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COMPARATIVE EVALUATION OF PASSIVE FIT FOR TWO MANDIBULAR FULL ARCH TITANIUM FRAMEWORKS

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ABSTRACT

INTRODUCTION: The demands for constructing a passively fitting immediate full arch screw retained restoration are rapidly increasing; intra-oral spot welding has been a well-documented idyllic modality for a long time. New variations were proposed to overcome welding limitations, one recent alternative is the introduction of Fast Bridge, Fast Pack system by iRES.

AIM OF THE STUDY: To evaluate the marginal vertical gap between abutment finish-lines and framework respective surfaces in the proposed study groups using optical microscope.

MATERIALS AND METHODS: This In-vitro study involved two symmetrical models with four implants installed in each numbered from #1 to #4 representing the two study groups, group A and B. With a total number of 16 samples, eight screw-retained frameworks were constructed on each model.

For Group A: Frameworks were constructed using the conventional intra-oral spot resistance welding technology, as For Group B: Screw-retained frameworks were constructed using the iRES bars.

Applying one screw test method, with the help of high accuracy industrial optical microscope, a passivity analysis was done, by measuring the marginal vertical gap for each implant at three different points (mesiobuccal, midbuccal and distobuccal).

RESULTS: When comparing the mean gap values of the two groups, the study has shown that group B obtained a statistically significant better marginal vertical gap values. ($p<0.001$).

CONCLUSION: Within the limitations of this study, it can be concluded that the new technique being evaluated in this study renders more passive frameworks. It displayed absolute fit results that were only theoretically desired. Elimination of tension at construction phase played a key role in the final framework fit.

KEYWORDS: Full arch, Titanium framework, Implant, Marginal fit, Vertical gap, Optical microscope.

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INTRODUCTION

The eventual objective of recent dentistry is to restore patient's normal facial contour, biology, esthetics, speech, psychological health and most importantly, the function in a precise and fast way with the least possible complications for both dentist and patient. (1) Along the past years, up until this moment, concerns have been directed to obtain such objectives specially while treating completely edentulous patients, whom were the main targets for Dr. Branemark when he first introduced titanium implant fixtures to dental field.

Hence, an implant supported, immediately functioning restoration for edentulous arch is considered an ideal treatment modality A key factor to guarantee success for such treatment modality is to have a rigidly splinted and passively fitting prosthesis, with respect to all biological and bio-mechanical limitations. Passive fit, (also known as ideal fit) is assumed to be one of the most evident prerequisites for the maintenance of the ideal bone-implant interface. Although it was concluded that absolute passivity cannot be obtained, it was reported by Taylor et al.(2) that, to cater passivity or a strain-free restoration, a framework should, in the absence of any external load, have independent zero strain on the supporting implant elements and the surrounding bone. In particular, for screw retained prosthesis, Carr et al.(3) confirmed that if excessive marginal gaps are present, higher pre-loads are then brought to the abutments and prosthetic fixation screws causing loosening or fracture, a common complication in screw-retained implant restorations, resulting in mechanical complications such as, cracking or fracture of the fixture components and screw loosening or biological complications as, bone resorption, soft tissue changes and even the loss of osseo-integration in form of fibrous integration due to existence of macro-motion exceeding the forgiving and favorable threshold of micro-motion as reported by Goodacre at al, Romero et al. and Gratton et al (4-6).

Keith et al. and Guichet et al. (7,8) followed by, Takahashi and Gunne, Yoko et al. and Karl et al. (9-11) illustrated that, the fit of one-piece conventional cast metal frameworks is questionable. The conventional cast lost-wax technique, widely used to construct prosthetic superstructures on implant, frequently results in porosity, deformation, warpage and most importantly, loss of passivity. This can be reasoned out to the numerous sensitive technical steps by both dentist and technician, and the integral properties of the materials as reported by Sahin and Cehreli (12). Spotting of marginal gaps was previously detected by Goll (13) with the help of an explorer, enhanced lighting and magnification besides some qualitative methods as the existence of pain or tension as informed by the patient. Many assured that the presence of noticeable gap is an absolute indication that sectioning and re-soldering or welding of the restoration framework is inevitable Hellden and Derand (14). Subsequently, Interest in a chair-side, accurate and easily handled alternatives, as in intra-oral spot welding protocol, ball welding bars (BWB)(15), Computer Aided Design (CAD)/ Computer Aided Manufacturer (CAM) technology and rapid prototyping (RP) applications for construction of frameworks is dramatically growing.

It started as early as in 1982, when P. L. Mondani and P. M. Mondani, presented the equipment and techniques necessary for intra-oral welding, a procedure used to acquire an immediate fixed prosthesis without the need for compound laboratory procedures (16). It was basically based on passing an electric current between two electrodes under an argon gas flux (16). Degidi et al. After 20 years, used same technique to immediately load multiple implants using a preformed bar that was welded intra-orally to special abutment cylinders, getting advanced success rates, it was also supported by finite element analysis tests (18,19). Several variations and alternatives to the welding classical technique were proposed in recent literature (22-25). As mentioned before, rapid prototyping is representing a competitive treatment modality for framework construction. Rapid prototyping is based on layer by layer additive technique where 3D CAD models are transformed into physical parts; the fabrication of metal dental prostheses by rapid prototyping is now one of its crucial applications. For its high accuracy, low cost and short production time. Titanium is fortunately considered to be one of the most suitable materials in this promising field of manufacturing. (26,27,28)

In our present work, we are presenting and evaluating new alternative to manufacture screw-retained immediate framework for edentulous mandibles. This innovative type of prosthetic rehabilitation, which the manufacturers refer to as the “Fast Bridge, Fast Pack” technique, is characterized by prosthetic cylinders, interrelated by means of titanium bars (grade IV) which have ball terminals and are inserted in the rotating rings part of the cylinders. After the assembly installation, connections are stabilized by metal cement. All the components are self-posing and do not cause arcing or tension and it doesn't need a welding machine.

Hence, the aim of this study is to evaluate and compare the passive fit of frameworks constructed by this technique and the conventional intra-oral welding, by measuring the vertical marginal gaps existing between abutment shoulder and the framework respective surface using a high accuracy industrial optical scanning microscope. The null hypothesis of the study; there will be no significant difference in gap values between both groups.

MATERIALS AND METHODS

This study is parallel, experimental in vitro study, in which two groups of different types of titanium frameworks were evaluated. A high accuracy industrial optical microscope was used to capture all connection geometry and the measurements of the marginal gap existing in each group. Two test groups were presented, group A; representing the intra-oral spot resistance welded frameworks and group B; representing the new iRES fast bridge fast pack system. Eight framework samples were required for each group to estimate average difference of misfit measurements.

METHODS

1. Preparation of the model and restoration:

In this study a completely edentulous mandibular 3D printed model was used as the master cast produced by iRES® company with soft pink base plate wax resembling the gingival space.

1.1.Radiographic preparation:

A trial teeth denture base was constructed on the model, to produce the scanning appliance, 5 gutta-percha rounded points were added to act as reference points during superimposition of the scans.

Performing double scanning method, Radiographic imaging for both the model and the trial denture base together and the denture base on its own.

1.2. Surgical guide preparation:
To ensure standardization, surgical guide was constructed to place the implants in both models.
Designing the surgical guide was performed using In2Guide™ system (Cybermed Inc., CA, USA) powered by OnDemand3D™ (Cybermed Inc., CA, USA). Data of the model anatomical structure was gathered from the CBCT (Vatech green CT, USA) and saved as a Digital imaging and communications in medicine (DICOM) file. Those were imported into three-dimensional (3D) reconstruction software, where the surgical and prosthetic planning was performed, The DICOM file was opened using OnDemand3D and the surgical guide was designed using specialized software (In2Guide™). The diameter, length, and position of implants was planned following all-on-four concept rules, two implants were planned in the first molar areas, distally inclined, and two axials parallel in the canine area. All implant abutments were emerging from the model crest at the same level and parallel to each other's. Prosthetically driven implant positioning was ensured by transferring the DICOM files to (Exocad GmbH, Germany) software where denture scans were superimposed to radiographic scans.

The final product was designed then transferred to the 3D printer machine (EnvisionTEC DDP, EnvisionTEC GmbH, Germany). Eshell 300 liquid photo-reactive acrylic resin (EnvisionTEC GmbH, Germany) was used to construct the surgical guide. The resin was applied in layers of 0.25-0.1 microns and was dried consecutively

1.3. Implant placement:
Full Seating of surgical guide was checked on both models, Implant sites were prepared, and implants placed with a fully guided protocol using the tissue level iMAXMUA (NHSM 0°, 30°) one-piece implant fully guided manufacturer kit.
The implant used in this study is a one-piece implant with a multi-unit abutment that can be provided in a straight or angled (30 degrees) form. (Figure 1)

1.4. Abutments preparation:
Marking all the abutments at three different sites (mesio-buccal, mid-buccal, and disto-buccal) was done. Those marks acted as reference points at which microscopic measurements were recorded.

2. Samples preparation:

2.1. Group A: In the case of intra-oral welded bar,
Special weldable cylinders, supplied by the manufacturer were screwed to the multi-unit abutments using prosthetic screw, a prefabricated grade II titanium bar (2 mm in thickness), supplied by the manufacturer was prepared and suitably bent following arch curvature, leaving an adequate crestal space and connecting all abutments together, extending to the cantilever area. Also, it had to be touching all abutment cylinders at the same time without exerting any external pressure.
Special pincers were used to pass an electrical current between them for fraction of seconds, while touching the bar and abutment to form welding spot. Starting always with one of the distal end abutments to allow bending the wire properly and to dissipate the formed tension. The whole framework was constructed in the same manner. (Figure 2 (a,b))

This was repeated for all the 8 samples. Regarding time needed for construction, and for each framework it was different as a new bending for the titanium bar was required. Although it was done by a trained clinician and on the model not intra-orally, it still required a quite long time to finish all the required frameworks. It ranged between 20 to 30 minutes for each framework. Sometimes, more than one welding spot was needed to optimally weld the bar. Care was taken to keep the bar stabilized along the whole procedure without any changes in original position and without exerting any external pressure to connect the bar to the abutments.

2.2. Group B: In case of the iRES Fast Bridge, Fast Pack framework system,
The vertical cylinders were screwed to the abutments. Then the support horizontal elements were fixed at suitable heights. These elements have rounded openings at both ends to receive the ball part from the adjacent bar elements. Which can be adjusted to different lengths by adjusting the rod inside the bar pieces or by choosing another piece size to accommodate the spaces between the implants. (Figure 2 (c,d))

Metal cement was used to hold the adapted pieces together after the whole assembly was constructed, for each ball and socket connection, PANAVIA™ F 2.0 dual-cure resin cement was applied and light-cured. A coat of metal primer was applied first and then a drop of the cement mix was added using a bonding brush. The utilization of luting adhesives has been applied for 25 years as bonding metal to metal offers a reliable long-term connection. Previous tests with load application of 500-N showed no failures. (39)

Again, this was repeated for the 8 samples of this group similarly. These frameworks exhibited less construction time and was easier to deliver. As the distances between implants were fixed for all the frameworks, almost less than five minutes were needed to complete the full construction of the framework.

3. Measurements step:
Each sample was fixed on the model using only one screw, always tightening the right posterior implant screw #1. A high accuracy optical microscope Mahr Marvision MM 320 from Mahr Inc. was used in this study. This optical microscope is a two-dimensional evaluation tool that uses a series of glass lenses to produce clear magnification, it is widely used for surface quantitative mensuration (28,29). In

addition to that, it is a cheaper technology compared to the other methods which does not require a special education to use it and easily handled. It can provide fine measurement information up to 0.0001 mm in x, y and z axis. (29,30). Stabilization of the models was done in the same way for both models and for each sample, making the recording points centralized and perpendicular to the central beam of the microscope. All abutments were inspected for any marginal gap and distance between the abutment shoulder and framework cylinders was measured for each implant, starting from the right posterior to the left posterior implant. Measurements were collected at the three mentioned recording points, for each point two readings were taken, and the average value was calculated. Digital photographs for all the marginal configurations were captured by microscope macro lens and saved by the M3-software. (Figure 3 (a-f))

Statistical and data analysis:

In this In vitro study, the sample size calculation was carried out by a “power and sample size” program (G*Power program 3.0.1). Based on Rosner’s method, this number was estimated by Sample size calculation done in Public Health department, Faculty of Dentistry, Alexandria University.

For the study results, data were fed to the computer and analyzed using IBM SPSS software with a package version 20.0. (Armonk, NY: IBM Corp). The Kolmogorov-Smirnov was used to confirm the distribution normality of variables. Quantitative data were represented using range (minimum and maximum), mean, standard deviation and median. Significance of the obtained results was measured at $p<0.05$ or $p<0.001$.

Mann Whitney test was used to compare between two groups for not normally distributed quantitative results. Significance of the presented results was judged at the 5% level.

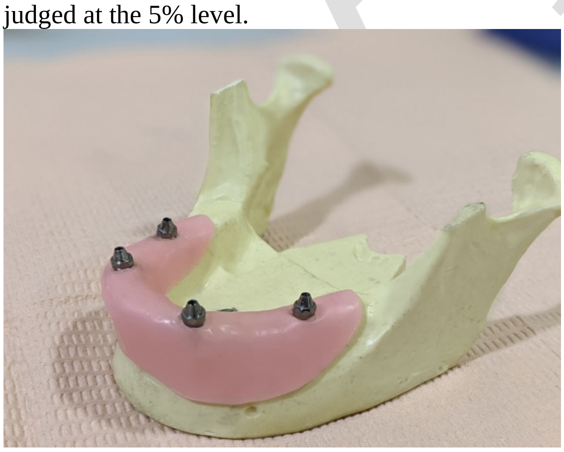

Figure 1: Four one-piece implants with multi-unit abutment after placement in the model using surgical guide.

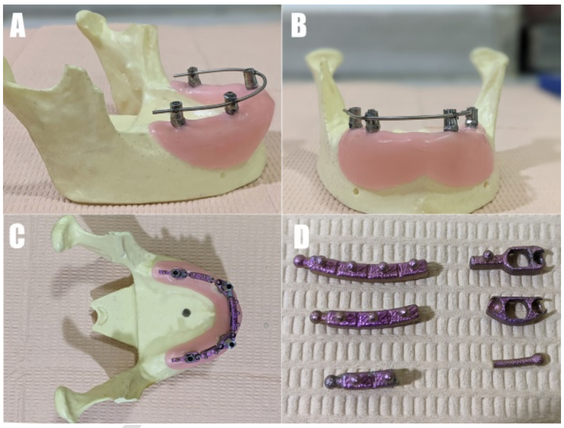

Figure 2: Showing used frameworks in the study **(a-b)** Side and front view for intra-oral spot welded framework. **(c)** IRES Fast Bridge, Fast Pack framework installed. **(d)** IRES Fast Bridge, Fast Pack used pieces before installment.

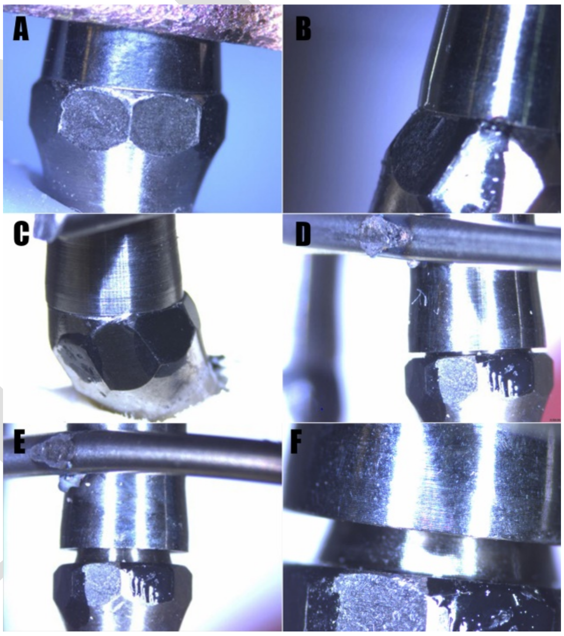

Figure 3: Showing captured views for the marginal gaps geometry under optical microscope. **(a-b)** Relation between for iRES Fast Bridge, Fast Pack framework cylinders and respective abutment finishline showing absence of marginal gaps and absolute fit. **(d)** Relation between spot welded framework cylinder and respective abutment finish line in a tightened implant showing absence of marginal gaps and perfect fit. **(d-e-f)** Relation between spot welded framework cylinder and respective abutment finish line in non-tightened implants showing variable degrees of marginal gaps indicating misfit.

RESULTS

The average marginal vertical gap value for both studied groups was calculated for each implant at the three marked positions, the smallest marginal gaps were observed always at the tightened right posterior implant. With a range of (0.001 – 0.0105) for group A, and (0.0007 – 0.0017) for group B. (Figure 3(a-c))

On the contrary, the largest marginal gaps were observed at the posterior left implant for group A, with a range of (0.1035 – 0.9277) and (0.0005 – 0.0015) for group B.

A wide range of gaps values was noticed at group A at non tightened implants #2, #3 and #4 when compared to the tightened implant results, on the other hand for group B, values were almost the same for all implants. (Figure 3 (d-f))

Statistically significant difference was found when comparing the results for each implant, and between the two groups when all implants were combined, with a P value less than ≤ 0.001. (Table 1)

Table 1: Comparison between the studied frameworks regarding the vertical marginal gaps for all implants. (n=16).

			Welded (n = 8)	iRES (n = 8)	p
Left Posterior	DB	Mean ± SD.	0.2528 ± 0.3067	0.0013 ± 0.0006	<0.001*
		Median (Min. – Max.)	0.1483 (0.019 – 0.973)	0.0013 (0.0005 – 0.002)	
	M	Mean ± SD.	0.2604 ± 0.2986	0.0011 ± 0.004	<0.001*
		Median (Min. – Max.)	0.1418 (0.0645 – 0.949)	0.0013(0.0005 – 0.0015)	
	MB	Mean ± SD.	0.2567 ± 0.2679	0.0010 ± 0.0005	<0.001*
		Median (Min. – Max.)	0.150 (0.0395 – 0.8610)	0.001 (0.0005 – 0.0015)	
	Average	Mean ± SD.	0.2566 ± 0.2866	0.0011 ± 0.0003	<0.001*
		Median (Min. – Max.)	0.1292(0.1035 – 0.9277)	0.0012(0.0005 – 0.0015)	
Right Posterior	DB	Mean ± SD.	0.0021 ± 0.0017	0.0011 ± 0.0006	0.382
		Median (Min. – Max.)	0.0018 (0.0005 – 0.005)	0.001 (0.0005 – 0.002)	
	M	Mean ± SD.	0.0015 ± 0.0011	0.0014 ± 0.0006	0.721
		Median (Min. – Max.)	0.0013 (0.0005 – 0.004)	0.0015(0.0005 – 0.0025)	
	MB	Mean ± SD.	0.0048 ± 0.0102	0.0009 ± 0.0006	0.234
		Median (Min. – Max.)	0.0015 (0 – 0.030)	0.0005 (0.0005 – 0.002)	
	Average	Mean ± SD.	0.0028 ± 0.0032	0.0011 ± 0.0004	0.038*
		Median (Min. – Max.)	0.0018 (0.001 – 0.0105)	0.0011(0.0007 – 0.0017)	
Left Anterior	DB	Mean ± SD.	0.3007 ± 0.2115	0.0011 ± 0.0007	<0.001*
		Median (Min. – Max.)	0.2363 (0.0495 – 0.591)	0.0008 (0.0005 – 0.002)	
	M	Mean ± SD.	0.2898 ± 0.1895	0.0015 ± 0.0007	<0.001*
		Median (Min. – Max.)	0.2580 (0.025 – 0.552)	0.0015(0.0005 – 0.0025)	
	MB	Mean ± SD.	0.2431 ± 0.183	0.0019 ± 0.0006	<0.001*
		Median (Min. – Max.)	0.2425(0.0265 – 0.5095)	0.0018 (0.001 – 0.0025)	
	Average	Mean ± SD.	0.2779 ± 0.1871	0.0015 ± 0.0005	<0.001*
		Median (Min. – Max.)	0.2542 (0.0387 – 0.539)	0.0016(0.0007 – 0.0022)	
Right Anterior	DB	Mean ± SD.	0.0603 ± 0.0555	0.0011 ± 0.0007	<0.001*
		Median (Min. – Max.)	0.0525(0.0105 – 0.1890)	0.0013 (0 – 0.0020)	
	M	Mean ± SD.	0.0502 ± 0.0505	0.0017 ± 0.0007	0.005*
		Median (Min. – Max.)	0.0435(0.0010 – 0.1595)	0.0018(0.0005 – 0.0025)	
	MB	Mean ± SD.	0.0545 ± 0.0553	0.0009 ± 0.0005	<0.001*
		Median (Min. – Max.)	0.0373(0.0120 – 0.1705)	0.0008(0.0005 – 0.0015)	
	Average	Mean ± SD.	0.0550 ± 0.0516	0.0012 ± 0.0005	<0.001*
		Median (Min. – Max.)	0.0367(0.0087 – 0.1730)	0.0011(0.0008 – 0.0018)	
Total average		Mean ±	0.14808 ± 0.11779	0.00125 ± 0.00025	<0.001*
		dian n. – k.)	0.10520 (0.04746 – 0.38229)	0.00125 (0.00080 – 0.00154)	

U: Mann Whitney test
SD: Standard deviation
p: p value for comparing between the two studied groups
*: Statistically significant at p ≤ 0.05

DISCUSSION

In recent years, several clinical studies have reported excellent results acquired using intra-oral spot resistant welding techniques for the rehabilitation of completely edentulous mandibles with immediately functioning screw-retained full arch prostheses and Toronto bridges (17-21). Confirming the belief that intraoral welding can be successfully used for the rehabilitation of edentulous patients.

One of the unmistakable rewards of the intra-oral welding technique is, as previously mentioned in the introduction the ability to serve a restoration in a very short period of time and with very limited costs for edentulous patients, without having to go through lengthy and complex surgical, prosthetic and laboratory phases (17-21,29). Lately, some potential alternatives to the traditional technique originally proposed by P. L. Mondani and P. M. Mondani (16) and subsequently thrived by Degidi et al. (18,20,21,26) have been propose Using a "guided-welded approach," Albiero and Benato clarified that they were able to acquire a very precise passive fit of full-arch prosthesis supported by 4 implants and loaded immediately. That passive fit helped implant healing and the use of guided surgery had the benefit of reducing the surgery time and the time needed for adaptation and bending of the titanium wire to the abutments after implant placement (23). Another variant presented by Fornaini et al. (22,24,25), where he used laser technology for bar welding to 4 implants placed in a completely edentulous arch. They favored laser for having extra advantages of being used with all metals, without filler metal nor a shielding gas and the extremely small beam dimensions that is well focused (0.6 mm), causing no adverse effect (as overheating) on the surrounding tissue (22,24,25). In addition, lasers can be used on all patients (even on patients with pacemakers) (22,24,25), which on the contrary, considered the main limitations regarding intra-oral spot resistance welding technique.

Furthermore, the ball welded bar (BWB) was introduced by 2017, representing a more recent and simple treatment variant of intra-oral welding. It allowed rapid fabrication of framework by welding small pieces together causing neither tension nor distortion. (15) This technique achieved high success rates, supporting the previous results of Degidi's work and it subsequently proved accountability of this technique. (19-21)

In our present in-vitro research, we introduced a newborn possible modality for immediate full-arch frameworks construction; the so-called "Fast Bridge Fast Pack" bar system presented by iRES Company, the original assemblage was designed and patented by the manufacturers. The procedure for full framework construction is fast, and can be managed by a single operator, without the need for additional machines or appliances and therefor offering a diminished rehabilitation time and overall costs.

The mechanical properties of this new bar (constructed using pure Titanium grade IV) and produced by rapid prototyping fine technology, delivered a precise well-fitting pieces that allowed for the rapid fabrication of the framework without any applied tension nor distortion to the original assembly after finalizing the construction procedure, resulting in a superior fitting characteristics of the final restoration. Although the original design is patented by the manufacturers and this is considered the first research utilizing and evaluating this framework, it's a known fact that the medical grade IV titanium is the strongest among the four commercially pure titanium grades. For its great strength, durability, corrosion resistance and cold formability, it has been utilized in most of the medical and surgical hardware industrial processes.(40) This means that there will be excellent biological and bio-mechanical tissue tolerance whenever using any of the loading protocols (including immediate functional loading).

In this present study, two symmetrical 3D printed models, representing two study groups, with four implants placed and a total number of 16 study samples, with the posterior right implant prosthetic screw always being the only torqued screw throughout the test.

Utilizing the proper measurement method is mandatory to obtain reliable results. Although many methods are available to capture such measurements, the selection of an incompetent measurement technique may lead to biased results and inconclusive study (27). Among researches, Dentistry, and in particular Implant Dentistry requires micrometric examinations to provide trustworthy results. One of the most widely used approaches to obtain micrometric analysis is Optical Microscope (OM). The OM is considered the best methodology to measure the superficial marginal gaps as it can provide fine measurement information up to 0.0001 mm in x, y and z axis. (29,30)

When comparing marginal gaps values at the marked 12 points for the two study groups, results revealed the highest gap values in Group A, with a statistically significant difference in the marginal gap values between the two groups in the unfastened implants (#2, #3 and #4) (Table 1). When observing the marginal geometry, the weldable ready-made, originally having a perfect fit, showed variable ranges of marginal openings and loss of passive adaptation of the cylinders on the vertical plane mainly and sometimes on the horizontal plane as well (Figure 3 (d-f)). Hence, the null hypothesis was rejected.

It was obvious that, the welding process, even when optimum manufacturers' recommendations were followed, has exerted tension forces on the weldable abutment cylinders causing them to lose their perfect adaptation and fit while their screw is not tightened. The applied tension caused the welded cylinder to be pulled up

once the retaining screw was removed. To gain optimum fit again, all the screws needed to be fastened. This consequently induced some external pre-loads. It was reported in previous studies that, a marginal gap of 0.5 mm could be easily closed by just torqueing the retaining screw with a 10N force.
While for group B, the original perfect fit and adaptation between the abutments and cylinders respective surfaces was maintained as no modifications or changes were made to the original relation and the whole assembly was stabilized mechanically by means of adjustable rings and rotating spheres. (Figure 3(a-b))

For implant #1, the implant with fastened prosthetic screw, the difference between the groups was statistically non-significant. Both groups showed almost very similar results. (Table 1) This abutment framework connection geometry showed a constant degree of fit and adaptation in all samples on both vertical and horizontal levels.

One screw was tightened all through this study; The Sheffield test or the one-screw test, is an efficient way to evaluate framework fit. (31,32) When one screw on the most distal abutment is fastened without causing a gap between the other abutments and cylinders, the prosthetic framework is then thought to have a clinically approved fit.(33,34) This technique is useful for long-span frameworks, in which the vertical gap tends to be inflated at the far opposite abutment.

Although in the literature, quantitative values for the acceptable vertical misfit have been varied from 10 up to 150µm. Dr Branemark considered 10 µm is the maximum marginal opening between prosthesis and abutments (1). In 1992, Assif et al. have proposed that 26µm is an acceptable marginal opening. (36) According to (Jemt 1991; Yanase et al.1994, Klineberg and Murray 1985) from 40µm to 150µm was acceptable range (35,36). Regardless of this wide range, All claimed that absolute passive fit can't be achieved, and although no study could directly relate misfit of prosthesis to a specific failure, there is a strong agreement that an extra torque would be applied to seat a non-passively fitting framework, while it might appear to be fully seated with no marginal gaps after all screws tightening, that applied external pre-load will inevitably affect the stresses transmitted to the prosthetic screw causing some technical complications as unwinding or fracture, and in some cases this can unfavorably affect peri-implant tissue health either by bone or osseo-integration loss. Some, on the other hand, in other animal studies have shown that prostheses with misfit did not lead to biologic failure but may instead promote bone remodeling (Duyck et al. 2005; Jemt et al. 2000)(37). In another clinical study on prostheses with different levels of misfit, no differences in marginal bone loss were reported (Jemt and Book 1996) (38). Regarding our present study, it was observed that, the well documented welding technique in group A, showed variable ranges of marginal gaps, most of them were within the documented accepted range and some exceeded that range. In group B, the marginal gaps were equal or even less than the least documented value.
Therefore, the used technique in this study can help in providing desired absolute passive fit of chair-side titanium frameworks for full arch implant restoration.
Our present study has limitations, for example, the limited number of samples and the evaluation parameters; therefore further studies on a larger number of samples are needed to confirm the positive clinical outcomes reported here before more specific conclusions can be drawn about the full reliability of this new and innovative technique. Bio-mechanical evaluation of this framework is required.

CONCLUSION

The iRES Fast Bridge, Fast Pack system displayed successful outcomes in terms of passive fit and marginal adaptation, it was found to have exciting and competitive passivity results and was smoother to construct when compared to the well documented electrical resistance spot welding technique offering a precise, easily adjustable, fast and low cost treatment modality for same day construction of reinforced full arch hybrid implant restorations.
Yet, this is a new technique that needs further studies regarding the bio-mechanical behavior specially after functional load.

CONFLICT OF INTEREST

The authors declare that they have no conflicts of interest.

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