ORIGINAL RESEARCH

Comparative Study between Two Adjacent Implants Supported Crowns and One Implant Supported Cantilever Fixed Dental Prosthesis: An *In Vivo* Study

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Abstract

Aim: To assess hard as well as soft peri-implant tissues within cases having two lost adjacent anterior teeth treated through placing either two implants with two separate crowns or only an implant along with a crown with a cantilever, and evaluating the effect of polyetheretherketone (PEEK) restoration on cantilever design up to 18 months after functional loading.

Materials and methods: Twenty-seven participants (15 males and 12 females; mean age, 38.6 years; range 20–50 years) with missing two adjacent anterior teeth were treated with implant system (Flotecno implant system, Italy). In the first group (implant–implant metal ceramic group), we treated nine participants utilizing two adjacent implants with two separate single metal ceramic crowns. In the second group (implant–cantilever metal ceramic group), we treated nine participants by placing single implant with cantilever metal ceramic fixed dental prosthesis (FDP). In the third group (implant–cantilever PEEK group), we treated nine cases utilizing single implant with a cantilever PEEK FDP framework. Clinical and radiographic examinations were recorded. Marginal bone level, implant stability, and prosthetic complications were assessed during an 18-month follow-up period.

Results: Marginal bone loss (MBL) exhibited similar measurements among all groups. The clinical outcomes did not address significant variance among all groups as regards implant stability within the period of follow-up. We also observed minor prosthetic complications. Participants were very satisfied within all groups.

Conclusion: Based on the limitations of our research, utilizing cantilever extensions has no influence on MBL as well as implant stability.

Clinical significance: Mean marginal bone level exhibited a significant rise from baseline to 18 months for all groups, however, still within the clinically accepted range. Regarding implant stability, no significant variance was observed among all groups for 18 months. The cantilever FDP design facilitated prosthesis fabrication among those having laterals of narrow diameters. Further research is required to investigate such a particular concern due to a limited sample size in our research.

Keywords: Crowns, Dental prosthesis, Framework, Implants, *In vivo* study.

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Introduction

Implant-based rehabilitation in esthetic zone presents a significant clinical challenge. Specifically, achieving softtissue contour, mimicking that of natural teeth, remains difficult to predict.[1]

Although there have been improvements in implant dentistry, replacing two lost adjacent anterior teeth remains challenging for clinicians. The tooth-implant papilla fill, when replacing a single tooth, is mostly influenced by the neighboring tooth's attachment level integrity. For two neighboring implants, it remains challenging to create the necessary presence as well as stability of papillae between the two implant restorations owing to the lack of dentogingival fibers attachment.[2] Yet, it is essential to maintain at least 1.5 mm spacing between teeth and implants' surface in order to prevent bone resorption. Additionally, when placing two neighboring implants, they need to be positioned 3 mm apart to provide an ideal papilla between them.[3]

The maxillary lateral and mandibular incisors are of small diameter. When two neighboring implants are utilized for replacement, they are commonly positioned in close proximity to each other, thus compromising the superior esthetic outcomes. When the distance between implants is less than 3 mm, the loss of crestal bone might impact the bone height between implants. Inter-implant bone loss leads to more papilla loss, which may negatively impact esthetics, thus producing inaccessible areas that are difficult to clean or prone to food accumulation.[4]

Implant-supported single crowns have become a widely accepted and favorable approach for replacing a single tooth loss. When it comes to replacing two adjacent missing teeth, there are

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two treatment approaches: utilizing two implants with two distinct crowns or using one implant for supporting a cantilever fixed dental prosthesis (FDP) with two units.[5] Typically, the cantilever design is used to address issues related to alignment, bypassing anatomical limits, requiring large bone grafting, and for esthetic purposes, particularly in cases where there is little space between the anterior as well as posterior teeth.[6]

Utilizing the cantilevers in fixed prosthodontics has created controversies regarding the pontic's function as a lever, thus probably producing lateral forces that provide a higher risk of overloading in implant-supported FDP. Therefore, it was anticipated that there would be a greater occurrence of biological and prosthetic issues with this particular form of rehabilitation, as opposed to those without cantilevers.[7] However, research has shown comparable rates of success for implants, regardless of whether they had cantilever extensions or not. Currently, the cantilever extensions' impact on marginal bone level as well as problems related to biologic or prosthetic factors is not well understood.[8]

Nevertheless, using implant-supported cantilevers has introduced details about the prolonged stability as regards survival rates of implants as well as peri-implant marginal bone loss (MBL). However, in a prospective study that lasted for 7 years with cantilever FDP supported by implants, when controls were absent, the implants' survival rate indicated 97% while success rates of prostheses reached 98%.[9] Zurdo et al.[10] addressed that the frequently occurring adverse events for FDP with cantilevers involved veneers' fracture (10%), abutment screws' fracture (1.6%), decementation (6.9%), as well as loosening of screw (7.9%).

Polyetheretherketone (PEEK) has excellent chemical resistance and superior mechanical characteristics, while being biocompatible. It exhibits superior compatibility with recent imaging technology. It is a dental implant material that is tooth-colored and often utilized when esthetics is a significant factor.[11] Polyetheretherketone could be employed as a superstructure for implants, abutments, as well as implant body or impression post. The Young's modulus of pure PEEK indicates 3.6 GPa, while that of carbon-reinforced PEEK indicates 18 GPa, as well as glass fiber reinforced PEEK indicates 12 GPa. The Young's modulus of PEEK is similar to that of cortical bone, thus exhibiting less stress shielding compared with titanium material.[12]

Regardless of the attempts to prevent MBL, it seems to occur more frequently at the implant-neck level after implant insertion and loading. During the first year following the surgical procedure, a dental implant often experiences a certain degree of physiological MBL, which may occur both horizontally and vertically. However, following this period, there is only limited further bone loss yearly.[13] The process of bone remodeling is a crucial determinant in assessing the success of an implant. The necessary conditions for the successful placement of an implant include an MBL of up to 1 mm during the first year after its insertion, as well as a mean yearly MBL approaching 0.2 mm throughout subsequent monitoring duration. However, ensuring the prolonged esthetic and functional success related to FDP supported by implants requires the maintenance and improvement of soft tissue and bone contour.[14]

The study's null hypothesis is that: there was no variance among the first group of two separated adjacent implants with titanium abutments and two separate metal ceramic crowns, the second group of FDP with a cantilever supported by single implants using titanium abutment as well as two metal ceramic FDP and the third group of FDP with a cantilever supported by single implants using PEEK framework, regarding the evaluated parameters of marginal bone level, stability of dental implant, chipping of veneering as well as screws' loosening while following up with cases.

After thorough research of literature, it was found that the studies comparing the two adjacent implants supported crowns and one implant supported cantilever FDP are scarce.

Materials and Methods

Patient Selection and Grouping

Our research took place at the Crown and Bridge Department, Faculty of Dental Medicine, Al-Azhar University, Egypt. This study was conducted from January 2021 to February 2024 following the approval from the ethical committee, and then conducted based on the World Medical Association Declaration of Helsinki's guidelines (approval code: 599/1671). A written informed consent was obtained from patients.[15]

Study Design

This prospective randomized controlled open-label study was conducted on 27 participants (15 males and 12 females), with an age range falling between 20 and 50 years. The mean age was 38.6 years. They had two adjacent missing anterior teeth, then encouraged for placing implants, the absence of any systemic conditions affecting the tissue reactivity to implants, the presence of a healthy ridge at the site of surgical procedure with compressible oral mucosa covering it and no movable or excessive tissues, the availability of enough space between the arches, a normal maxillomandibular relationship, the absence of temporomandibular joint (TMJ) or neuromuscular conditions, favorable oral hygiene, as well as sufficient bony structure.

Sample Size Calculation

The sample size calculation was done by G*Power 3.1.9.2 (Universitat Kiel, Germany). According to a previous study,[5] the mean ± standard deviation (SD) of MBL was 1.2 ± 0.9 mm in the first group and 1.0 ± 1.1 mm in the second group, and we demonstrated a 50% increase (mean difference = 1.2 mm) in the third group than the first group. The sample size was based on the following considerations: 1.030 effect size, 95% confidence limit, 90% power of the study, group ratio 1:1:1. Two cases were added to each group to overcome dropout. Therefore, we recruited nine patients in each group.

The exclusion criteria were general medical diseases (such as stroke, recent cardiac infarction, severe bleeding disorder, or cancer); psychiatric contraindications to implant surgery; poor oral hygiene; smokers; conditions that complicate wound healing, for example, uncontrolled diabetes (defined as HBA1c level >7%), alcohol or drug abuse, or severe parafunctional habits; bruxism and clenching; uncontrolled periodontal conditions or oral diseases; pregnancy; on certain medications like bisphosphonates currently or within the past 3 months; history of radiotherapy in head and neck region; perforated and/or lost labial bony plate; obvious undercut on the labial cortical plate; and history of grafting procedures at the area of interest.

Randomization and Blindness

An online randomization program (http://www.randomizer.org) was used to generate a random list, and each patient's code

was kept in an opaque sealed envelope. Patients were randomly allocated with 1:1:1 allocation ratio into three groups in a parallel manner based on the FDP design and restorative material: control group (implant–implant metal ceramic group) consisting of two adjacent implants with two titanium abutments and two separate metal ceramic crowns; second group (metal ceramic cantilever design) included a single implant with a titanium abutment and two units of metal ceramic cantilever FDP; and third group (PEEK cantilever design) consisted of FDP with a cantilever supported by single implants utilizing a PEEK framework. This study was open label due to the different techniques used.

All participants within our research underwent diagnostic procedures, involving a thorough assessment of their medical history, a clinical examination, an examination of study casts, as well as cone-beam computed tomography using computed tomogram scanner (3D Accuitomo 170 CBCT scanner, J. Morita Corporation, Japan). These procedures were conducted to confirm the measurements of bone width, length, and quality. All individuals received implants from the Flotecno implant system, which is based in Italy.

Surgical and Prosthetic Procedures

One day prior to the insertion of the implant, patients commenced the use of a 0.2% chlorhexidine mouthwash (Al Esraa Pharmaceuticals, Badr Industrial City, Cairo, Egypt). Prior to implant surgery, patients began a course of antibiotics (amoxicillin 500 mg, administered three times each day for a duration of 7 days). The implant site was prepared under local anesthesia utilizing Mepivacaine HCl (36 mg/1.8 mL) along with Levonordefrin HCl (0.108 mg/1.8 mL). A surgical guide was employed to guide the preparation process. The implants' placement was carried out with a handpiece in strict adherence to the guidelines provided by the manufacturer, which specified a speed approaching 15 rpm as well as a torque reaching 90 Ncm. Implant insertion was conducted with a minimum torque of 45 Ncm. Fourteen days after the implants were inserted, the stitches were taken out. Follow-up visits were done on the patient every month till the loading time.[16]

A temporary removable partial denture was constructed to maintain esthetics and function and was adjusted to not exert pressure on the wound during the osseointegration phase

Following a period of 4 months, periapical X-rays were taken, thus looking for issues prior to the second surgical procedure, which involved exposing the implants. The healing abutments, which are essential for esthetic purposes, were put in place and attached for 3 weeks. A screw-retained provisional restoration was made in the dental lab. It included a temporary abutment against which a veneering resin was modeled.

Healing abutments were then taken off while inserting the provisional implant crowns. They were torqued to 32 Ncm and left for 3 months. The pressure applied to the mucosa by the temporary crown's cervical part achieved the optimal emergence profile.[17]

The indirect closed impression approach with an impression post as well as implant analog has been employed. A metal framework was made, and both clinical and radiographic tests were done to make sure that it fits properly within the case's oral cavity. After inserting final restoration, periapical images were taken to make sure the accuracy of the margins. Heavy contacts were removed from cantilever crown, leaving light contacts. With excursion, we avoided all contacts.[18]

For the PEEK group, a custom PEEK abutment was made using an addition silicone impression to the tie base so that a model could be scanned after the implant analog was screwed onto the tie base. Finally, PEEK frames were milled by a milling machine after the model was scanned utilizing a desktop scanner. The PEEK structure has been clinically tried and proven to work in the patients' mouths on a tie base. Following that, the PEEK framework was sent to the lab to be veneered with a nanocomposite material known as SR AdoroTM (Ivoclar Vivadent AG, Liechtenstein). It was then fired in a Lumamat 100 light furnace (Ivodent, Switzerland). Salicylic acid was used to etch the PEEK frames for 90 seconds. The SR Adoro link was put on top of the framework and stuck together. The finished prosthesis, which was made of PEEK as the framework and Adoro on top of it, was glued to the tie base in the patient's mouth with RelyX self-cure resin luting agent (3M ESPE, USA).[19]

Data Collection

Standardized digital periapical X-rays were used to check the level of the marginal bone employing paralleling techniques. As suggested by Adell et al.,[20] the implants' length was found within digital X-rays employing software (Scanora Lite 3.2; Soredex); then a comparison was conducted with actual lengths. The inter-marginal bone distance as well as the implant shoulder's marginal edge was used to measure the MBL. The average bone loss value seen both mesially and distally for all implants was employed to determine it.

Frequency resonance analysis (Osstell Mentor; Osstell AB) was used to measure the implant stability quotient (ISQ) values. Osstell ISQ values were employed to check how stable the implants were before they were loaded (baseline measurement). The SmartPeg was screwed and tightened through implant to about 5 Ncm. Osstell tip was held within right position as well as direction with the implant so that four readings could be taken for all implants. The average was then found. Such a test was implemented for observing how stable the implants were at various intervals after they were loaded.[21]

All of these parameters were assessed while loading (baseline) and at 3, 6, 12, and 18 months.

The primary outcome was MBL. The secondary outcome was implant stability.

Statistical Analysis

Statistical analysis was done by SPSS v26 (IBM Inc., Chicago, Illinois, USA). Quantitative variables were presented as mean and SD and compared among the three groups utilizing analysis of variance (*F*) test with *post-hoc* test (Tukey). Qualitative variables were presented as frequency and percentage (%) and were analyzed utilizing the Chi-square test. A two-tailed p-value < 0.05 was considered statistically significant.

Results

Thirty-six patients were assessed for eligibility; six patients did not meet the criteria, and three patients refused to participate in the study. The remaining 27 patients were randomly allocated into three equal groups (9 patients in each). All allocated patients were followed-up and analyzed statistically (Fig. 1).

Regarding MBL, no significant variance was observed among all groups up to 6 months, and then there was a significant variance among them up to 18 months. Mean marginal bone level exhibited a significant rise from baseline to 18 months for all groups (Tables 1 and 2 and Figs 2 and 3).

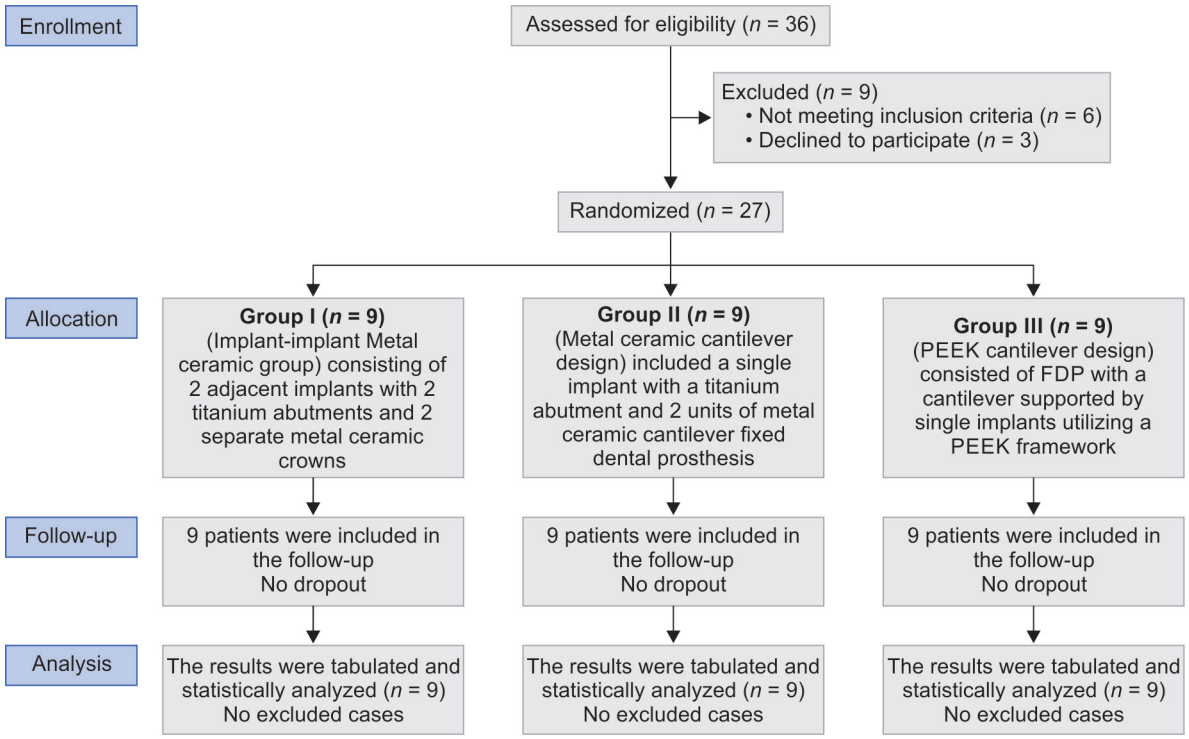


Fig. 1: CONSORT flowchart of the studied group

Table 1: Mean ± standard deviation of marginal bone loss for three groups through different intervals

Marginal bone level	*Group I (two implants) (n = 9)*	*Group II (cantilever PFM) (n = 9)*	*Group III (cantilever PEEK) (n = 9)*	*Test value*	*p-value*
Baseline	0.01 ± 0.13	0.02 ± 0.15	0.07 ± 0.10	1.088*	0.580
After 3 months	0.27 ± 0.23	0.45 ± 0.16	0.24 ± 0.17	4.729*	0.094
After 6 months	0.69 ± 0.10	0.64 ± 0.12	0.70 ± 0.07	1.331*	0.514
After 12 months	1.01 ± 0.13	1.19 ± 0.13	1.06 ± 0.15	3.678*	**0.040#**
After 18 months	1.14 ± 0.13	1.35 ± 0.21	1.26 ± 0.08	4.392*	**0.024#**

Data are presented as mean± standard deviation. *Kruskal–Wallis test. #Significant *p*-value < 0.05. PFM, porcelain fused to metal

Table 2: Comparison between the different time periods in each group according to marginal bone level

Marginal bone level	*Baseline*	*After 3 months*	*After 6 months*	*After 12 months*	*After 18 months*	*Test value*	*p-value*
Group I	0.01 ± 0.13	0.27 ± 0.23	0.69 ± 0.10	1.01 ± 0.13	1.14 ± 0.13	35.289	**0.000***
Group II	0.02 ± 0.15	0.45 ± 0.16	0.64 ± 0.12	1.19 ± 0.13	1.35 ± 0.21	35.685	**0.000***
Group III	0.07 ± 0.10	0.24 ± 0.17	0.70 ± 0.07	1.06 ± 0.15	1.26 ± 0.08	36.000	**0.000***

Data are presented as mean± standard deviation. *Significant *p*-value < 0.05. Group I: two implants, Group II: cantilever PFM, and group III: cantilever PEEK

Regarding implant stability, no significant variance was observed among all groups for 18 months (Tables 3 and 4 and Figs 4 and 5).

Regarding prosthetic complications, no veneer fracture was observed among the three studied groups. Only one case from second group (cantilever metal ceramic group) came with screw loosening.

The implants were placed by using a handpiece according to the manufacturer's instructions (maximum speed of 15 rpm and torque of up to 90 Ncm). The implants were placed with an insertion torque of at least 45 Ncm. The implant or plate form to be located at the bony level and reevaluated by periapical radiograph. After 4 to 6 months healing period, the patients were called back for the second stage surgery. Healing abutments were tightened for 15 days and evaluated radiographically. Three months later, another closed tray impression was done using polyvinyl siloxane impression material (two-phase one-step technique) through impression post and implant analog to transfer the hard and soft tissue relationship to the laboratory technician for fabrication of a definitive metal ceramic restoration. Then, final abutment was tightened using

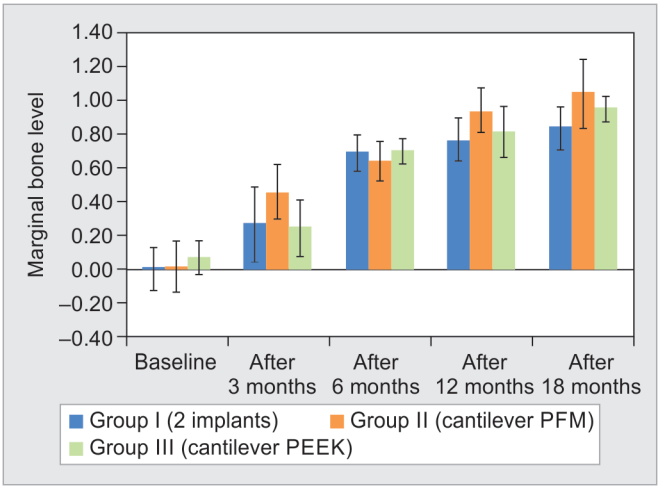


Fig. 2: Marginal bone level at different times among the three groups

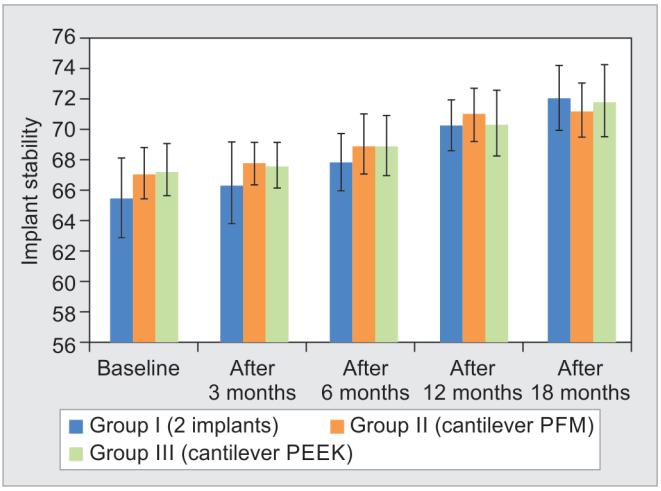


Fig. 4: Comparison among all groups based on ISQ

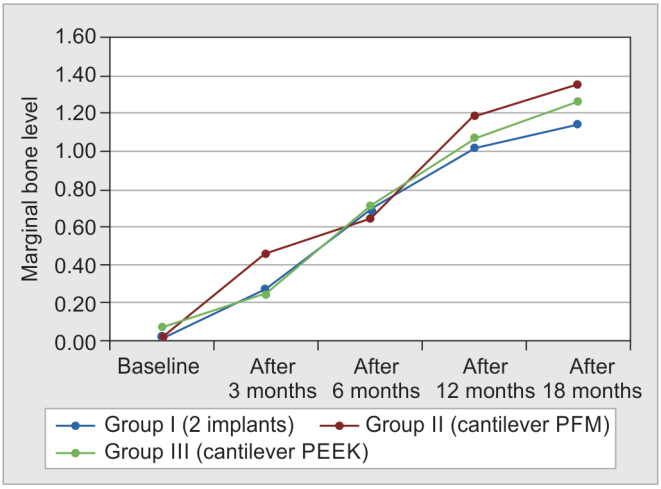


Fig. 3: Comparison among the different time periods in each group according to marginal bone level

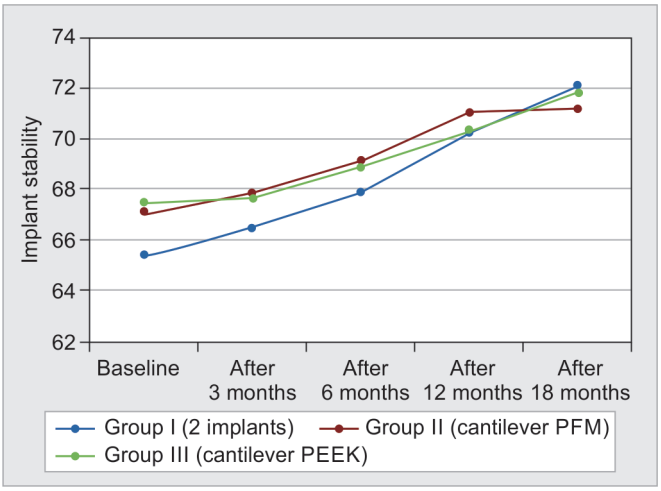


Fig. 5: Comparison among the different time periods in each group according to stability

Table 3: Descriptive statistics of implant stability quotient in each studied group

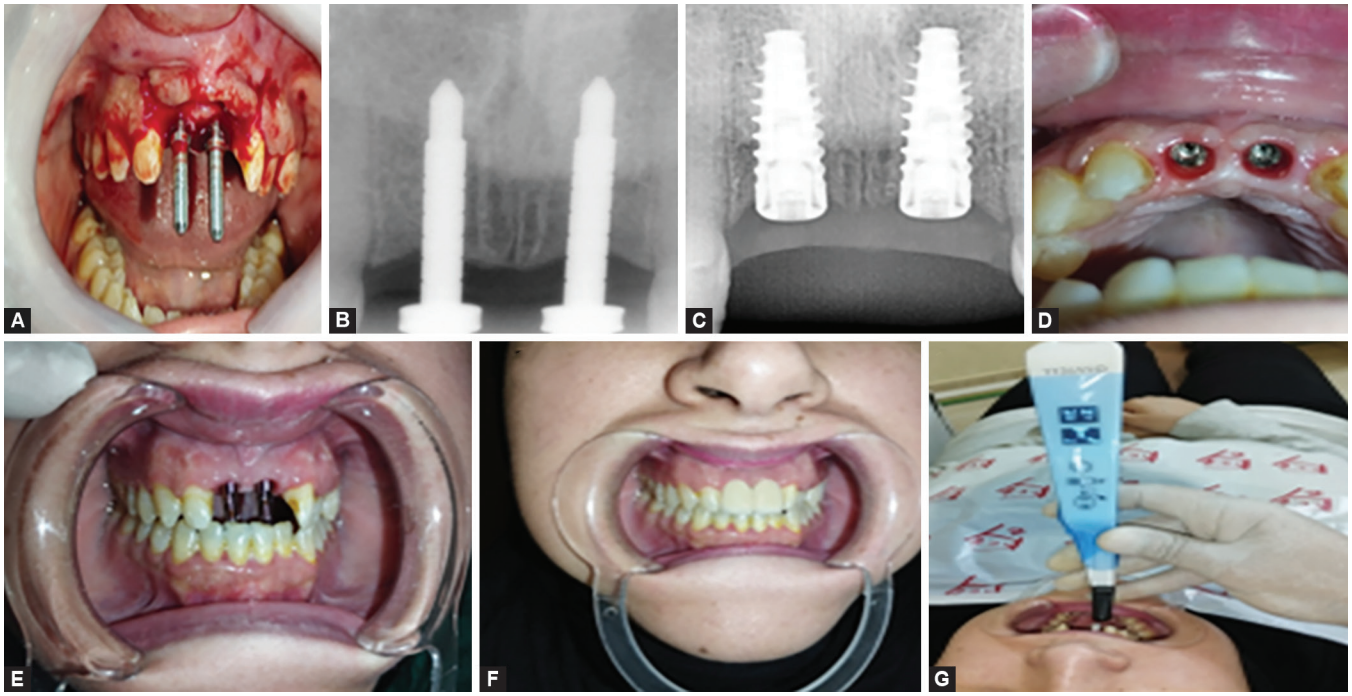
Implant stability	*Group I (two implants) (n = 9)*	*Group II (cantilever PFM) (n = 9)*	*Group III (cantilever PEEK) (n = 9)*	*Test value*	*p-value*
Baseline	65.44 ± 2.60	67.11 ± 1.69	67.33 ± 1.66	2.323*	0.120
After 3 months	66.44 ± 2.70	67.78 ± 1.39	67.67 ± 1.50	1.288*	0.294
After 6 months	67.89 ± 1.90	69.00 ± 1.94	68.89 ± 1.96	0.901*	0.419
After 12 months	70.22 ± 1.64	71.00 ± 1.73	70.33 ± 2.18	0.457*	0.638
After 18 months	72.00 ± 2.18	71.22 ± 1.79	71.78 ± 2.33	0.324*	0.727

Data are presented as mean± standard deviation. *One-way analysis of variance test. #Significant *p*-value < 0.05

Table 4: Comparison between the three studied groups according to stability

Implant stability	*Baseline*	*After 3 months*	*After 6 months*	*After 12 months*	*After 18 months*	*Test value*	*p-value*
Group I	65.44 ± 2.60	66.44 ± 2.70	67.89 ± 1.90	70.22 ± 1.64	72.00 ± 2.18	28.281*	**<0.001#**
Group II	67.11 ± 1.69	67.78 ± 1.39	69.00 ± 1.94	71.00 ± 1.73	71.22 ± 1.79	67.720*	**<0.001#**
Group III	67.33 ± 1.66	67.67 ± 1.50	68.89 ± 1.96	70.33 ± 2.18	71.78 ± 2.33	47.881*	**<0.001#**

Data are presented as mean± standard deviation. *Repeated measures analysis of variance test; group I: Two implants, group II: Cantilever PFM, and group III: Cantilever PEEK. #Significant *p*-value <0.05



Figs 6A to G: Two implants with two separate crowns design. (A) Evaluation of the osteotomy site clinically using parallel pins; (B) Evaluation of the osteotomy site radiographically with parallel pins; (C) Implants after placement of cover screw radiographically; (D) Soft tissue contour after removal of healing abutment; (E) Evaluation of the implant abutments clinically; (F) Clinical evaluation of the metal ceramic definitive restoration; and (G) Implant stability evaluation using Osstell

35 Ncm torques and checked the need for angled abutment or not in addition to evaluation of implant abutment connection clinically and radiographically. Ceramic try was done to evaluate the restoration before glazing. The final metal ceramic crowns were examined clinically and radiographically. Clinically by checking the seating of the crown, margin and occlusion, anatomical features, contours, and color matching. Radiographically by checking the marginal adaptation between abutment finish line and margin of the restoration (Fig. 6).

Another case of single implant supporting two units (cantilever design) as the case attended with missing upper right canine and adjacent lateral incisor and restored with single implant supporting two units of metal ceramic FDP over titanium abutment (Fig. 7).

Discussion

The presence of neighboring missing maxillary or mandibular anterior teeth remains challenging while placing implants. The diameters of the upper laterals along with all lower incisors are pretty small. When two implants are utilized to replace them, they are often placed very close to each other, thus potentially leading to bone loss as well as soft tissue recession that may not be ideal for the esthetic outcomes.[3]

Significant crestal bone loss was observed around implants close to the cantilever in comparison with other implants within 12 and 18 months follow-up. These findings fell within the normal and accepted clinical range. As regards the implant stability, no significant variance was documented among the studied groups.

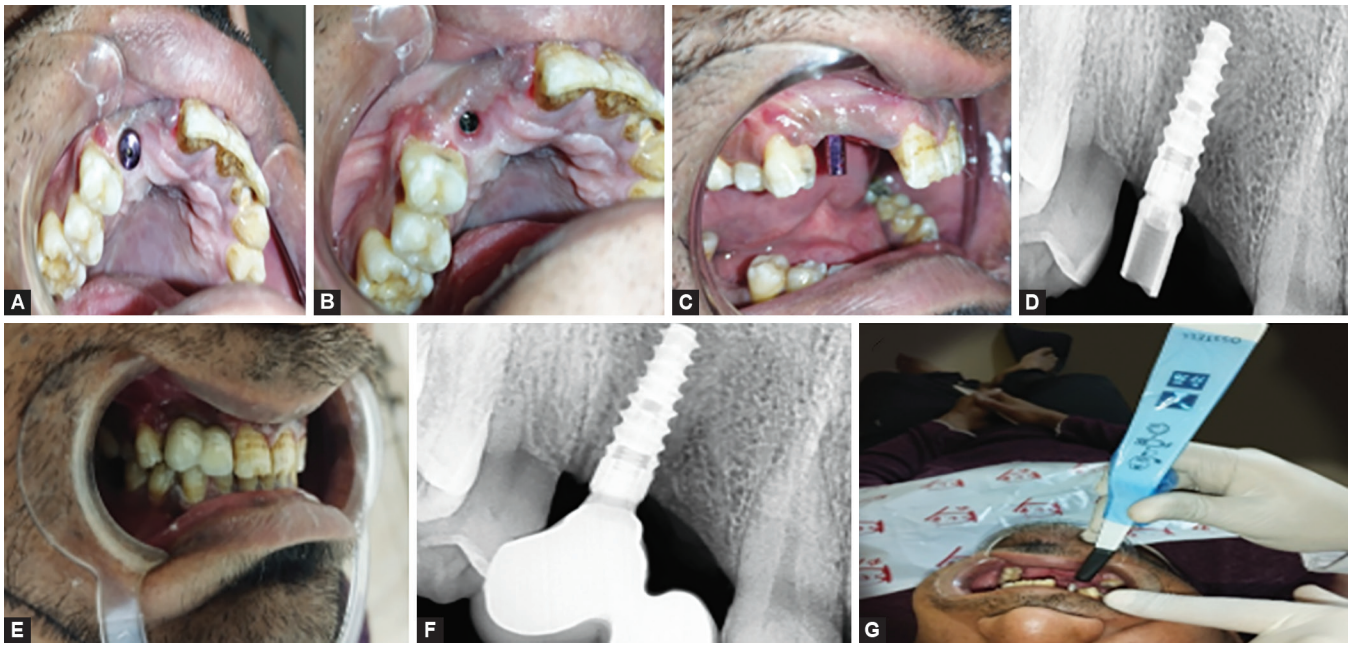
Marginal bone level is a key factor since bone remains crucial for a successful implant. Our research addressed that implant close to the cantilever exhibited a slight increase as regards the average MBL, indicating 1.35 ± 0.21 mm for PFM cantilever group, while 1.26 ± 0.08 for PEEK cantilever group after 1.5 years, which revealed a significant variance in comparison with the first group of two implants with separate crowns. Nevertheless, all bone loss measurements remained within the accepted clinical range.

Our research's findings supported several prior studies. Wennström et al.[22] along with Hälg et al.[23] addressed a reduced peri-implant bone loss for an implant cantilever FDP (ICFDP), which exhibited no significant variance in comparison with that around the implant within controls. The same findings were observed by Kim et al.,[24] revealing no significant variance as regards overall bone loss among ICFDPs and non-cantilevered FDPs supported by implants.

Romeo and Storelli found similar findings to ours. Following a mean period approaching 3 years of function, the peri-implant bone loss amount near the cantilever extension of FDPs showed significant variance in comparison with the peri-implant bone loss within FDPs without cantilevers.[25]

Roccuzzo et al.[5] revealed that the mean MBL remained stable (<1.5 mm) during the observation time in both the groups. These findings differ from those described by Van Nimwegen et al.,[6] who reported an increased "MBL at the distal side of the central implant (cantilever side) compared with the mesial side (noncantilever side) in the implant-cantilever group" at 5-year follow-up. This discrepancy could be caused by the different location of the cantilever (mesial vs distal) or explained by a wide range of follow-up times (7–64 months) in the present study. However, Wu et al.[26] reported a mean MBL of 1.35 mm at the 3-year follow-up, with no significant difference between the mesial and distal aspect, which is consistent with data from the present study.

The mean ISQ measurements for osseointegrated implants has fallen between 65.4 and 72. In our research, the Osstell results revealed that within 18-months period, the stability related to implant near the cantilever exhibited greatly reduced values in



Figs 7A to G: Cantilever design (A) Healing abutment in place; (B) Soft tissue contour after removal of healing abutment; (C) Evaluation of the implant abutment clinically and (D) Radiographically; (E) Evaluation of the metal ceramic definitive restoration clinically; and (F) Radiographically; and (G) Implant stability evaluation using Osstell

comparison with that of the other implants without cantilever, but without a significant variance. Though a significant variance was observed for the same implants as regards MBL after 12 months, it had no effect on implant stability. The findings of MBL as well as stability tests are not generally correlated with each other since other factors like the local bone quality and quantity often influence the implants' stability.[27]

Taha et al.[28] revealed that the average MBL for implants near the cantilever was significantly higher than that for the other implants in the two designs, with a value of 1.8 mm at the 2-year follow-up examination, which was also within the typical range of bone loss per year.

Utilizing cantilever implants within the anterior regions has many benefits. First, it helps in preventing inter-implant bone loss. Additionally, it allows for soft tissue grafting, which may result in a tissue height extending 6 mm beyond the crestal bone. This, in turn, enables the construction of an ovate pontic with full papillae.[29]

Over time, it has been evident that implants exhibit distinct behaviors and possess superior resistance to force compared with natural teeth. As stated by Schulte et al.,[30] the implant survival rates do not seem to be influenced by the concept of crown-to-root ratio. Another example is cantilevers; implants seem to have a higher tolerance for cantilevers.

Roccuzzo et al.[5] found that the implant survival rate was 100% for a two-unit cantilever FDP after a mean of 33 months of prosthetic loading, which is consistent with studies with a follow-up from 1 to 5 years. Jung et al.[31] reported in a systematic review with meta-analysis on 46 included studies 5-year results of single implants with single implant-supported crowns without a cantilever. They reported a 5-year implant survival of 97.2% and a 5-year crown survival of 96.3%. Jensen-Louwerse et al.[32] reported that the implant survival and restoration survival were both 100%.

Our findings align with the conclusions of prior research. In a pilot trial, Tymstra et al.[18] did not address significant variance among inserting one implant and two neighboring implants when it came to replacing lost maxillary central and lateral incisors. This finding was seen throughout a 10-year follow-up period.

A systematic review and research with a follow-up period lasting for 10 years by Meijer et al.[33] determined that using a restoration of two units supported by one implant may be a feasible option instead of placing two separate crowns supported by one implant in the esthetic zone.

There were no instances of veneers chipping, retention loss, screws' breakage, or implants' loss seen after 18 months. Out of the second group (specifically the cantilever metal ceramic group at the 3 months follow-up visit), just one case had screw loosening, which may be attributed to an insufficient screw torque or premature contact; however, when torqued again with correct torque and the occlusion was adjusted, no screw loosening was observed. Nevertheless, longer periods could influence the outcome. So, we cannot definitively confirm that ICFDP placement could show prolonged success when replacing anterior teeth.[34]

Palmer et al.[35] revealed that the incidence of abutment screw loosening in their study was higher than that experienced in single-tooth replacements.

The limitations of this study included that this research confined to missing anterior two adjacent teeth; however, there was no standardization regarding the specific implant site or diameter. Second, the low number of participants with some dropouts may have affected the results. Finally, follow-up times need to be more extended. Comparisons between the two treatment alternatives should be made with caution because of the randomized nature of the study.

Conclusion

Implant cantilever FDPs could be successful while replacing missing anterior teeth. The cantilever design had no negative influence on the clinical outcome. The cantilever FDP design

facilitated prosthesis fabrication among those having laterals of narrow diameters. Further research is required to investigate such a particular concern due to a limited sample size in our research.

Clinical Significance

Marginal bone (MB) was significant variance among them up to 18 months.

Mean MB level exhibited a significant rise from baseline to 18 months for all groups.

Regarding implant stability, no significant variance was observed among all groups for 18 months.

Data Materials and Code Availability

Data are available upon reasonable request from the corresponding author.

Ethical Approval

The research was carried out in the Department of Crown and Bridge, Faculty of Dental Medicine, Al-Azhar University, Egypt (Approval code: 599/1671).

Authors' Contribution

All authors contributed to the study conception and design. Material preparation, data collection, and analysis were performed by Mohamed R Hussain, Mohamed M Shrif, and Hesham I Othman. The first draft of the manuscript was written by Hussain R Mohamed, and all authors commented on previous versions of the manuscript. All authors read and approved the final manuscript.

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