

## **Bite Force Evaluation of Acetal Resin Denture Base in Kennedy Class I Partially Edentulous Patients**

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### **Abstract**

**Objective:** The Objective was to evaluate the bite force in metallic and thermoplastic acetal resin denture bases in bi-lateral free end saddle cases at three and six months after denture insertion.

**Materials and Methods:** Twenty-four partially edentulous patients with mandibular Kennedy Class I were randomly selected. Written informed consent was taken from all selected patients after explaining the detailed treatment protocol as per the patient information sheet. The patients were assigned into two groups (twelve patients in each group). Group 1: Patients received metallic RPD. Group 2: Patients received thermoplastic acetal resin RPD. For each patient, bite force was measured at three and six month's follow-up periods using occlusal force meter device, [GM10<sup>®</sup> - Nagano Keiki Co. LTD. - J. Morita Co. -Japan].

**Results:** The results of the current study revealed that, the biting force significantly increased in metallic dentures more than thermoplastic acetal resin one in all follow-up periods.

**Conclusion:** The thermoplastic acetal denture base accompanied with decreased biting force.

**Keywords:** Bite Force; Acetal Resin; Edentulous Patients

### **Introduction**

Loss of teeth, which may be due to trauma, dental diseases, not only alters the psychological thought of the patients but also disturbs the esthetics, phonetics, and functional occlusion. Replacement of missing teeth is highly essential in order to restore the defect and regain function as best as possible [1,2].

The design of distal extension removable partial dentures that will preserve the abutment teeth, hard and soft tissues of the edentulous ridge has taxed the ingenuity of dentists for years especially in patients with compromised bony conditions [3-5]. These dentures drive their support from the relatively stable supporting abutment tooth or teeth and the resilient soft tissues overlying the residual edentulous ridge. These two tissues exhibit different degrees of displaceability. The resiliency of the mucoperiosteum is twenty-five times greater than that of periodontal membrane of the abutment teeth, thus the distribution of the load would not be equal as the compressibility coefficients are different [6].

Physiologic adaptation of the denture base to the tissues as well as maximum coverage aids in load reduction. The design of the removable partial dentures should be able to control and minimize these forces [7,8].

For many decades removable cast partial dentures are used as definitive removable prostheses. Recently thermoplastic acetal resin has been used in the fabrication of partial dentures as an alternative treatment of cast one which offers comfort, esthetics, function, biocompatibility and unique physical properties. It can be built quite thin yielding more sensation, it is nearly unbreakable, lightweight, resilient, colored pink like the gums and can form not only the denture base, but the clasps as well [9-12].

Bite force is an important variable to investigate oral function [8]. Maximum bite force (MBF) also directly influences diet choice, which has an important role in the maintenance of masticatory function [9-12]. In fact, the masticatory force of completely edentulous patients is 20% to 40% of that of healthy dentate persons. Therefore, complete denture wearers need up to seven times more chewing strokes to reduce food particle than do dentulous subjects [13,14].

The chewing forces used by denture wearers may be limited by the discomfort and the pain that happens when one or both of the dentures lose their retention, or even by the fear of such pain. The maximum bite force that can be exerted by denture wearers on objects placed between their dentures has also been shown to be considerably lower than that observed in dentate persons [15].

Flexible dentures are an excellent alternative to traditional hard-fitted dentures. Traditionally dentures with a soft base increases comfort and provide more esthetics at the cost of masticatory efficiency [19]. Thermoplastic resins can be broadly classified as thermoplastic acetal, thermoplastic polycarbonates, thermoplastic acrylic and thermoplastic nylon [20,21].

Thermoplastic acetal is a poly-oxy-methylene-based material. Acetal resin is very strong, resists to wear and fracturing, and is flexible, which makes it an ideal material for pre-formed clasps for partial dentures [22,23], partial denture frameworks, provisional bridges, occlusal splints. Acetal resins resist occlusal wear and are well suited for maintaining vertical dimension during provisional restorative therapy [24,26].

This study was done to evaluate bite force in metallic and thermoplastic acetal resin denture bases in bi lateral free end saddle cases at three and six months after denture insertion.

### Materials and Methods

Twenty-four partially edentulous patients with mandibular Kennedy Class I were randomly selected in this randomized clinical study from those patients attending the Removable Prosthodontic Clinic, Faculty of Dental Medicine Al-Azhar University, Cairo, Egypt. Written informed consent was taken from all selected patients after explaining the detailed treatment protocol as per the patient information sheet.

The patients were assigned into two groups (twelve patients in each group):

- **Group 1:** Patient received metallic RPD. [Dentorium™ products Co., INC. New York] (Figure 1a).
- **Group 2:** Patient received thermoplastic acetal resin RPD. [BIOCETAL® - Thermoplastic Acetal - Roko® - Poland] (Figure 1b).

The Inclusion criteria include: Lower bilateral free end saddle cases with opposing full dentate arch, class I jaw relationship, non-RPD wearers, six months at least were elapsed from last extraction, proper inter arch space, no systemic diseases was defined related to bone resorption, the remaining teeth extending at least from first premolar to first premolar in the other side, and no detected mobility in the remaining teeth.

The exclusion criteria include: Patients with history of drug therapy, which interferes with bone resorption, abnormal jaw relationship, patients with parafunctional habits, inadequate inter arch space.



Figure 1: A) Metal framework, B) Acetal resin framework.

### Bite force measurements

For each patient at each follow-up session, the maximum bite force was recorded using occlusal force meter device, Force Meter GM10® - Nagano Keiki Co. LTD. - J. Morita Co. - Japan (Figure 2). Bite force was measured for all patients at three and six month's follow-up periods. The recorded force during maximal clenching was obtained with one bite force meter placed between pairs of opposing teeth. The meter was located at the area of premolar/molar with a strong determinant of muscle action and subsequent great bite force.



Figure 2: Occlusal force meter.

During testing, the patient will be seated in an upright position. The tip of the disposal cap that covered the arm of the meter device will be inserted into the patient’s mouth and he asked to bite on it slowly.

When the force has exceeded the set-point, the buzzer will sound. For each patient, the mean of at least 10 records of the right and left sides will be collected and will be used in the statistical analysis. Data was collected, tabulated and statistically analyzed using student’s t test SPSS For window V20.

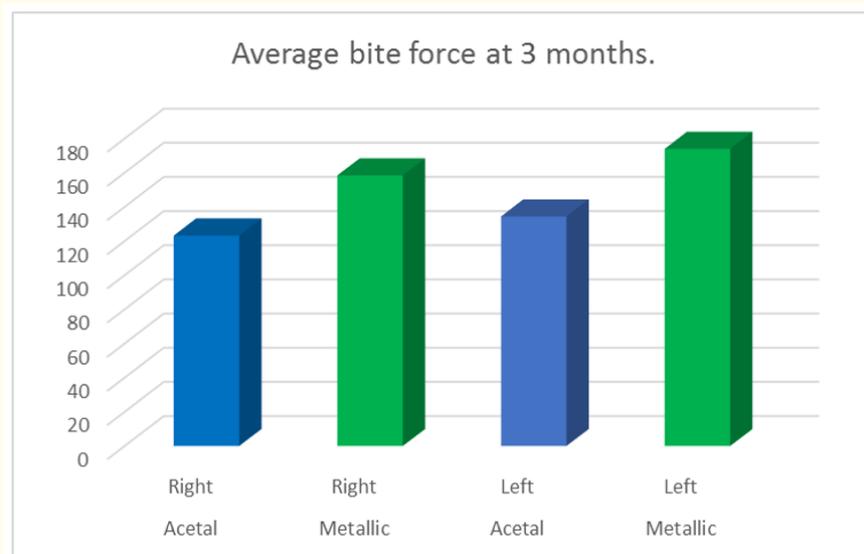
**Results**

This study was done to evaluate bite force in metallic and thermoplastic acetal resin denture bases in bilateral free end saddle cases at three and six months after denture insertion.

At three months after denture insertion, the bite force changes in both groups are summarized in table 1 and figure 3. At right side, mean value of average bite force at this side was 158.45 N and 123.21 N for group one and group two respectively. At left side, mean value of average bite force at this side was 174 N and 134.42 N for group one and two respectively. The Statistical analysis of the mean value of average biting force in all groups at both sides showed significant difference ( $p \leq 0.05$ ).

	Right		Left	
	Acetal	Metallic	Acetal	Metallic
Mean	123.21	158.45	134.42	174
SD	18.42	19.36	16.63	21.34
P-value	0.0072		0.0042	
SIG	Significant		Significant	

**Table 1:** Comparison between both groups according to average bite force at three months.

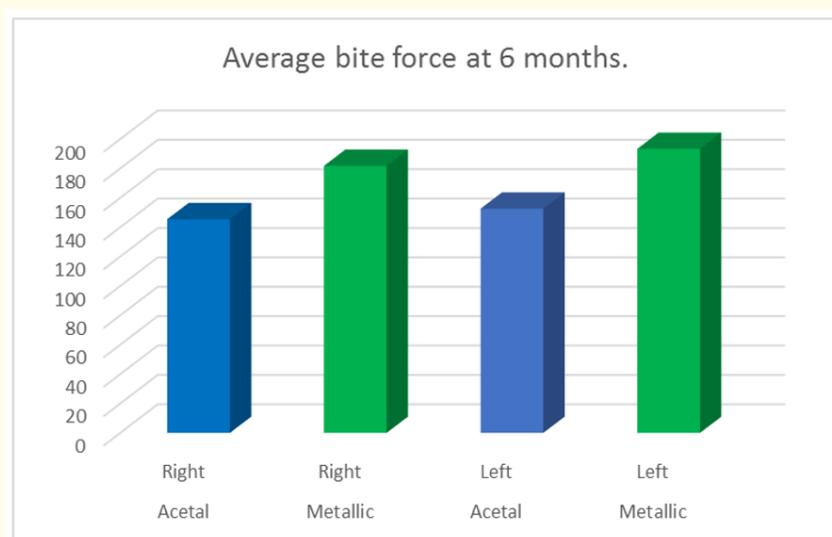


**Figure 3:** Average bite force at three months.

At six months after denture insertion, the bite force changes in both groups are summarized in table 2 and figure 4. At right side, mean value of average bite force at this side was 181.79N and 145.46N for group one and two respectively. At left side, mean value of average bite force at this side was 193.34N and 152.62N for group one and two respectively. The Statistical analysis of the mean value of the average biting force in all groups at both sides showed significant difference ( $p \leq 0.05$ ).

	Right		Left	
	Acetal	Metallic	Acetal	Metallic
Mean	145.46	181.79	152.62	193.34
SD	22.37	25.38	29.84	33.35
P-value	0.016		0.035	
SIG	Significant		Significant	

**Table 2:** Comparison between both groups according to average bite force at six months.



**Figure 4:** Average bite force at six months.

**Discussion**

This study was done to evaluate bite force in metallic and thermoplastic acetal resin denture bases in bilateral free end saddle cases at three and six months after denture insertion.

Patients with severe positional changes in the remaining natural dentition were excluded to avoid the effect of irregular or improperly inclined occlusal plane on abutments, residual ridge and on the stability of the partial dentures [27].

Patients exhibiting abnormal jaw relationship and abnormal oral habits were excluded to avoid the effect of the resulting off vertical forces on the partial denture supporting structures [28].

Patients with systemic disease or neuromuscular disorders were excluded to avoid any effect on the muscle tone and hence resultant masticatory efficiency [29].

Patients with temporo-mandibular joint dysfunction were also excluded to avoid any disturbance in muscle behavior [30].

At least a period of six months was elapsed after the extraction of teeth because bone resorption takes place rapidly in the first six months after extraction then progresses slowly [31,32].

Clasps with stress breaking effect were proposed for RPDs to achieve abutment preservation. Since RPI is highly recommended and more commonly used to retain RPDs [33]. The RPI clasp evaluated in this study possess biomechanical compatible effect because they exhibit medially placed rests, vertical reciprocation and gingivally projecting retentive arms, These criteria provide better stress distribution, enhanced support, together with controllable flexibility and retention required for RPDs [34].

The maximum voluntary bite force was evaluated using a digital force gauge with 5.6 mm thick bite element (Occlusal Force-Meter GM 10). This device has several advantages: it is easy to use, does not need any special mounting, has a small thickness of about 5.4 mm, does not interfere with the tongue, and can be easily disinfected by changing the disposable plastic coverings. However, it has a plastic covering that can still be considered hard to bite and this may be the main potential disadvantage [35].

The number of occlusal contacts is a strong determinant of muscle action and bite force than the number of teeth, this support the insertion of the bite force meter posteriorly at the premolar-molar area of the tested dentures [36].

To assess MBF of the RPD replaced side, the force transducer was positioned on the occlusal surface of the artificial first molar. Subjects were seated upright in a dental chair and were trained before the actual test to create confidence. The highest value out of 3 tests, with a one-minute rest between tests, represented the MBF for each side [37].

The results of the current study revealed that, the biting force significantly increased in metallic dentures more than thermoplastic acetal resin one in all follow-up periods. This could be explained due to the added hardness of the metallic one. Increasing the hardness of the denture base material increased the bite force significantly.

It can be supposed that the use of materials with lower modulus of elasticity as acetal may result in pain due to greater mobility of the denture and its worse stabilization, both leading to a decrease in chewing efficiency [38].

### Conclusion

From the results of this study, it can be conclude that the thermoplastic acetal denture base accompanied with decreased biting force.

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