

RADIOGRAPHIC AND CLINICAL ASSESSMENTS OF CAD/CAM TITANIUM AND BIOHPP FRAMEWORK IN MAXILLARY FIXED IMPLANT-SUPPORTED PROSTHESIS

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ABSTRACT

Aim: Comparing titanium framework and BioHPP framework for maxillary implant fixed-supported prostheses

Methods: The study was conducted on fourteen patients rehabilitated with maxillary fixed implant-supported prostheses supported by six dental implants. Patients were randomly divided into Group I: maxillary fixed implant-supported using a titanium framework. Group II: maxillary fixed implant supported using the BioHpp framework Cases were evaluated for crestal bone loss at zero, six, and twelve months and for gingival index and pocket depth at zero, three, six, and twelve months.

Results: Overall bone loss in group I was 0.14 mm and 0.12 mm, and in group II, it was 0.18mm and 0.15 mm at 6 months and 12 months, respectively; lower values of bone loss for the titanium framework compared to the BioHPP framework were found but considered statistically not significant. Gingival index in group I was 0.28, 0.22, 0.18, 0.1, and in group II, it was 0.32, 0.28, 0.22, 0.22, and probing depth in group I was 1.05, 1.5, 1.37, and 1.39, and in group II it was 1.06, 1.4, 1.35, 1.38 at baseline, 3 months, 6 months, and 12 months, respectively, and was found statistically not significant with better results for the BioHPP framework compared to the titanium framework.

Conclusion: Within the study's limitations, the BioHPP framework material is considered to be a reliable material to be used for framework fabrication..

KEYWORDS: Titanium, bioHPP, edentulous maxilla, CAD/CAM.

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INTRODUCTION

With the introduction of dental implants, both patients and healthcare professionals today have higher expectations for aesthetics.⁽¹⁾ Implant therapy's main goal is to either eliminate the need for complete removable dentures or improve the stability and retention of complete removable dentures by using implant-supported fixed prostheses instead of fully removable dentures⁽²⁾

An implant-supported hybrid prosthesis is a potential alternative for rehabilitating edentulous individuals with resorbed alveolar ridges.⁽³⁾ It combines the advantages of removable and fixed prostheses, provides lip support, corrects soft tissue deficiencies in the mouth, and benefits the patient physiologically and psychologically. Usually, a framework and a veneering substance make up this kind of prosthesis.⁽⁴⁾ Traditionally, zirconia, titanium, or precious or non-precious metals have created the framework.

The standard treatment method for full-arch implant-supported rehabilitations uses metal-acrylic resin prostheses because of their great performance and simplicity of repair if the veneering material is damaged. More resilient veneering materials, including acrylic or composite resin, have been suggested for coating rigid metal frames to reduce occlusal stresses because of their capacity to absorb shock.⁽⁵⁾

Metal processing for fixed prosthesis frameworks is expensive and time-consuming. Because of their poor adhesive affinity with acrylic resin, dental cosmetic veneers frequently chip away from the supporting structure, resulting in discomfort for the patient. However, due to its superior aesthetics and strong flexural properties, zirconia is frequently employed as a core material for creating the frameworks for implant-supported fixed partial dentures.⁽⁶⁾ However, it has drawbacks such as long-term deterioration, aging, chipping of the veneering porcelain, and stress concentration inside

a framework that could lead to veneer porcelain breaking. The introduction of monolithic zirconia restorations or pressing the veneering porcelain to the zirconia framework has reduced the inaccuracies in veneering ceramics⁽⁷⁾

Bredent Factory introduced the BioHPP (High-Performance Polymer), a dental material for producing superstructure dentures on dental implants based on the polyether-ether-ketone (PEEK) polymer. This material combines outstanding physical qualities with high-temperature stability and chemical deterioration resistance. Their exceptional ceramic filler, which improves the mechanical qualities and has a grain size of 0.3 to 0.5µm, strengthens them. This fine grain size allows for consistent homogeneity.^(8,9) Additionally, it has an elastic modulus similar to bone's, is radiolucent, bioinert, and compatible with carbon and glass fibers.^(10,11)

CAD-CAM High-performance polymers (HPPs) have been created as titanium and zirconia replacements. The usage of BioHPPs has increased, resulting in restorations with improved and repeatable mechanical properties as a framework material for permanent, detachable, and implant-supported prostheses.^(12,13) Marginal bone loss (MBL), in particular, is one of the elements that affect implant success that is under dispute.⁽¹⁴⁾ Therefore, the aim of this study was to compare the titanium framework and the BioHPP framework in maxillary implant fixed-supported prosthesis clinically and radiographically.

Methods and study design:

Patient Selection and Study Design

From outpatient clinic of Prosthodontics Department, Faculty of Dentistry, Ain Shams University, selection of 14 fully edentulous patients between 55 and 65 was done. The inclusion criteria of the present trial was patients with an angle's class I maxillomandibular connection, healthy mucosa

covering the maxillary ridge without any indications of inflammation or bony undercuts, and the absence of systemic diseases that might affect the oral tissues or the bone metabolic rate qualified. At least 15 mm should separate the occlusal plane from the bone level for the patients to have enough restorative space. Heavy smokers and parafunctional habitual patients were excluded. Patients with conditions like liver disorders that could make surgery more difficult were also not included.

All patients received information on this therapy surgical technique and prosthetic stages. Additionally, they received information on the value of carefully adhering to instructions and completed informed consent forms. The patients formally signed their releases. The ethical review board for the Ain Shams University School of Dentistry gave the study proposal acceptance (Local ethics committee, FDASU-Rec IR102213:). Clinical trials adhered to CONSORT standards.

SUBJECTS AND METHODS

Sample size calculation was performed using G*Power version 3.1.9.7 based on the results of a previous study (Mansour et al., 2020). A power analysis was designed to have adequate power to apply a two-sided statistical test to reject the null hypothesis that there is no difference between groups. By adopting an alpha level of (0.05) and a beta of (0.2), i.e. power = 80% and an effect size (d) of (0.625) calculated based on the results of a previous study. The predicted sample size (n) was found to be a total of (14), i.e., Group I: CoCr (n=7) and Group II: PEKK (n=7). This was calculated to detect differences between groups in regard to Colony-forming unit (CFU)

Surgical phase

All selected patients received new complete dentures. The new maxillary denture was duplicated to create a radiographic stent (with gutta-percha

radiopaque markers fitted to the polished surface). A cone beam computed tomography (CBCT) scan was taken for each patient while wearing the radiographic guide and his lower denture and biting in centric occlusion. Another scan was made for the modified upper denture alone on the table. The two scans were superimposed onto each other guided by the radiographic markers and the CBCT raw data was converted into 3D information by Blue Sky Plan software. The final file contained reformatted images in 3D bone model, 3D radiological data-set and 3D radiographic modified denture guide model.

The software allows to rotate the 3D images, decide the proper treatment plan, and select the suitable implant's location (mainly two implants at the laterals, two at the premolar site and two at the first molar site), length, and diameter according to the patient's bone quantity following the all on 6 concepts. And to ensure that implants were evenly distributed over the entire arch and vertically aligned. The produced stereolithographic surgical guide (partially guided) with a rapid prototyping machine* was provided with six metallic sleeves matching the precise depth, angulation, mesiodistal and buccolingual positioning of each implant as the virtually planned drilling sites. In addition, it had three windows labially for fixation screws.

Preoperative drugs comprised the following: It is recommended to prescribe Augmentin® 1g, prednisone, and chlorhexidine digluconate 0.2%, starting 8 hours before surgery and continuing 3 times per day for 7 days after surgery. Each patient got a bilateral infiltration of articaine hydrochloride and adrenaline (1: 100,000) in the labial, buccal, and palatal regions. The 3D surgical guide was stabilized on the upper ridge through the fixation pins. The sequential drilling was done for each implant** following a flapless surgical approach, and then the surgical stent was removed. Open a sterile vial containing the implant, place the implant

* (Formlabs Form 3+ 3D printer)

** V plus implant, Vitronix, Italy

into the osteotomy site, and rotate it clockwise with a finger driver. It took several turns of the ratchet wrench to firmly seat the implant and cover all exposed threads. Each implant underwent the same procedure. Implants were fitted with multiunit abutments*, which were then tightened with torque 25 N following the manufacturer's recommendations using the torque ratchet **as presented in Figure (1)**. Multiunit abutments had healing abutments linked to them.



Fig. (1) Multiunit abutments

Prosthetic phase:

After the period of osseointegration (3-4 months), healing abutments were unscrewed and removed. Transfer copings of multi-unit abutments were attached to multiunit abutments. The transfer copings were splinted intraorally using dental floss and low-shrinkage resin material. Then, an open tray impression was taken with putty and light-bodied impression material** (Elite HD+ putty soft fast; Zhemack SPA) to record the positions of the implants and the soft tissues. **As presented in Figure (2)**, After setting the impression material, the open tray copings were unscrewed, the impression was removed, and the multiunit abutments' analogs were screwed to the transfer copings. The impression was poured to obtain a master cast. Then, a verification jig was done on the master cast to ensure the accuracy of the impression and then transferred back to the patient's mouth to verify passivity. **As presented in Figure (3)**, a Cold-cured acrylic resin mandibular trial denture base was constructed on the final stone cast. It was connected to multiunit abutments anteriorly and

* (straight MUA abutment, vitronex, Italy)

** (Elite HD+ putty soft fast; Zhemack SPA)

two multi-unit abutments posteriorly to be implant-supported. Then, a wax rim was added to the trial denture base. A face bow record was made to mount the maxillary cast on a semi-adjustable articulator. The lower cast was mounted by centric occluding relation recorded following the interocclusal wax wafer technique, and a Protrusive record was made to adjust the horizontal condylar guidance of the articulator. Then, Patients were divided randomly into two equal groups according to the framework material of the final prostheses:

Group A: For these patients, maxillary fixed implant-supported prostheses were constructed using a titanium framework,

Group B: For these patients, maxillary fixed implant-supported prostheses were constructed using the BioHPP framework.

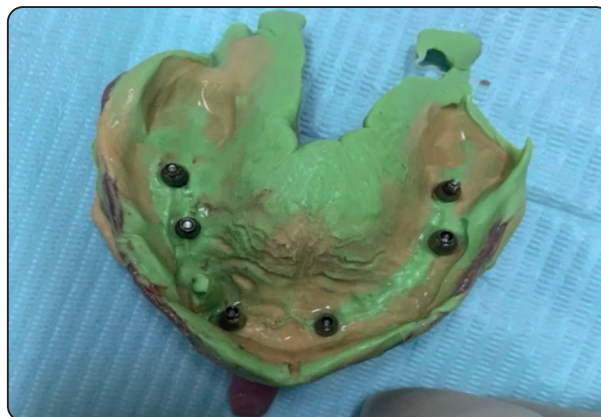


Fig. (2) Open tray impression was taken with putty and light-bodied impression material



Fig. (3) Verification jig in the patient's mouth to verify passivity

CAD/CAM Fabrications of the BioHPP and titanium Frameworks. The upper wax-up denture was placed on the cast and digitally scanned after the spray application. (3D shear scan spray, titanium dioxide free). The opposing lower cast and the upper wax-up denture on the semi-adjustable articulator were scanned with a laboratory scanner.

Both groups constructed either BioHpp or titanium frameworks using CAD/CAM technology. The Exocad software* was used, and the main window was opened. It was essential to select the steps : reduced wax-up, adjacent teeth, antagonist, and pontic wax-up ; then the type of restoration and material that was designed ; and just the implants already previously generated STL files were imported into a CAD**, and the files were overlapped on each other. The virtual cutback was performed with the CAD software to create a screw-retained Framework abutment preparation for future multiple crown cementation. After that, the CAD/CAM milled BioHpp, and titanium frameworks were tried, and the fit was confirmed clinically and radiographically to ensure the seating and passivity of the framework using the one-screw test and taking peri-apical radiographs to check for misfits

The BioHpp and titanium frameworks were scanned in the laboratory, then the STL files were saved in the CAD software, and the STL files were used to digitally design and fabricate the definitive zircon crowns. *** Then, zirconia crowns were attached to the titanium bar or the BioHPP framework. The final prosthesis was inserted in the patient's mouth. The occlusion was adjusted, and the screws were tightened according to the manufacturer's instructions. Screw access holes were sealed with flowable composite. **as presented in Figures (4-5).** The occlusion was adjusted if needed.



Fig. (4) Intraoral view of metal framework



Fig. (5) Final prosthesis (zirconia veneers with metal framework) A. Frontal view, B. occlusal view

* (Exocad DentalCAD 2016 GmbH, Darmstadt, Germany)

** (program (Exocad DentalCAD 2016 GmbH, Darmstadt, Germany)

*** (Dental Direkt germany).



Fig. (6) Final prosthesis (BioHPP framework)
A.on the cast B- Intlagic surface,
C.Intraoral frontal view

Methods of evaluation

-Radiographic evaluation

Following denture placement, consultations were scheduled at six and twelve months to assess crestal bone loss by cone beam CT as show in the **Figure (7)**. Using the linear measuring tool provided by the On-Demand 3D imaging software, peri-implant bone loss was assessed on all four surfaces: labial,

lingual, mesial, and distal. The implant-abutment interface (also known as the implant shoulder) and the initial implant-bone contact point were both crossed by two horizontal lines that were parallel to one another. The amount of peri-implant bone loss at the midline of each implant’s labial, lingual, mesial, and distal portions was calculated by measuring the space between these two lines.

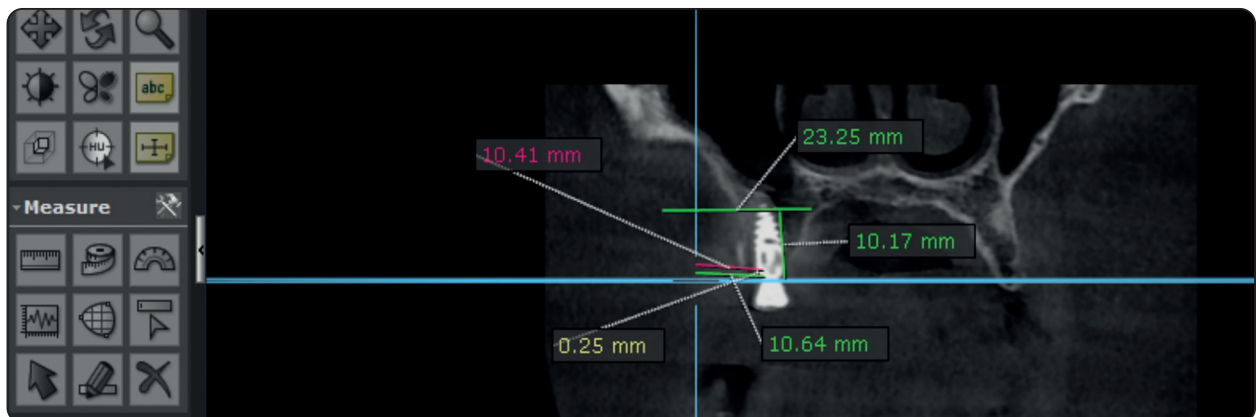


Fig. (7) Crestal bone loss using cone beam CT

-The Gingival Index (G.I.)

Gingival tissues were isolated and carefully dried with gauze around the implants. The buccal and lingual surfaces of each implant were scored individually. Mombelli et al. (15) described gingival scores as follows: G.I. 0 denotes normal, healthy gingiva; G.I. 1 denotes mild gingival inflammation with a slight change in color, minor edema, and bleeding on probing; G.I. 2 indicates moderate gingival inflammation with redness, glazing, and bleeding on probing; and G.I. 3 denotes severe gingival inflammation with marginal edema and redness, ulceration, and spontaneous bleeding. **Figure (8)**

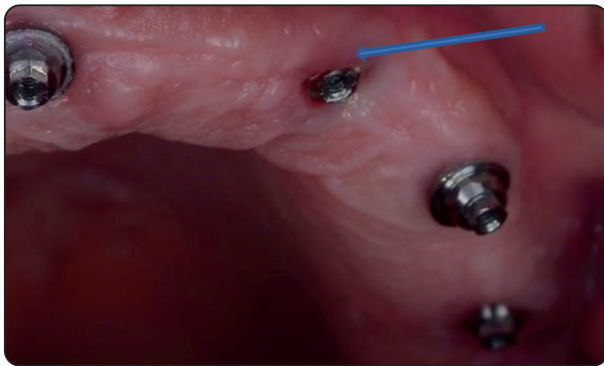


Fig. (8) Mild gingival inflammation with a slight change in color

The same observer recorded data for each participant. The pocket depth around each implant was calculated as the distance between the free gingival margin and the probe’s apex using Williams’ periodontal probe. Each implant’s mesial, distal, buccal, and lingual surfaces had their midpoint measurements taken. The mean probing depth for each implant was determined by calculating the

mean values of the scored surfaces. The information was tallied and statistically examined.

RESULTS

The statistical presentation of all the data uses the mean and standard deviation. The data was displayed in three tables. We analyzed using Windows Excel, GraphPad Prism, and SPSS 16® (Statistical Package for Scientific Studies). The quantitative data were examined using the Shapiro-Wilk and Kolmogorov-Smirnov tests for normality, which revealed that the significant level (P-value) was inconsequential, as a P-value > 0.05. The data came from a parametric normal distribution that resembled a normal Bell curve. As a result, to compare the two groups, we employed an independent t-test.

The results of the current study are demonstrated in the following tables (1-3) and figures (9-11)

Comparison of total peri-implant bone loss (mm) between the two groups:

An unpaired t-test was used to test for significance between the two groups, and the mean and standard deviation were calculated. The calculated mean of the measured overall bone loss in Group I was 0.14 mm, and in group, II was 0.18 at 6 months; bone loss in Group I was 0.12 mm and in Group II was 0.15 between 6- 12 months, so in group, I total bone loss was 0.26 mm and in the group II was 0.33 from loading to 12 months. Lower values of bone loss for the titanium framework compared to the BioHPP framework were found but considered statistically not significant (P ≤ 0.05).

TABLE (1) Mean difference and standard deviation (SD) values of total bone loss (mm) in both groups

Follow-up interval	Total Bone loss in both groups				P-value
	Group I (titanium framework)		Group II (BioHPP framework)		
	Mean difference	SD	Mean difference	SD	
Baseline-6 months	0.14	0.09	0.18	0.1	0.446
6months-12months	0.12	0.07	0.15	0.09	0.499
Baseline-12 months	0.26	0.09	0.33	0.13	0.130

*; significant (P ≤ 0.05) ns ; non-significant (P > 0.05)

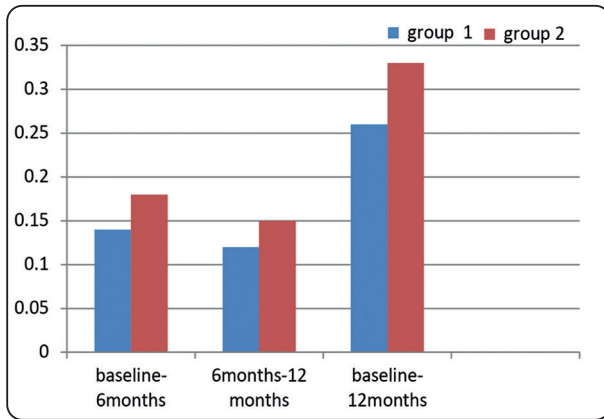


Fig. (9) Graph of crestal bone loss (mm) for both groups

Comparison of peri-implant tissue health parameters between the two groups:

An unpaired t-test was used to test for significance between the two groups, and the mean and standard deviation was calculated.

TABLE (2) Mean difference and standard deviation (SD) values of Gingival index in both groups

	Group 1 (titanium framework)	Group 2 (BioHPP framework)	P value
Baseline	0.28 ± 0.70	0.32 ± 0.48	0.897
3 months	0.22 ± 0.42	0.28 ± 0.32	0.756
6 months	0.18 ± 0.32	0.22 ± 0.42	0.835
12 months	0.1 ± 0.30	0.2 ± 0.336	0.606

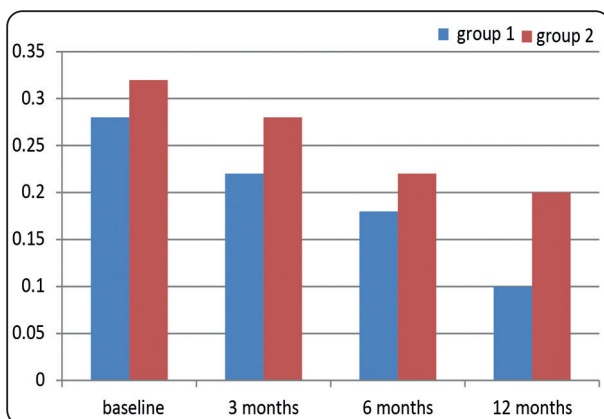


Fig. (10) Values of Gingival index in both groups

The calculated mean of the gingival index baseline in group I was 0.28; in group II was 0.32, group I was 0.22. Group II was 0.28 at 3 months, group I was 0.18 and group II was 0.22 at 6 months; group, I was 0.1 and II was 0.2 at 12 months and was found statistically not significant ($P \leq 0.05$) with better results for the BioHPP framework compared to the titanium framework.

The calculated mean of probing depth in group I was 1.05, and in group II was 1.06 at the baseline; in group I was 1.5 and in group II was 1.4 at 3 months, group I was 1.37 and in group II was 1.35 at 6 months, in group I was 1.39. and group II was 1.38 at 12 months and was found statistically not significant ($P \leq 0.05$) with better results for the BioHPP framework compared to the titanium framework.

TABLE (3) Mean difference and standard deviation (SD) values of probing depth in both groups

	Group 1 (titanium framework)	Group 2 (BioHPP framework)	P value
Baseline	1.05 ± 0.10	1.06 ± 0.12	0.941
3 months	1.5 ± 0.10	1.4 ± 0.10	0.085
6 months	1.37 ± 0.11	1.35 ± 0.10	0.714
12 months	1.39 ± 0.10	1.38 ± 0.10	0.812

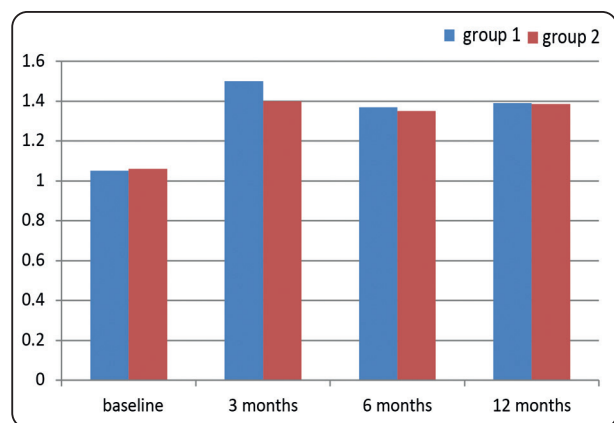


Fig. (11) Values of probing depth in both groups

DISCUSSION

Many treatment options are available to restore missing teeth, and dental implants are one of them. A popular and well-respected option for restoring missing teeth is dental implants. They have altered how lost teeth are repaired, with a high success rate since they Osseo integrate with the surrounding bone and are regarded as a significant contribution to dentistry, particularly in damaged ridges. For many elderly patients, implant-supported dentures represent an incredible rehabilitation option. Implant-supported overdentures and fixed dentures are the two types of implant-supported dentures.^(16,17)

An implant-supported overdenture offers enough retention and comfort while requiring fewer dental implants for rehabilitation than a traditional complete denture. However, the drawbacks include an unnatural appearance and a loss of psychological satisfaction because it is removable and somewhat larger. For these patients, implant-supported fixed restorations are the treatment of choice because they are fixed, have a natural appearance, do not completely cover the palatal region, are therefore suitable for patients who gag, cannot be taken out for cleaning, and can withstand the highest masticatory forces.^(18,19)

To reduce the influence of human factors and prevent unfavorable factors from affecting the results of the study, patients were carefully selected based on established criteria. Patients were evaluated to ensure adequate inter-arch space that accommodates the prosthesis, where construction of fixed implant prostheses needs a minimum height of 15 mm between the edentulous ridge and the opposing occlusal plane. This provides sufficient space for adequate material thickness and prevents prosthetic complications. This also permits a prosthesis design to establish aesthetics and hygiene⁽²⁰⁾.

For both groups, an arbitrary face bow was used as it locates the arbitrary hinge axis within 5 mm of the true hinge axis. A semi-adjustable articulator was used as it allows adjustment to replicate

average mandibular movements. This appliance is highly advantageous for dental professionals in modern dentistry. Its utilization reduces the number of intraoral interventions. Since most occlusal adjustments might be performed directly on the articulator^(21,22) The advantage of using multi-unit abutments is having a much easier and more predictable seating of the final restoration, creating reduced stress translated into the restorative system due to the passive nature of the seating process of multiunit abutments.^(23,24)

The "all on 6" ideas allowed for the rehabilitation of resorbed ridges without the need for bone augmentation, while distal slanted implants reduced the cantilever length. These procedures can be performed with cylindrical and tapered implants, as was also mentioned in a systematic study by Markadam Antal et al. that revealed that tapered profile implants have a better bone response than cylindrical implants.⁽²⁵⁾ Full arch rehabilitation with five to six implants in the maxilla is becoming a common approach. Increase in the anteroposterior spread and number of implants increases the predictability of the success of all 6 implant procedures.⁽²⁶⁾

According to a systematic review, compared to the All-4 implant concept, the All-6 implant concept has a higher success rate, less plaque accumulation and pocket formation, less crestal bone loss, and increased stability after 12 months of replacement⁽²⁷⁾. Implant techniques for these individuals have drawbacks like time-consuming procedures, blood loss, discomfort, and longer healing times. CAD/CAM and 3D-printed surgical guides can improve implant placement and reduce trauma. Conventional implants have disadvantages like higher costs and bone necrosis. A temporary screw-retained prosthesis can be created after three months.^(17,28)

Oral rehabilitation by implant-supported prostheses for an edentulous arch by the implant-supported fixed prosthesis and implant-supported removable prosthesis are popular treatment options for restoring function and esthetics, improving

masticatory efficiency, and patient satisfaction.⁽¹⁹⁾ Edentulous patients frequently experience problems with their complete mandibular dentures due to a lack of stability and retention of the mandibular denture and a decreased chewing ability. Insertion of implants creates a more favorable restoration in such patients.⁽²⁹⁾

With high implant success rates (92.4–100%), titanium, its alloys, and zirconia were offered as substitute materials to construct implant frameworks using CAD/CAM technology⁽³⁰⁾. These two substances are biocompatible because they avoid galvanic corrosion, a common drawback of non-noble metal alloys. Zirconia frameworks, as opposed to titanium ones, displayed higher strain concentrations in a recent *in vitro* investigation. The authors also advised using zirconia frameworks with caution where there were possible risk factors for mechanical difficulties (such as parafunctional behaviours).⁽³¹⁾ Another clinical study found a 31.25% porcelain chipping/fracture rate after 2–4 years of function. Titanium provides good rigidity in the face of a higher flexion resistance than other metals. However, due to its high melting point and reactivity, it requires special equipment for its manufacturing. Finally, technical complications with both CAD/CAM zirconia and titanium frameworks for implant-supported prostheses were previously reported^(32,33).

BioHPP implant frameworks combined with pre-fabricated high-impact PMMA teeth can be an alternative treatment for all-on-4 implant-supported restorations. It has many advantages, like elasticity similar to that of bone and a shock-absorbing effect. Also, the polymeric biomaterial PEEK may be a valuable material for infrastructure due to the polymer's increased radiolucency and decreased stiffness.^(34,35) BioHPP rehabilitation considerably reduces vertical and lateral movement masticatory forces compared to titanium, zirconium, or ceramic. This characteristic positively influences the patient and boosts the restoration's durability. Furthermore, using CAD/CAM milling to make the prosthesis as

passive as possible has proven to be more favourable than traditional approaches regarding passive fit and accuracy.^(36,37)

The information on the stress distribution around the implant-bone interface is critical for its long-range stability. The stresses transferred into the bone from different framework materials are divergent due to the variation in its Young's modulus of elasticity^(38–40). One study demonstrate that a flexible framework seems to increase stresses falling on implant assembly and cortical bone, especially on oblique loading. The use of a flexible framework that can bend during chewing stresses the screw and bone.⁽⁴¹⁾ One study found that the frameworks constructed from PEKK and PEEK materials, which have relatively low elastic modulus as compared to Ti and M-Zr, resulted in less stress in the frameworks themselves but higher transference of stress to bone, dental implants, abutments, and screws⁽⁴²⁾

Our results agreed with previous studies, in which the change in superstructure material did not affect the amount of marginal bone loss⁽⁴³⁾, and those of experimental *in vivo* studies, in which different materials resulted in similar outcomes.⁽⁴⁴⁾ A previous study concluded that using BioHPP as framework material in fixed-detachable prostheses gives predictable results comparable to those of cast Co–Cr alloy.⁽⁴⁵⁾ Lee et al.⁽⁴⁶⁾ which compared and evaluated the stresses in implant-supported prostheses with PEKK, Zr, and Ti frameworks, found that the PEKK prosthetic frameworks' capacity for shock absorption is rather small and only efficient against compressive stress. The authors came to the conclusion that using high-elastic modulus materials for fabricating prosthetic frameworks reduced stress transfer to dental implants and peri-implant bone when compared to using low-elastic modulus materials to construct frameworks, Similar to. In their FEA investigation, Sirandoni et al.⁽⁴⁷⁾ showed that the von Mises stresses in the framework, implants, and abutments resulted in low and limited efficiency of the PEEK materials' shock-absorbing function. Moreover, the study found the

most favourable biomechanical results with stiffer materials that decreased the stress levels for bone, dental implants, screws, and abutments, as well as the magnitude of displacement of frameworks

Biologically, the literature shows how the PEEK represents a reliable alternative to titanium, showing an absence of increased risk of marginal bone loss and soft tissue recession during the initial healing period in implant-supported prosthetic treatments.⁽⁴⁸⁾ Moreover, despite the increased roughness when compared to titanium, this material appears to be less plaque-retentive^(49,50) As PEEK has very low or no solubility in conventional solvents (at room temperature), procedures related to surface modifications by physical agents were determined according to the dental PEEK manufacturer⁽⁴⁹⁻⁵¹⁾

An implant-supported fixed prosthesis with a PEEK framework and PMMA veneers can offer a positive prognosis for missing teeth patients, in contrast to other traditional abutment materials.⁽⁵²⁾ Watchet *et al.*⁽⁵³⁾ discovered that the PEEK superstructure on conventional titanium implants provided 100% protection against bacterial leakage under cyclic masticatory pressure. They explained this result by pointing to the PEEK superstructure's high elasticity and self-deformation capacity, preventing micromovements at the implant-abutment contact. Few studies have examined how the oral mucosa responds to implant components made of various materials. In an experimental study, According to Abrahamsson *et al.*⁽²⁾ report on experimental research, the abutment material may impact how well the mucosa adheres to the implant abutment. Studies have demonstrated that zirconium, titanium, and aluminium-based ceramic abutments promote the best soft tissue healing. However, abutments made from polymer materials have not been studied extensively.^(54,55)

CONCLUSION

Within the study's limitations, the BioHPP framework material is considered to be a reliable material to be used for framework fabrication.

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