Original Article

Clinical Assessment Of Inlay Retained Bridge Designs (Tub Shaped And Inlay Shaped) In Missing Posterior Teeth Cases. (Randomized Controlled Trial)

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Abstract

Objective: The aim of this study was to compare two inlay retained bridge designs (tub shaped and inlay shaped) used to replace missing posterior tooth cases regarding fracture resistance, bone loss, and retention.

Materials and Methods: thirty inlay retained bridge were done for restoring missing posterior tooth. Scalling and polishing were done for all patients two weeks before preparation. The patients were classified into two groups according to the preparation designs. Group 1: (tub shaped design) and Group 2: (inlay shaped design). PMMA resin was used for try in stage, and monolithic zirconia (Katana, Kurary) was used for the final restorations. The try in, temporary restoration and the final restorations were done using CAD/CAM (DWX-50) machine with software (Exocad). The restoration surfaces were treated using sandblasting and Z-prime S (Bisco) and the cementation was done by using self-adhesive resin cement (Bisco). Frature resistance and retention were evaluated immediately after cementation using the Modified United States Public Health Service for restoration clinical assessments (MUSPHS standards). These measurements were repeated after one, three, six, nine, and twelve months respectively. Bone loss was also assessed by using x-ray.

Results: It was found that there was no significant difference between the two studied groups regarding different studied variables.

Conclusion: Within limitations of this study, the following conclusion could be drawn as follows: Up to one year clinical observation period, inlay retained fixed dental prostheses made from monolithic zirconia with two designs (inlay shaped and tub-shaped) revealed successful clinical performance in terms of fracture resistance, retention and bone loss.

Keywords: Inlay bridge, Missing posterior teeth ,Fracture resistance, retention .

Introduction:

It is advisable for missing posterior tooth to be replaced by the most conservative way instead of the full coverage fixed partial denture which need aggressive amount of tooth reduction. **(Karaarslan et al., 2011)**

If patient rejects an implant treatment and enough sound tooth structure is available, it would be desirable to restore a missing tooth with inlay-retained fixed partial denture instead of full coverage retained one. **(Ohlmann et al., 2008)**

Because of the recent technology of adhesion and cementation, Inlay fixed partial dentures luted using the adhesive procedures offer a clinical alternative for the restoration of single missing posterior tooth. **(Iglesia et al., 2003)**

The continuous improvement of adhesive systems and luting agents make this type of restorations possible, offering good aesthetic and functional results.

The procedure is minimally invasive and conservative, when compared to the reduction needed for the full coverage fixed partial denture.

The use of all-ceramic materials for inlays and onlays in restorative dentistry is becoming more popular. The proper selection of restorative materials, careful preparation designs and adequate adhesion between tooth/restorative material interfaces considered important factor to prevent failures. **(Hopp and Land, 2013)**

Zirconia was introduced in dentistry since 1990s.The high initial strength and fracture toughness of zirconia results from a physical property of partially stabilized zirconia known as transformation toughening. On the other hand, its white color, similar to the color of natural teeth and its ability to transmit light makes it useful in aesthetically important areas. **(Vagkopoulou et al., 2009)**

Inlay retained bridges compresses different designs such as tub shaped, conventional inlay shaped, and box shaped. These designs should be evaluated clinically to prove that the inlay retained bridges were a proper substitute for the full coverage fixed partial denture**. Consequently** this study was aimed to evaluate the clinical assessment of inlay retained bridged designs (tub shaped and inlay shaped) in restoring missing posterior tooth. **(Kilicarslan et al., 2004)**

Materials and methods:

1. Materials:

Materials used in this study (table 1) and its physical and mechanical properties (table 2).

Table (1): Materials used in this study

Material	Composition and Description	Manufacturer
zirconia (Katana) **Fig. (1)**	**Zirconia oxide** **Yttrium oxide** **Pigments**	**Kuraray Noritake Dental Inc.** **Japan**
PMMA resin disc **Fig. (2)**	**Poly methylmethacrylate resin** **Carbon black** **Ferric Oxide** **Titanium dioxide**	**Yamahachi dental Co.** **Japan**
Theracem resin cement **Fig. (3)**	**Base : Portland cement 20-50%,** **yetterbium,barium 30-50%** **proprietary 1-10%,** **yetterbium fluoride 1-5%** **and BISGMA1-5 %** **Catalyst:MDP10 30%,** **hydroxyethylemethacrylate1-5% and** **Tert-butyl perbenzoate1-5%.**	**Bisco, Inc.** **Schaumburg,Chicago,USA**

Zirclean **Fig. (4)**	**Potassium hydroxide <10 %**	**Bisco, Inc.** **Schaumburg, Chicago,** **USA**
Z-prime plus **Fig. (5)**	**Ethanol 75-85%** **BisphenolA Diglycidylmethacrylate 5-10%** **2- Hydroxyethyl Methacrylate 5-10%** **Proprietary 1-5%** **MDP 1-5%**	**Bisco, Inc.** **Schaumburg, Chicago,** **USA**
All bond universal **Fig. (6)**	**Bisphenol A Diglycidylmethacrylate** **Ethanol** **2-Hydroxyethyl Methacrylate**	**Bisco, Inc.** **Schaumburg, Chicago,** **USA**
Phosphoric acid gel **(Fine etch)** **Fig. (7)**	**Phosphoric acid,H_2O,xanthan gum**	**Spident** **Incheon, South Korea**
Intensiv Unigloss paste **Fig. (8)**	**ultrafine granulated diamonds**	**Swiss dental products** **Switzerland**

Fig. (1): Katana zirconia disc

Fig. (2): PMMA resin disc

Fig. (3): Theracem self-adhesive resin cement

Fig. (4): Zirclean

Fig.(5): Z-prime plus

Fig. (6): Bonding agent (All bond universal)

Fig. (7): acid etch 37% phosphoric acid gel

Table (2): The physical and mechanical properties of the materials used

Material	Property	Model
Monolithic zirconia disc (Katana)	Fracture toughness (K_{IC})	>5Mpa. $m^{1/2}$
	Thermal expansion coefficient	10.4 x 10^{-6} K^{-1}
	Flexure strength	1125Mpa
	Transmittance rate	31%
PMMA resin disk	Fracture toughness (K_{IC})	3.8 Mpa. $m^{1/2}$
Self-adhesive resin cement (Theracem)	Physical state	Solid
	Appearance	Viscous resin paste
	Color	White opaque
	Odor	Acrylic
Restoration cleaner (Zirclean)	Physical state	Liquid
	Appearance	Gel
	Color	Deep blue
	Odor	odorless

MDP containing primer (Z-primer plus)	Physical state	Liquid
	Appearance	clear liquid
	Color	Pale yellow
	Odor	Ethanol odor
All-Bond Universal	Physical state	Liquid
	Appearance	Clear liquid
	Color	Pale yellow
	Odor	Ethanol odor
Fine etch 37 % phosphoric acid	Appearance paste	Gel
	Color	Blue
	Solubility	Partially soluble
Intensiv Unigloss paste	Appearance	Paste
	Color	Blue
	Odor and taste	No odor and no taste

Statistical methods

2.1. Diagnostic phase:

2.1.1. Intra-oral examination:

- Dental examination.
- periodontal evaluation.
- The symmetry of the gingival level.
- oral hygiene.
- dental caries.
- parafunction habits.

2.1.2. Extraoral examination:

Anextraoral examination was carried out to identify any potential pathology or dysfunction of the TMJ or cervical adenopathy to ensure that no pathology was present.

2.1.3. Photographs:

Pre-operative photographs for each patient were taken using Canon 650D DSLR camera.[(1)]

Extra-oral view:

Fig. (8): Right side view

Fig. (9): Frontal view

Fig.(10):Left side view

Intraoral view:-

Fig. (11): Retracted view with maximum intercuspation

Fig. (12): upper arch (occlusal view)

Fig. (13): lower opposing arch (occlusal view)

Fig. (14): Right lateral view (maximum intercuspation

Fig. (15): Left lateral view (maximum intercuspation)

Results;

This study was performed in Fixed Prosthodontics Department clinics of Faculty of Dentistry, Cairo University, Cairo, Egypt. A total of 30 inlay retained monolithic restorations were included in the study and completed by one operator.

Patients were allocated into 2 groups with ratio 1:1.

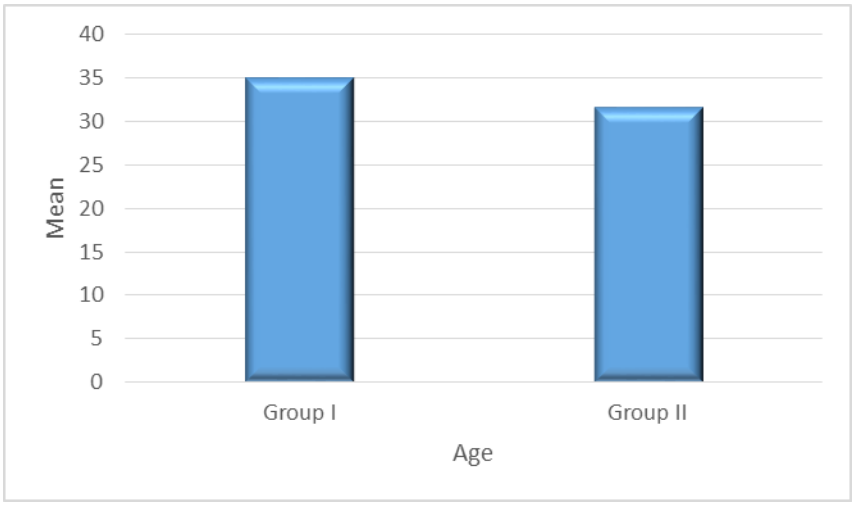
Group (I): tub shaped inlay retained bridges group

Group (II): conventional inlay shaped retained bridge group

That males in group I were 5(33.3%) and females were 10(66.7%) while in group II, males were 7(46.7%) and females were 8 (53.3%). Age in group I ranged from 24-46 with mean value 35±7.69 and in group II ranged from 23-41 with mean value 31.6±6.50. There was no statistical significant difference between the two studied groups regarding age and gender (P > 0.05) Table (3) shows:

Table (3): Comparison between the two studied groups regarding age and gender.

	Group I		**Group II**		**test P value**
Age					
Range	24-46		23-41		T=0.98
Mean	35		31.6		0.101
SD	7.69		6.50		
Gender	**No**	**%**	**No**	**%**	X^2 =0.55
Male	5	33.3	7	46.7	0.457
Female	10	66.7	8	53.3	



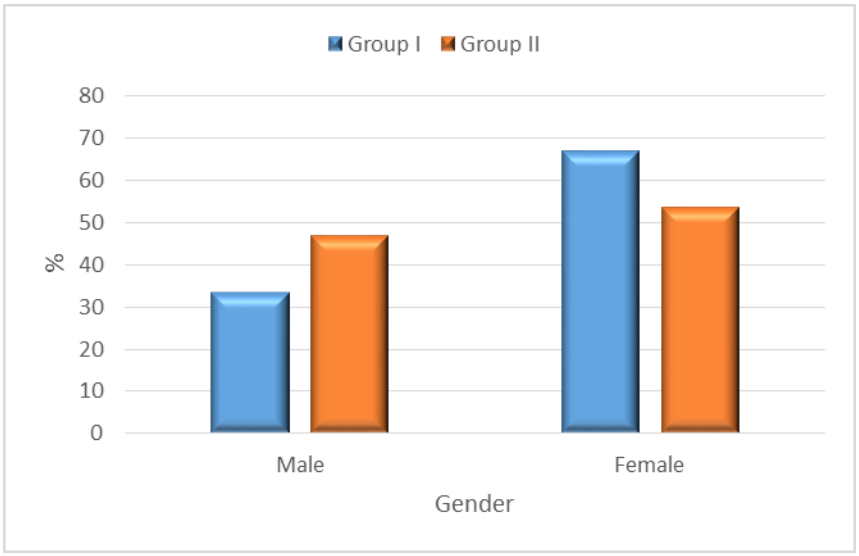


Fig. (16): Comparison between the two studied groups regarding age and gender.

That fracture at immediate, after 1, 3, 6 months all in both groups was Alpha score 15(100%). After 9 months in group I were all alpha score 15(100%) while in group II were 14(93.33%) alpha score and 1(6.67%) Bravo score. After 12 months in group I, alpha score was 13(86.7%), Bravo was 1(6.7%) and Charlie was 1(6.7%) while in group II were 12(80%), 1(6.7%) and 2(13.3%) respectively. There was no statistical significant difference between the two studied groups regarding fracture at different period of follow up (P> 0.05) shows in table (4) .

Table (4): Comparison between the two studied groups regarding fracture at different period of follow up.

Fracture	Group I		Group II		P value
	No	%	No	%	
Immediate Alpha	15	100.0	15	100.0	-
1 month Alpha	15	100.0	15	100.0	-
3 months	15	100.0	15	100.0	-

Alpha					
6 months					-
Alpha	15	100.0	15	100.0	
9 months					
Alpha	15	100.0	14	93.33	0.163
Bravo	0	0.0	1	6.67	
12 months					
Alpha	13	86.7	12	80.0	0.089
Bravo	1	6.7	1	6.7	
Charlie	1	6.7	2	13.3	

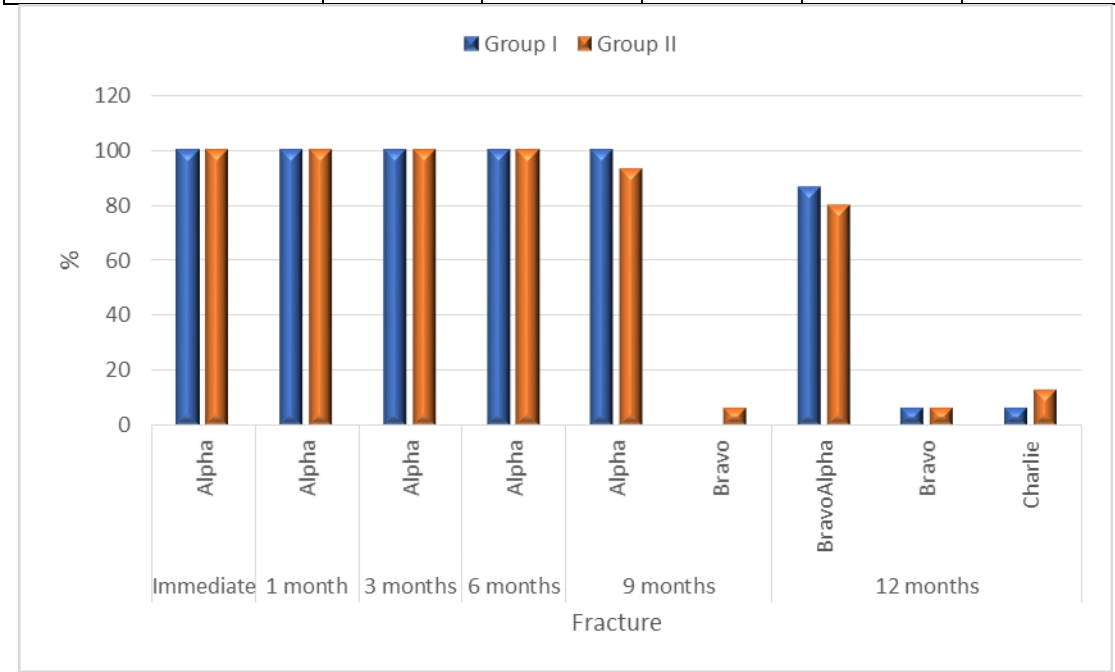


Fig. (17): Comparison between the two studied groups regarding fracture at different period of follow up.

That marginal adaptation scores at immediately, after 1, 3, 6 months all in both groups was Alpha score 15(100%). After 9 months in group I were all alpha score 15(100%) while in group II were 14(93.33%) alpha score and 1(6.67%) Bravo score. After 12 months in group I, alpha score was 14(93.3%), Bravo was 1(6.7%) and Charlie was none while in group II were 13(86.7%), 1(6.7%) and 1(6.7%) respectively. There was no statistical significant difference between the two studied groups regarding marginal adaptations score at different period of follow up (P> 0.05). Shows in Table (5)

Table (5): Comparison between the two studied groups regarding marginal adaptations score at different period of follow up.

Marginal adaptation scores	**Group I**		**Group II**		**P value**
	No	**%**	**No**	**%**	
Immediate					-
Alpha	15	100.0	15	100.0	

1 month					-
Alpha	15	100.0	15	100.0	
3 months					-
Alpha	15	100.0	15	100.0	
6 months					-
Alpha	15	100.0	15	100.0	
9 months					0.163
Alpha	15	100.0	14	93.3	
Bravo	0	0.0	1	6.7	
12 months					0.205
Alpha	14	93.3	13	86.7	
Bravo	1	6.7	1	6.7	
Charlie	0	0.0	1	6.7	

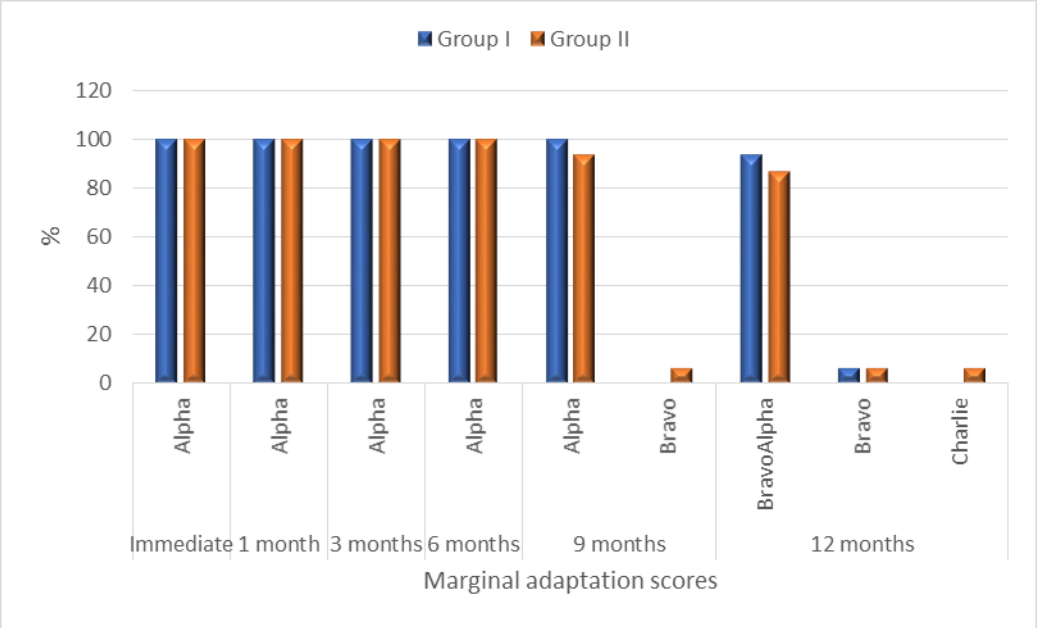


Fig. (18): Comparison between the two studied groups regarding marginal adaptations score at different period of follow up.

That retention scores at immediately, after 1, 3, 6 months all in both groups was Alpha score 15(100%). After 9 months in group I were all alpha score 15(100%) while in group II were 14(93.33%) alpha score and 1(6.67%) Bravo score. After 12 months in group I, alpha score was 14(93.3%), Bravo was 1(6.7%) and Charlie was none while in group II were 13(86.7%), 1(6.7%) and 1(6.7%) respectively. There was no statistical significant difference between the two studied groups regarding retention score at different period of follow up (P> 0.05) Shows in table (6).

Table (6): Comparison between the two studied groups regarding retention at different period of follow up.

Retention	**Group I**		**Group II**		**P value**
	No	**%**	**No**	**%**	

Immediate					
Alpha	15	100.0	15	100.0	-
1 month					
Alpha	15	100.0	15	100.0	-
3 months					
Alpha	15	100.0	15	100.0	-
6 months					
Alpha	15	100.0	15	100.0	-
9 months					
Alpha	15	100.0	14	93.3	0.163
Bravo	0	0.0	1	6.7	
12 months					
Alpha	14	93.3	13	86.7	0.205
Bravo	1	6.7	1	6.7	
Charlie	0	0.0	1	6.7	

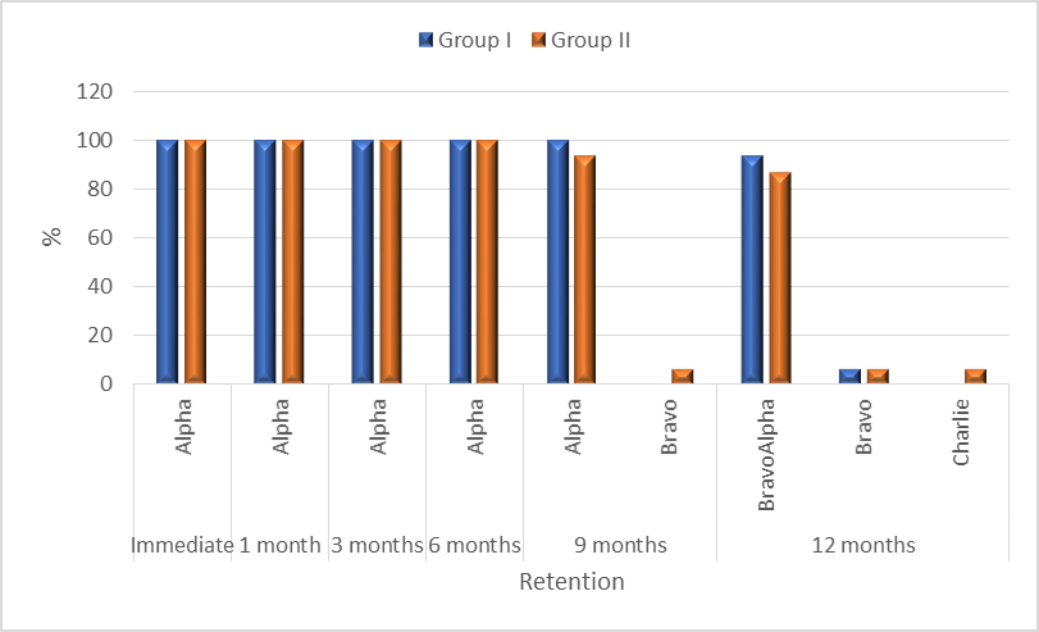


Fig. (19): Comparison between the two studied groups regarding retention at different period of follow up.

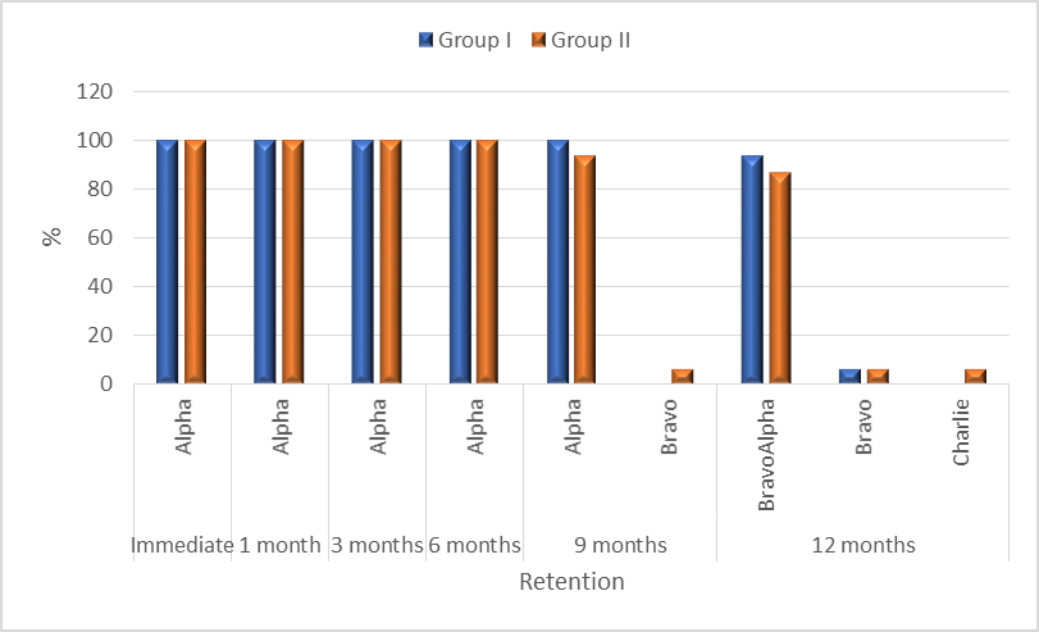


Fig. (20): Comparison between the two studied groups regarding retention at different period of follow up.

That bone loss after 6 months in group I ranged from 0.0-0.082 with mean value 0.037±0.03 and in group II ranged from 0.0-0.079 with mean value 0.031±0.03. After 9 months in group I ranged from 0.017-0.081 with mean value 0.034±0.02 and in group II ranged from 0.012-0.063 with mean value 0.038±0.02. After 12 months in group I ranged from 0.011-0.072 with mean value 0.048±0.02 and in group II ranged from 0.013-0.078 with mean value 0.047±0.02. There was no statistical significant difference between the two studied groups regarding bone loss (mm) at different period of follow up (P > 0.05) Shows in table (7)

Table (7): Comparison between the two studied groups regarding bone loss (mm) at different period of follow up.

Bone loss (mm)	Group I	Group II	P value
After 6 month			
Range	0.00-0.082	0.00-0.079	0.280
Mean	0.037	0.031	
SD	0.03	0.03	
After 9 month			
Range	0.017-0.081	0.012-0.063	0.313
Mean	0.034	0.038	
SD	0.02	0.02	
After 12 month			
Range	0.011-0.072	0.013-0.078	0.431
Mean	0.048	0.047	
SD	0.02	0.02	

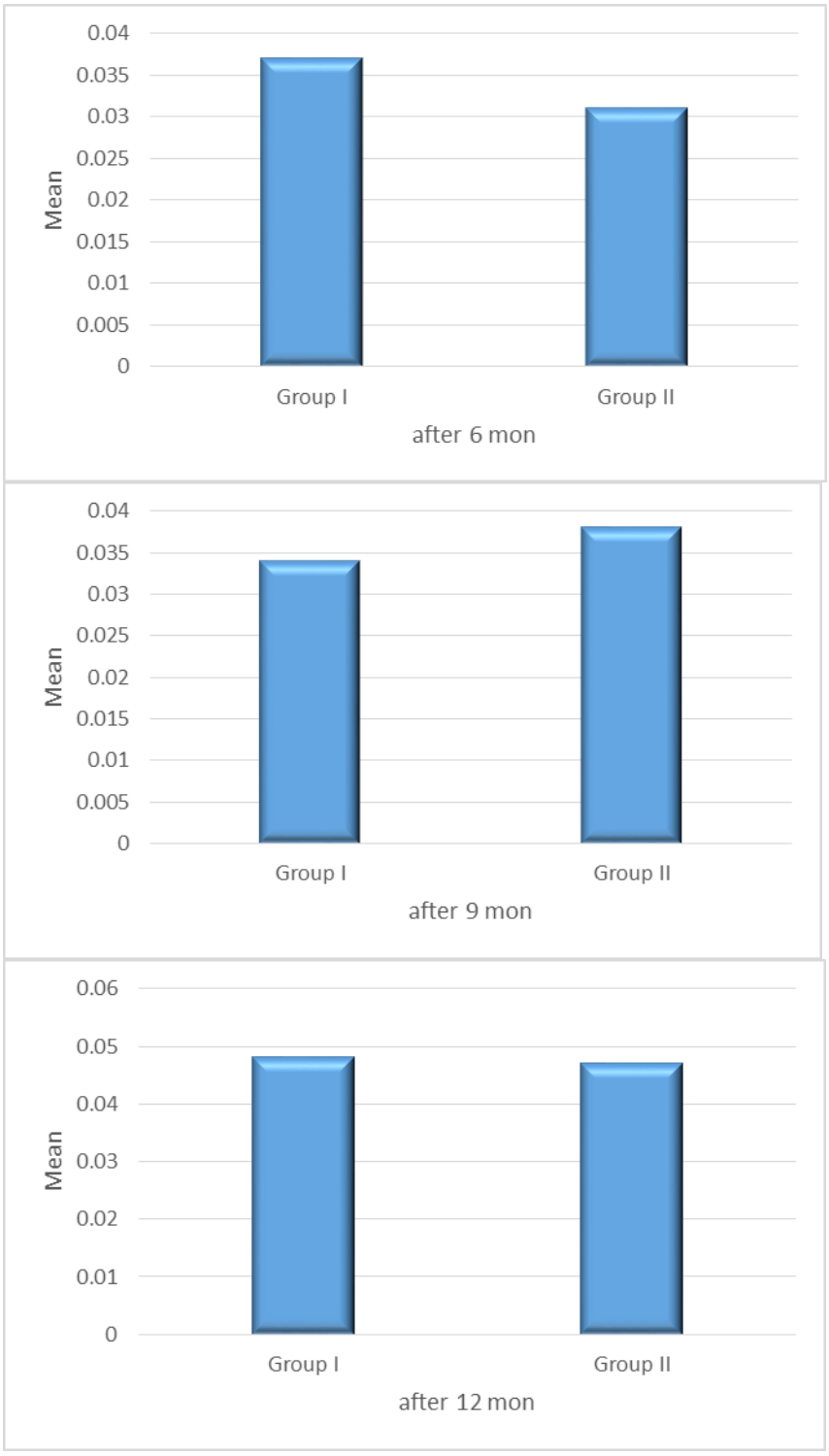


Fig. (21): Comparison between the two studied groups regarding bone loss (mm) at different period of follow up.

Discussion:

Our hypothesis was accepted as the result show that there is no significant difference between tub and box shaped inlay retained fixed partial denture regarding fracture rate and bone loss. And they were a good substitute for the conventional full coverage fixed partial denture

In this present study, we investigated the clinical assessment of three-unit inlay retained bridges with two different designs (tub shaped and inlay shaped) regarding fracture resistance, bone loss, and retention. These bridges constructed from monolithic zirconia. The assessment was done using MUSPHS criteria, and CBCT through 12 months of follow up.

This study was a randomized, double-blinded clinical trial where randomization was carried out by the website (www.randomizer.org) to eliminate the risk of selection bias of the included patients.

Minimal invasive methods of treatment are the main concern today in the dental field. Although the implant-supported FDP is considered the most conservative approach to replacing the posterior missing single tooth, clinical contraindications, sometimes patient refusal due to financial reasons and the fear of surgery may be encountered **(Monaco, 2005).**

Today, the need for the inlay retained bridges to preserve the tooth structure and to minimize abutment teeth preparation has increased. Pulpitis and long-term pulpal reactions seem to be considerable risks of crown preparations. In a recent trial, irreversible pulpitis and pulpal necrosis had occurred after 10 years in 15.6% of the teeth restored with single crowns and in 32.5% of teeth restored with bridge restorations respectively. Approximately 63% - 73% of coronal tooth structure was needed to be removed when teeth are prepared for all-ceramic restorations **(Castillo-Oyagü et al., 2018).**

Following a general trend towards better esthetic restorations and increased biocompatibility, metal-free (fiber-reinforced composite resin or ceramic) resin-bonded fixed dental prosthesis have been developed **(Ayna and Celenk 2005).**

Although initially successful, the low (73% to 78%) 5-year survival of posterior fiber-reinforced composite resin RBFDPs gave rise to doubts regarding the long-term success of the treatment. **(Göhring and Roos 2005).**

For inlay retained restorations fabricated from heat-pressed lithium disilicate glass-ceramic, a survival rate of 38% after 8 years contraindicated their use **(Harder et al., 2010).**

Recently, new materials and techniques have been introduced to create all-ceramic fixed partial dentures that are esthetically suitable for the rehabilitation of many cases with a wide range of indications, especially all zirconia-based ceramic materials that show significant improvements in esthetic parameters, biological compatibility, and superior mechanical characteristics **(Silva et al., 2017).**

In a study by **Chaar and Kern (2015),** encouraging a cumulative 5-year survival rate of 94.5% was observed for zirconia-based inlay retained restorations with a modified, more retentive framework design with additional lingual and buccal retainer wings.

Although zirconia has superior mechanical properties, to achieve a natural appearance and acceptable esthetics, its opaque white color, and insufficient translucency require glass porcelain veneering in the framework. However, a major complication of these restorations has been reported to be cracking or chipping the porcelain veneer. The possible causes of porcelain veneer cracking are differences in thermal expansion coefficient between zirconia framework and porcelain, firing shrinkage of porcelain, porosity, poor veneering wetting, flaws in porcelain veneering, inadequate framework design to support porcelain veneering and overloading **(Miyazaki et al., 2013).**

To overcome the problems of veneering zirconia, full-contoured, monolithic zirconia restorations without veneering porcelain have become increasingly popular. Translucent monolithic cubic zirconia, due to its increased translucency, provides a new restorative option that combines strength with enhanced esthetics. **(Özkurt-Kayahan, 2016).**

Monolithic zirconia became popular due to its high flexural strength; less wear on the antagonists and need minimal preparation of the tooth. Monolithic zirconia crowns can be manufactured for patients with compromised

occlusion or parafunction with an occlusal reduction of as little as 0.5 mm. The material can also be shaped and polished easily with a special polishing kit **(Kontonasak et al., 2019).**

In our study, the translucent zirconia milled from a prefabricated blank with the aid of computer-aided design/computer-aided manufacturing (CAD/CAM) technology.

CAD/CAM systems offer the advantages of production automation Standardized, high-quality procedures in a short period. They have the potential to minimize technique inaccuracies and minimize the hazards associated with infectious contamination. It allows the application of recent, high-resistance materials with superior biological compatibility combined with high esthetic design, excellent fit accuracy, and longevity **(Uzun, 2008).**

ML (Multi-Layered) Katana zirconia disks were used in this clinical trial. The zirconia disk consists of four pre-colored layers. These layers are enamel layer (35 % thickness), transition layer 1 (15% thickness), transition layer 2 (15% thickness), and body layer (35% thickness). They show superior esthetic, translucent, shrinking consistency, and high flexural strength **(Ueda et al., 2015).**

The extra oral scanner was used to scan the master cast to design the restoration using a computer. These scanners provide reliable, accurate, and quick scanning without any intro-oral restrictions (such as blood, saliva, and tongue movements). Blue light technology has been used, which enables quick scanning and provides high precision **(Rudolph et al., 2016).**

For all patients, full mouth scaling has been started to remove the biofilm, periodontal bacteria, toxins, calculus, and debris from the full circumference of exposed teeth surfaces supra- and subgingivally, prevent gingival inflammation and leave smooth surfaces of the teeth, reduce the risk of recolonization and subgingival adhesion of biofilms **(Reynolds, 2018).**

Shade selection was done before the preparation of the teeth to avoid eye fatigue and changes in shade due to changes in moisture. The VITA 3D shade guide was used for this. This shade guide still constitutes the only standard shade guide on which color determination in dentistry is based, it provides a rapid and economic method for measuring tooth color, and studies have shown that it is more precise than the spectrophotometer **(Parameswaran et al,. 2016).**

There are different inlay designs, such as tub, proximal box-shaped preparations, and occlusal-proximal preparations. The size of these preparation features would depend on the tooth size. the most common designs for inlay retained restorations are (inlay-shaped, tub-shaped, and proximal box-formed) **(El-Mowafy and Rubo 2000) (Ohlmann et al., 2008)**

The final impression was taken with addition silicone impression material as it has low dimensional change, relatively short setting time, and moderate to high resistance to tearing. As polymerization reaction does not involve products, impressions are dimensionally stable and can be poured at the operator's convenience **(Al-Akhali et al., 2017).**

In this study we used one-step impression technique related to being more fast and simple with accuracy comparable to two-step technique, In a study by **Franco et al (2011)**. They found that the single-step technique produced smaller inaccuracies in the stone dies obtained from the impression materials investigated in this study, thus being advisable over the 2-step hydraulic and hydrophobic impression without relief **(Franco et al., 2011).**

Inter occlusal record was obtained using polyvinyl siloxane as the least error occurred among the materials used for this purpose. They were easy to manipulate and offer little or no closure resistance, set to a consistency that makes them easy to adjust without distortion, reproduce the details of the tooth accurately, and show less distortion **(Thanabalan et al., 2019).**

The try-in was milled from polymethyl methacrylate (PMMA) discs. The CAD/CAM PMMA was initially tried to check marginal fit, stability, occlusion, and connectors. Later, this restoration was used as provisional restorations. PMMA has several advantages including good marginal adaptation, more comfortable for patient, natural-looking, highly esthetic, extremely durable and they’re the strongest provisional restoration available. The provisional restorations were temporarily cemented using eugenol-free temporary cement **(Astudillo-Rubio et al., 2018).**

The milled inlay retained bridges were submerged in an ultra.sonic cleaner for one minute and then fully dried before sintering, for bridge cleaning, making them ready for bonding.

After the Inlay retained restorations had been tried, adjustments made, the crowns were re-polished and were cleaned to remove saliva remnant which could affect bond strength to the tooth structure. Monolithic Zirconia polishing was done instead of glazing, after occlusal adjustments. The glazing reduced translucent zirconia's flexural strength. Polishing produced a smooth surface that causes less wear than the glazing of the opposing natural enamel **(Kumchai et al., 2018) (Janyavula et al., 2013).**

Air abrasion with 50 um Al_2O_3 for 15 seconds at 2.5 bars and 1 cm. Air abrasion able to create irregularities on the surface of zirconia, in combination with phosphate ester monomer (MDP) containing primer and luting agents results in high, durable bond strengths because the phosphate ester group chemically bonds to metal oxides such as zirconium dioxide **(Mattiello et al., 2013).**

Sandblasting of zirconia surfaces was selected as showed higher bond strength than the silica coating group. **Rashad et al., (2013)** claimed that the increase in the surface area was created by sandblasting allowing acceptable roughness facilitating resin/ceramic micromechanical interlocks formation.

Remnants of provisional cement were removed by a polishing paste applied with bristle brush and rubber cup under water irrigation to ensure that the tooth surface is completely cleaned from provisional cement and contaminations which might affect the bond strength. **(Zortuk et al., 2012).**

After cleaning the abutment teeth, the enamel surface was etched with 37% phosphoric acid for 20 seconds. Etching gel is removed by rinsing for 20 seconds with an air/water spray, and bonding agent (All universal bond, Bisco)is applied for 20 seconds over both enamel and dentine, and gently evaporated. The bonding agent is applied with a micro brush and polymerized.

The three-step etch-and-rinse adhesives were selected as considered the 'gold standard' in terms of adhesion durability. Any kind of simplification in the clinical application procedure results in a loss of bonding effectiveness **(Munck et al., 2005).**

Theracem™, a self-adhesive dual-cure resin cement, was used for the final cementation of the inlay retained restoration. In a study by **Mahrous et al., (2020),** they reveal that Using MDP-containing calcium-fluoride-releasing self-adhesive resin cement (TheraCem) improves bond strength to all tested substrates (enamel, dentin, and zirconia) and can be considered a promising cement for many clinicians.

The MUSPHS criteria have provided a practical and logical approach to the assessment of the clinical performance of the restorations, are also widely used for the long-term assessment of the restorations and are considered to be valid for comparison purposes at different observation periods and provide a systematic approach that is now known to be universally accepted **(Hickel et al., 2010) (Moncada et al., 2014).**

The patients in this study would be with good oral hygiene, low susceptibility to decay, have a minimum coronal tooth height of 5 mm with parallel abutments and sufficient mesio distal edentulous gap dimensions, no active periodontal or pulpal problems, and sound teeth or teeth with shallow restorations **(Augusti et al., 2014).**

Any diseases with related psychiatric problems excluded from this study, in the study by Manish et al 2006, showed that these patients had “poor periodontal status with high treatment needs; only 1.9% had healthy periodontal tissues while bleeding on probing, calculus, shallow pockets, and deep pockets were found in 10.5%, 40.6%, 35.3%, and 7.8% respectively” **(Kumar et al., 2006).**

Pregnant female patients excluded from this study, in our trial, the exposure for the x-ray radiation would be impossible and it was found that depending on the amount of radiation and the stages of pregnancy, a “damage to the fetal cells may result in miscarriages, birth defects, or mental impairment **(Hemalatha et al., 2013).**

Participants with medical problems affecting mouth hygiene excluded from this study. Periodontal disease has recently been recognized as the “sixth complication” of diabetes mellitus as chronic periodontal disease results in progressive destruction of the supporting tissues of the teeth as well as pocket formation, recession or both, which

may lead to tooth loss because of extensive destruction of alveolar bone", also, uncontrolled diabetes mellitus may be associated with xerostomia with increased caries index and difficulty in maintaining good oral hygiene **(Chavez et al., 2001).**

A better designing of the IRFDP and tooth cavity surfaces conditioning before adhesive cementation procedures are necessary to avoid mechanical and biological complications **(Monaco et al., 2012).**

Many factors control the fracture resistance of ceramic materials such as the composition, microstructure, the fabrication technique, and the surface finish **(Cavalcanti et al., 2009).**

New high strength Monolithic zirconia, with their stiffness and high mechanical properties (i.e: resistance to fracture and/or fatigue), could be considered a right choice in an IRFDP **(Zhang et al., 2013).**

The dental restorations during function are subjected to biting and chewing forces; stress applied during mastication may range between 441-981 N in the molar region. According to DIN standards and some authors, the fixed dental prosthesis should withstand occlusal forces of more than 1000 N in a static fracture resistance test **(Özcan et al., 2012).**

The results of this study were in agreement with **Abou Tara et al., (2011)** who conducted a study to evaluate the clinical outcome of inlay-retained fixed dental prostheses (IRFDPs) made from a zirconia ceramic and found that there was no framework fracture during the observation period of 20 months. They conducted that the CAD/CAM-manufactured zirconia ceramic framework was used because of the significantly higher static and fatigue fracture strength as compared to other ceramic materials. **Chaar and Kern (2015)** found similar results with the favorable results related to fracture-resistant framework material used (zirconia), the modified preparation, and framework design, which seems to be of high relevance.

The favorable survival rate in the current study could not only be related to the fracture-resistant material used monolithic (zirconia), but it probably can be linked to the accurate preparation design and framework design, which seems to be of high relevance. Moreover, an adhesive resin cement (Theracem) was employed that contains a phosphate monomer (MDP), which seems to play an essential role to achieve a durable bonding to zirconia **(Aboushelib et al., 2010) (Abou Tara et al., 2011).**

Conclusions:

Within limitations of this study, the following conclusion could be drawn as follows: Up to one year clinical observation period, inlay retained fixed dental prostheses made from monolithic zirconia with two designs (inlay shaped and tub-shaped) revealed successful clinical performance in terms of fracture resistance, retention and bone loss.

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