articulators with facebows correlated with 70% higher patient-reported stability (due to accurate occlusion). 82.5% reduction in TMJ complaints (attributable to physiological jaw positioning). These outcomes validate the role of skull-based jaw relations in preventing prosthetic complications [15]. Experience and Training Deficits: 60% of clinicians had ≤5 years of experience (Table 4), potentially explaining low technique adoption. This signals a need for enhanced curricula and hands-on training in advanced prosthodontic methods [17].

Conclusion

While conventional dentures restore basic function, their efficacy is limited by biological changes and technical inconsistencies. Integrating semi-adjustable articulators with facebows significantly enhances stability, comfort, and occlusal harmony. Bridging the gap between evidence and practice through training is essential for optimizing edentulous patient care.

Received*: 01-06-2025 -* ***Accepted****: 26-07-2025 -* ***Published****: 01-08-2025*

Conflict of interest. Nil

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Received*: 01-06-2025 -* ***Accepted****: 26-07-2025 -* ***Published****: 01-08-2025*