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COMPARISON OF THE FAILURE BETWEEN CONVENTIONAL PMMA AND MILLED PMMA FULL ARCH MAXILLARY INTERIM PROSTHESIS FIXED ON 4 IMPLANTS: AN IN VITRO STUDY

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Objectives: The principal objective of this study was to compare the failure load between the conventional heat polymerized PMMA and the CAD/CAM milled PMMA interim full arch implant prostheses. The secondary aim was to evaluate the success of the distal extension of the temporary PMMA prosthesis.

Methods: A metallic edentulous upper arch model with 4 Straumann screw-retained abutment digital analogs was used to create 15 specimens for each of the 2 groups: Conventional and milled. Failure load was measured on 5 different regions on the left and right side of each specimen with the YLE universal testing machine: Anterior, premolar, and molar.

Results: The maximum force supported before breaking was noted for each region (N). The medians of failure load were statistically analyzed. Significant differences were observed between the 2 groups and among each region in the 2 groups. The posterior cantilever was the weakest sector in both groups followed by the anterior then the premolar regions.

Conclusions: The interim milled PMMA prosthesis are a better choice due to their improved mechanical stability.

Keywords: All-on-4, CAD/CAM, Cantilever, Conventional, Immediate loading, Interim implant fixed prosthesis, Polymethyl methacrylate, Provisional.

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The authors declare no conflicts of interest.

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COMPARAISON DE LA RÉSISTANCE À LA RUPTURE ENTRE LES PROTHÈSES MAXILLAIRES COMPLÈTES TEMPORAIRES EN PMMA FABRIQUÉES CONVEMTIONNELLEMENT ET CELLES FRAISÉES ET FIXÉES SUR 4 IMPLANTS: ÉTUDE IN VITRO.

Objectifs: L'objectif principal de cette étude était de comparer la résistance à la rupture d'une prothèse provisoire complète en PMMA remplaçant une arcade maxillaire totalement édentée fixée sur 4 implants entre 2 méthodes de fabrication : polymérisation à chaud conventionnelle et fraisage par CFAO. L'objectif secondaire était d'évaluer le succès de l'extension distale de la prothèse provisoire en PMMA.

Méthodes: Un modèle d'arcade supérieure édentée métallique avec 4 analogues numériques de pilier vissé Straumann a été utilisé pour créer 15 échantillons pour chacun des 2 groupes : conventionnel et fraisé. La résistance à la rupture a été mesurée sur 5 régions différentes sur les côtés gauche et droit de chaque échantillon avec la machine de test universelle YLE : antérieure, prémolaire et molaire.

Résultats: La force maximale supportée avant rupture a été notée pour chaque région (N). Les médianes de la résistance à la flexion ont été analysées statistiquement. Des différences significatives ont été observées entre les 2 groupes et entre chaque région des 2 groupes. L'extension distale postérieure était le secteur le plus faible dans les deux groupes suivis par le secteur antérieur puis le secteur moyen.

Conclusions: Les prothèses provisoires fraisées en PMMA constituent un meilleur choix en raison de leur stabilité mécanique améliorée.

Mots clés: All-on-4, CFAO, Charge immédiate, Conventionnel, Polyméthacrylate de méthyle, Porte-à-faux, Prothèse provisoire implantaire fixe, Provisoire.

Introduction

Dental implants have been used to resolve functional and esthetic challenges associated with the edentulous arch, giving the patient the opportunity of a fixed reconstruction [1]. The full arch implant restoration presents several advantages, including a better function, esthetics, and the conservation of the remaining bone [2].

The concept of "all-on-4" was initially established by Maló in 1998. This procedure allows the immediate rehabilitation of edentulous arches in one surgical step, during which the implants are placed. Bone grafting is not needed, and the available bone is optimized to place the 4 implants. The 2 anterior implants are inserted vertically between the central and the lateral site. The 2 posterior implants are placed at a distal angle in order to minimize the length of the cantilever, between the 2 premolars [3].

The clinical success of immediate functional loading in the all-on-4 supported temporary restoration is particularly conditioned by several factors: implant primary stability, interim prosthesis solidity, bone quality and quantity, implant number, and a harmonized occlusion [4, 5]. Dierens *et al.* showed that immediate full-arch rehabilitation leads to an immediate remarkable enhancement in patient satisfaction. The patient's primary concerns revolved around comfort, esthetics, and phonetics, and this marked the most notable improvement [6].

Provisional restorations should achieve important mechanical functions over a duration extending from the surgical procedure until the positioning of the final restoration [7]. Since 1936, acrylic resin or polymethyl methacrylate (PMMA) has been considered the most commonly used material for fabricating interim restorations on 4 or 6 implants [8]. This popularity is a result of its lack of toxicity, fine aesthetic outcome, acceptable strength, facility of manipulation, ease of repair and low water absorption [9, 10]. However, the mechanical properties of heat cured PMMA were considered insufficient. Common disadvantages of this material involve dimensional changes, susceptibility to fracture, and liberation of residual monomers [11, 12].

Thanks to the progress made in the computer-aided design and manufacturing (CAD / CAM) method, manufacturers recently introduced the CAD/CAM milled polymethyl methacrylate polymers as a replacement material for provisional prostheses. The subtractive producing technique consists of the three-dimensional milling of a resin blank by using a computer numerical control machine [13]. Since the resin blanks have been formerly cured with a high degree of conversion, they have superior physical properties and precision than the direct process [14]. A recent study conducted by Angelara et al. compared the flexural strength and failure load of acrylic resin immediate implant-supported interim prostheses fabricated by conventional processing and computer-aided manufacturing. However, the prosthodontic designs used were representative of a partial segment and not a full arch implant supported interim prosthesis [15].

A particular characteristic of implant prostheses is the presence of distal extensions for the purpose of providing efficient masticatory function by maintaining at least one occlusion on the first molar. Most studies reveal that the most distal implant of the final prosthesis encounters a compressive force when the pressure is limited to the cantilever. Implants that are located in front of this distal implant are normally exposed to a tensile force when loads are applied to the extended segment [16-19]. However, there are few publications concerning complications at the level of distal extensions of total provisional prostheses [20].

The aim of this study was to compare the failure load of the conventional heat polymerized PMMA interim prostheses and the CAD/CAM milled PMMA interim prosthesis. The secondary aim of this study was to analyze and evaluate the success of the distal extension of the temporary interim prosthesis. The null hypotheses tested were that failure load of the different full arch implant supported interim prosthesis fabrication methods in this study would be similar and that there is no difference in failure load among the different points of pressure application.

Materials and Methods

Specimen design

A Desktop scanner (E3 scan, 3 Shape, Trios, Denmark) was employed to digitize a plaster edentulous maxillary model containing 4 Straumann screw-retained abutments (SRA, Straumann Dental Implants; Institute Straumann AG, Basel, Switzerland) to simulate an all on 4 upper arch case [21]. Abutment level implant scan bodies (CARES, Mono Scanbody; Institute Straumann AG, Basel, Switzerland) were tightened over the screw-retained abutment at 15 Ncm and the model was scanned with a desktop scanner (E3 scan, 3shape, Trios, Denmark) to create a standard tessellation language file (STL). This STL was imported into a designing software called Trios 3Shape (Dental system, 3shape, Trios, Denmark). The scan bodies' sites were replaced by SRA Digital Analogs sites on the software.

A metal model was made with a 3D printer called Mysint 100 (Sisma SPA, Arezzo, Italy) using an additive method called the selective laser melting technique (SLM) [22, 23]. During the fabrication, metallic powders are uniformly spread on a platform. A focused laser beam scans the powder bed, according to the predefined design, selectively melting the powders. Once the layer has been consolidated, the platform lowers, and this cycle is repeated until the manufacturing is achieved [24]. 4 straight SRA Digital Analogs (SRA, 4.6, Straumann Dental Implants; Institute Straumann AG, Basel, Switzerland) were inserted and bonded to the model using a light-cured conventional flowable composite (Tetric N-flow; Ivoclar Vivadent) [25].

A previously fabricated framework on the edentulous plaster model was digitally scanned and used to copy its design. The temporary was designed on NC/RC variobase for bridge/Bar Cylindrical Coping for SRA using the Dental Implant System. The measurements were chosen based on the literature. An abutment-level all-on-4 prosthesis requires approximately 15 mm of interocclusal space [26]. The anterior prosthesis region designed in this study had a 20-mm height, the middle region had a height of 15 mm, and the posterior region had a height of 16 mm.

According to Woelfel's Dental Anatomy, the mesiodistal diameter of a maxillary central incisor is 8.5 mm. For the maxillary lateral incisor, it is 6.5 mm and for the maxillary canine it is 7.5 mm. The natural maxillary first premolar has an average mesiodistal size of 7.1 mm and 6,8 mm for the second premolar [27]. All the mesiodistal measurements in this study followed those guidelines. The interim prosthesis was designed with a 10-mm length between the 2 anterior implants and a 10-mm length between the anterior and the posterior implant after having measured the distance between the implants that were already present on the model.

The interim prosthesis design had a maximum of 18-mm width in the anterior region, 13-mm width in the middle region, and 13-mm width in the posterior region. This also was a replication of the previously fabricated framework.

The cantilever prosthesis region had an 11-mm length between the posterior implant and the most distal point of the prosthesis according to Woelfel's measurements [20, 28, 29].

All provisional restorations made in the laboratory were spaced 2 mm apart from the model to eliminate the model strength factor (Figure 1) [28].

Conventional PMMA fabrication technique

2 groups with different fabrication methods were created: Conventional (Conv) and milled (Mil) PMMA. 15 specimens were fabricated for each method:

The specimens of this group were fabricated by the same operator. The STL file was sent to the dental technician who milled the interim prosthesis in a wax blank (95 mm x 20 mm) (UPCERA, Upcera Dental, Shenzhen, China) by using a zirconzahn wet milling machine (CAD/CAM M5, Zirkonzahn, Italy). 16 wax units were milled to obtain the 15 conventional interim prostheses (An extra one was used to help make the acrylic teeth for all the prostheses).) Each one of the 15 specimens underwent a wax elimination procedure using a flask in which plaster was poured (plaster of paris) (Prestia Dental SP). The teeth on the extra wax model were cut off with a rotating tungsten carbide bur fixed on a hand piece. This second model was then placed in its corresponding plaster site already obtained in the flask base after having eliminated the wax. A self cured acrylic white resin (Star-Fast; Faprodent, Marrakech) was made by mixing the powder (polymer) and liquid (monomer) in accordance with manufacturer's instructions. The material was packed in the upper half of the flask, replacing the teeth. A plastic sheet of cellophane paper was placed between the 2 halves of the flask. The flask was then closed pressed. After polymerization, the wax denture base was removed from the flask and replaced by a heat cured pink acrylic resin (MELIODENT, Heraeus Kulzer, Germany) [29]. The flask and clamp were then placed in a curing unite containing water. The unit was heated to 70ºC for 7 hours then to 100ºC for 3 hours. The flask was cooled to room temperature before deflasking began [30] to record the highest temperature reached when fast cured in boiling water and to determine the elevated boiling point of monomer under high pressure. Methods: A subminiature pressure transducer (temperature compensated to 94°C. The conventional PMMA resins were then stored in a distilled water bath at 37°C for 24 hours to complete their polymerization [12, 31].

Figure 1. Spacing of 2mm between the interim prosthesis and the mucosa. [28]

Milled PMMA fabrication technique

The specimens of this group were fabricated by the same operator. The STL file of the designed prosthesis was sent to the dental technician. A monochromatic PMMA CAD/CAM disk was milled in a 95 diameter PMMA blank (POLYWAX, BiLKiM, Turkey) (95 mm x 20 mm) by using a 5-axis milling machine CAD/CAM (M5, Zirkonzahn, Italy). The procedure was repeated 15 times.

All specimens were secured to the implant abutments by tightening the prosthetic screws to 15 Ncm as per manufacturer directions. Before testing, samples are kept in an incubator filled with distilled water at 37°C +/- 1°C for 7 days [32].

For each specimen whithin both groups, 4 NC/RC variobases for bridge/Bar Cylindrical Coping for SRA (Institute Straumann AG, Basel, Switzerland) were cemented using a dual-curing resin cement (Duo-Link Universal; BISCO Inc.). The resin luting cement was manually mixed and packed onto the surface of the 4 receiving sites of the PMMA restauration and then light cured for 20 seconds [33]. Prior to cementation, the cementable surfaces of all variobases underwent texture modification by airborne-particle abrasion using 50-mm Al_2O_3 (Aluminum oxide, Eisenbacher Dentalwaren; ED GmbH). The abrasion process was applied from a distance of 10 mm for 10 seconds [34].

Failure load

The universal testing machine present at Saint-Joseph University of Beirut (YLE GmbH Waldstraße Bad König, Germany) was used to determine the failure load. A compressive pressure of 1.0 mm/min was applied using a hemisphere head with a diameter of 10 mm. N was the measurement unit.

On each specimen, the specimen was applied on 5 regions: 2 posterior cantilevers (C), 2 premolar sectors (PM), and 1 anterior sector (A) (Figure 2).

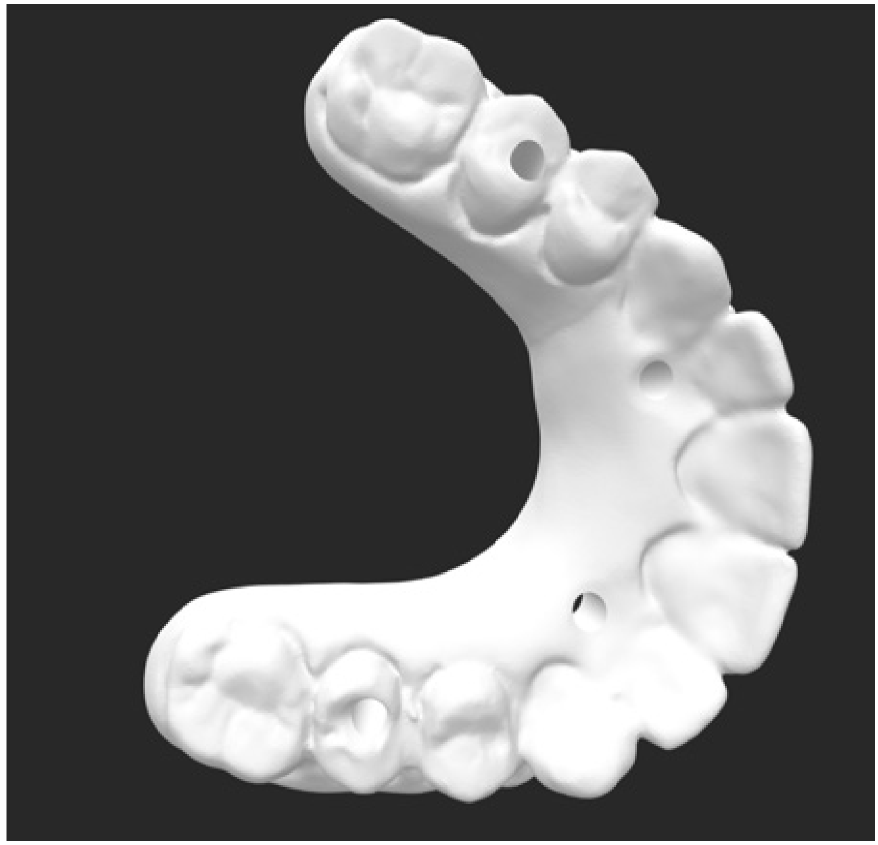

Figure 2. Regions where load was applied

Figure 3. Loading curves defining the different failure loads

The load direction was perpendicular to the occlusion table in the middle and posterior sectors. It was tilted 15 degrees in the anterior sector in order to simulate the protrusion.The failure load was defined when the loading curve reached a maximum, even if the fracture wasn't perceptible using a specific desktop software (UTM 03.13.02 R01) (Figure 3).

In the conventional group, the regions tested were named as follow:

Table 1. The correlation between pufa/PUFA scores and body mass index

Conventional or Milled	Region		N	Minimum	Maximum	Mean	Std. Deviation
Conventional	Anterior Region	Failure Load	15	450.0	1400.0	677.600	220.7703
		Valid N (listwise)	15				
	Molar Region	Failure Load	15	1362.0	2032.5	1654.800	225.1119
		Valid N (listwise)	15				
	Premolar Region	Failure Load	15	1801.5	3399.0	2536.733	391.2926
		Valid N (listwise)	15				
Milled	Anterior Region	Failure Load	15	589.0	2510.0	1078.000	543.4967
		Valid N (listwise)	15				
	Molar Region	Failure Load	15	1786.0	3407.5	2411.867	578.0474
		Valid N (listwise)	15				
	Premolar Region	Failure Load	15	1897.0	4975.5	3553.367	1032.2050
		Valid N (listwise)	15				

Conv/A, Conv/PM, and Conv/C. In the milled group, the regions were named as follow: Mil/A, Mil/PM and Mil/C.

Data were analyzed by using IBM SPSS Statistics for Windows (Version 26.0. Armonk, NY: IBM Corp.). The level of significance was set at 5% and all the analyses were two-tailed. Descriptive statistics of the continuous variable (failure load) were presented as means ± standard deviations (SD) (Table 1).

Statistical analysis

To assess the normality of distribution of the quantitative variable, Shapiro-Wilk test was used. To compare means of failure load between the 2 groups (milled PMMA vs. conventional PMMA), Mann-Whitney U test was used. Kruskal-Wallis test was conducted to compare means of failure load among the 3 regions (molar, premolar, and anterior), followed by Bonferroni post-hoc adjustments for pairwise comparisons.

Results

The mean failure load (N) of the conventional groups were Conv/A= 677 ± 220.7703, Conv/ PM= 2536.733 ± 391.2926, and Conv/C= 1654.800 ± 225.1119. For the milling groups they were Mil/A= 1078 ± 543.4967, Mil/PM= 3553.367 ± 1032.2050, and Mil/C= 2411.867 ± 578.0474 (Table 1). For both groups, the anterior region values were lower than the molar region. The highest values were recorded on the premolar region.

For the cantilever sector, the predominate failure for both groups were through the lateral areas of the interim coping connection holes (Figures 4 - 7).

Figure 6. Typical failure mode of a milled PMMA interim prosthesis on the posterior region during the application of the load.

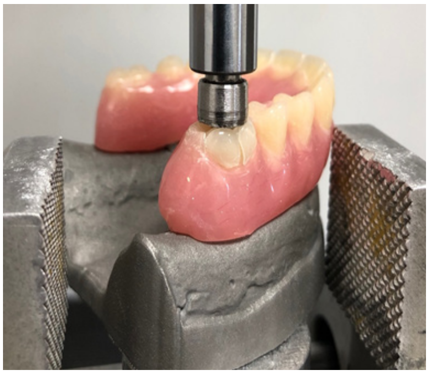

Figure 4. Typical failure mode of a conventional PMMA interim prosthesis on the posterior region.

Figure 5. Predominant typical failure mode of a conventional PMMA interim prosthesis on the posterior region.

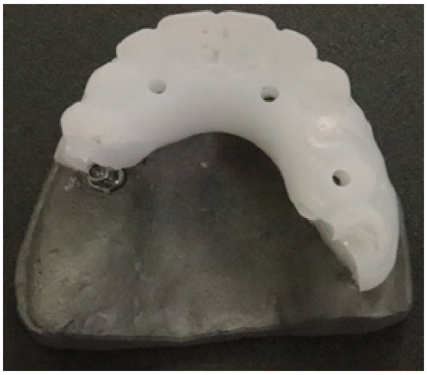

Figure 7. Typical failure mode of a milled PMMA interim prosthesis on the posterior region after the application of the load.

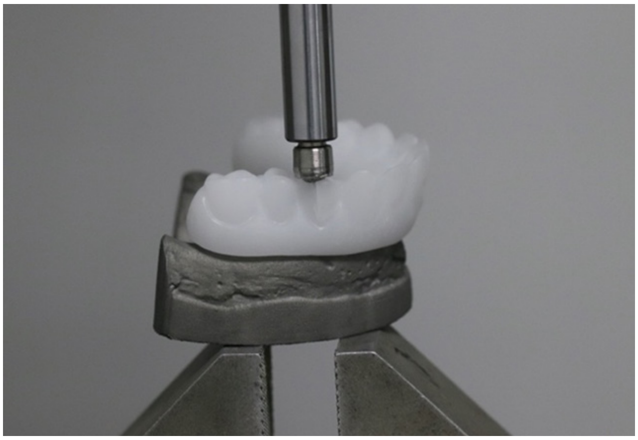

Figure 8. Predominance of a typical failure mode of a milled PMMA interim prosthesis on the premolar region during the application of the load.

Figure 9. Typical failure mode of a milled PMMA interim prosthesis on the anterior region after the application of the load seen under a magnifier.

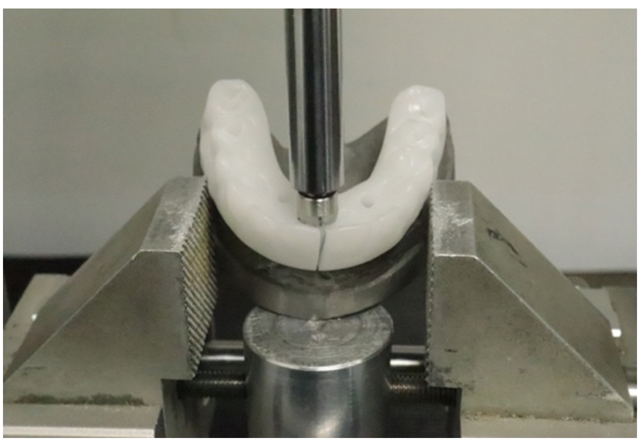

Figure 10. Typical failure mode of a milled PMMA interim prosthesis on the anterior region during the application of the load.

Figure 11. Typical failure mode of a milled PMMA interim prosthesis on the anterior region after the application of the load.

In the premolar region, the crack was similar in both groups. It was described as a partial fracture more than a complete fracture (Figures 8, 9).

The failure predominance in the anterior sector was in the middle, between the 2 central incisors in the milled PMMA group and it extended on all the surfaces (Figures 10, 11).

However, it was different in the conventional PMMA group. This failure was most of the time partial, perpendicular to the pressure applied on this sector and it involved the teeth (Figure12).

Statistical studies displayed the comparisons of the means of failure load (N) between both techniques

Figure 12. Typical failure mode of a conventional PMMA interim prosthesis on the anterior region.

Table 2: Kruskal-Wallis test comparing the 3 regions in both groups

Independent-Samples Kruskal-Wallis Test Summary

Conventional	Total N	45
	Test Statistic	38.108[a]
	Degree Of Freedom	2
	Asymptotic Sig.(2-sided test)	P< 0.0001*
Milled	Total N	45
	Test Statistic	29.426[a]
	Degree Of Freedom	2
	Asymptotic Sig.(2-sided test)	P<0.0001*

a- The test statistic is adjusted for ties. * significant if p<0.05

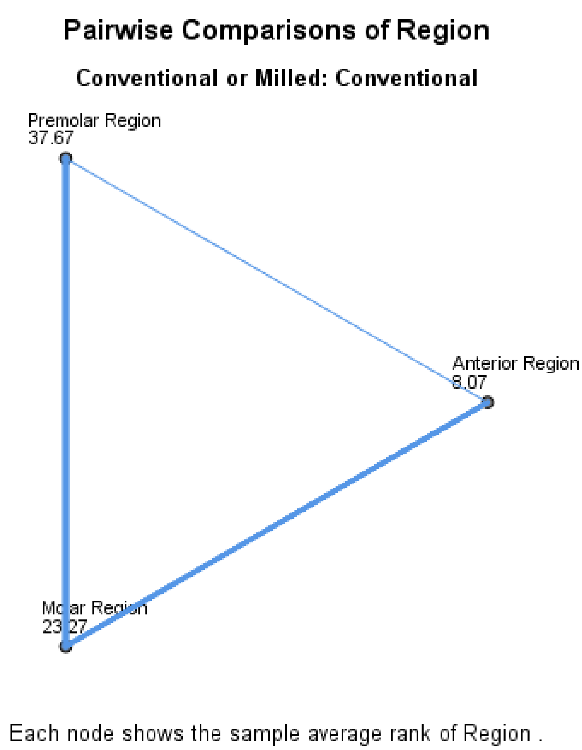

Figure 13. Pairwise comparisons of the 3 regions in the conventional group

of fabrication, as well as within each technique between the three regions.

The overall mean of failure load was significantly greater for the milled PMMA compared to the conventional one in all three regions considering the Mann- Whitney U test.

Kruskal-Wallis test and the pairwise test showed that there was a significant difference between the three regions (Table 2) (Figures 13 - 15). The statistical analysis showed that the premolar region is the most resistant in both groups followed by the posterior cantilever then the anterior sector.

The first null hypothesis was rejected as a significant difference was found between the milled CAD/CAM PMMA group and the conventional PMMA group. The second null hypothesis was also rejected as a significant difference was observed in both groups among the 3 regions studied (Table 3).

Discussion

The mean value for the anterior region within the milled group (1078.00 ± 543.4967) exceeded that of the conventional group (677.600 ± 220.7703).

Similar to this study, Angelara et al concluded that interim implant-fixed structures made by milling a high-density monochromatic PMMA blank had an ultimate breaking strength or flexural strength that was approximately 35% higher than that of the heat-processed denture base PMMA [15]. Aguirre et al as well as Prpic´ et al who compared the mechanical properties of CAD/CAM and conventional PMMA also reached the same conclusion. They found that CAD/CAM materials exhibited greater flexural strength values in comparison to compression-molded denture base materials [33, 36]. Since CAD/CAM PMMA blanks are produced with concentrated acrylic resin under elevated temperature and pressure, resulting in minimal shrinkage, porosity, and free monomers [37], the anticipation of higher failure load and flexural strength values for CAD/CAM materials, as demonstrated in these 3 studies, is justified. The structural characteristics of PMMA based polymers created with CAD/CAM technology can overcome the weaknesses of conventional resins. These problems include weak mechanical strength due to the presence of porosities, empty spaces, and the polymerization shrinking that appears while being mixed and packaged [38].

However, Ayman [39] and Pacquet et al [40] found greater flexural strength values in heat-polymerized PMMA compared to CAD/CAM denture base material. Variations in flexural strength between CAD/CAM and heat-polymerized denture base ma-

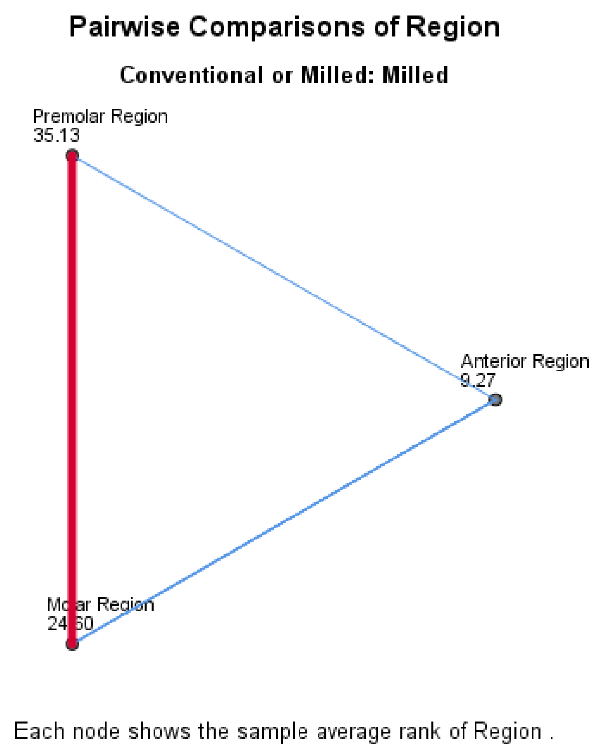

Figure 14. Pairwise comparisons of the 3 regions in the milled group

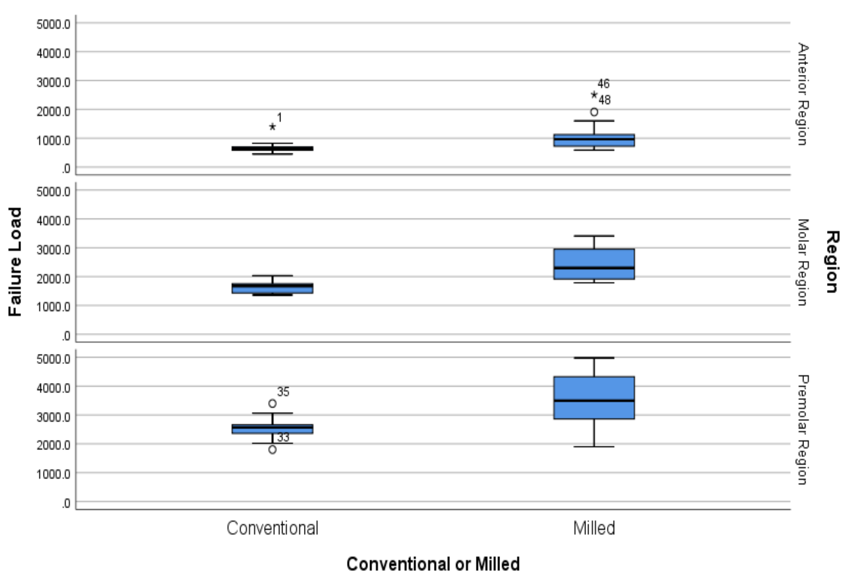

Figure 15. Failure loads of milled and conventional implant fixed dental prosthesis applied to 3 sites

terials might be attributed to the use of different materials from various manufacturers in different studies.

Polymethyl methacrylate (PMMA) has been the most commonly material over the past eight decades in the world of dentistry in order to fabricate temporary dentures [41]. This material exhibits both favorable and unfavorable properties. To overcome these drawbacks, different approaches have been used. One approach is to increase its mechanical properties by presenting CAD / CAM fabricated polymers based on poly (methyl methacrylate) (PMMA) as an alternative material for temporary prostheses [42]. A well-planned and well-executed prosthesis is crucial to prevent excessive stress on the bone and implant constituents. Due to anatomical constraints, a molar-sized distal extension (cantilever) is common in this type of interim prosthesis. Most studies indicate that the most distal implant of the final implant prosthesis encounters a compressive force when the load is primarily concentrated on the extension part of this prosthesis. Implants that are located in front of this distal implant are generally subjected to a tensile force when loads are applied to the cantilever [16-19]. However, there are few publications concerning complications at the level of distal extensions of complete provisional prostheses [20].

In this study, the distal extension proved to have significantly lower means than the premolar region in both groups. Moreover, the most frequent failure for both groups on the cantilever sector was distal to the interim coping connection holes. In a research conducted by Stegaroiu et al, it was discovered that the highest stress levels in 42 cortical bones were 1.5 times greater in a cantilevered model compared with a non-cantilevered model [43]. Kunavisarut et al observed that the presence of a cantilever considerably increased the stress in the prosthesis, implant, and surrounding bone [44]. In a study conducted by Drago, the cantilever lengths were notably shorter than those documented in Gallucci et al.'s research [49]. Notably, the complication rates were significantly lower (19%) in Drago's study compared to the rates reported by Gallucci et al [20, 30]. Sertqoz and Guvener found that stresses at the bone/implant interfaces were highest at the most distal bone/implant interfaces on the loaded sides, and these stresses increased significantly with greater cantilever length [46].

When examining the impact of extending the cantilever arm, it was observed that the stress on the

Table 3: Summary of the rejection or acceptance of the null hypothesis.

Hypothesis Test Summary

Region	Null Hypothesis	Test	Sig.	Decision
Anterior Region	The distribution of Failure Load is the same across categories of Conventional or Milled.	Independent-Samples Mann Whitney U Test	.004*	Reject the null hypothesis.
Molar Region	The distribution of Failure Load is the same across categories of Conventional or Milled.	Independent-Samples Mann-Whitney U Test	.000*	Reject the null hypothesis.
Pre-molar Region	The distribution of Failure Load is the same across categories of Conventional or Milled.	Independent-Samples Mann-Whitney U Test	.010*	Reject the null hypothesis.

Asymptotic significances are displayed. * Significant if <0.05

framework increased from 10 to 15 mm, but then decreased when the extension ranged from 15 to 20 mm [47]. According to Benzing et al, when a load is applied to a framework supported on implants, it generates deformation energy within the system, resulting in bending. If the framework absorbs a substantial amount of this deformation energy, it leads to a reduction in the transmitted energy, subsequently reducing the stress within the structure [48].

The findings of an FEA study conducted by Rubo et al showed that the more rigid the framework is, the better the distribution of stress among the abutments/ implants, and less stress is seen in the framework [47].

Many factors can also decrease the stress distribution on the cantilever section such as the increased abutment length, the increased implant length, … [47].

In contrast to the front teeth, the back teeth mainly endure axial forces during chewing, which are safer in terms of preventing tooth fractures compared to lateral forces. Shamseddine and Chaaban found that nonaxial forces were more harmful to the tooth restoration and increase the frequency of fracture [49]. This explains why in this study, the failure load in the anterior sector was the lowest in both regions.

In this study, the failure in the anterior sector was most of the time partial and involved the acrylic teeth in the conventional group. Similarly to this study, Darbar estimated that the debonding or breakage of the anterior acrylic teeth from the denture base occurs in 22 to 30% of conventional denture restorations. A study conducted by Shen et al showed that in the case of immediate loading full-arch acrylic resin prostheses fabricated with heat-cured acrylic resin, fractures of the base occurred more often in the back region, while the front teeth experienced fractures more frequently than the back teeth [50]. This explains why in this study, the fracture in the conventional group concerned predominantly the acrylic teeth.

The heat polymerization method of attaching the teeth to the denture has shown stronger bonds compared to other methods. Theoretically, the ideal bond could only be made under the condition that base and tooth material were simultaneously polymerized in one step. However in this case the esthetic outcome is not ideal [51].

In this study, a 2 mm spacing was done between each specimen and the model. Adequate spacing is crucial to ensure accurate and reliable test results. It prevents interference between the prosthesis and the study model and ensures that the specimen has room to deform. It also helps in achieving uniform stress distribution across the specimen [52] .

Limitations

However, the model used is typically rigid, while the gum tissue in the mouth tends to be soft. This may introduce bias into the study. A replicated system based on the traditional Frasaco model but lacking teeth, allowing the use of the soft gum material, would likely provide a more accurate representation of reality.

Another limitation of this study includes the absence of a confounding factor explaining the correlation between the fracture description and the manufacturing technique.

Conclusion

According to the results obtained from this study, the following conclusions were formulated:

1. The CAD/CAM milled PMMA group, can handle more occlusal load than the conventional group during the 6 months following the implant rehabilitation.
2. Reduced anterior and posterior cantilevers play a huge role in reducing the risks of interim prosthesis fracture.

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