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Research Article

Assessment of Bone Resorption of Patients Wearing Complete Denture and Different Types of Mandibular Implant Supported Overdenture: A Clinical trial

Kaify Wali Ahmed[1]*, Rizgar Mohammed Ameen Hasan[2]

[1*,2]Department of Prosthodontics, College of Dentistry, Hawler Medical University, Erbil, Iraq.

***Corresponding Author:** Kaify Wali Ahmed
*Department of Prosthodontics, College of Dentistry, Hawler Medical University, Erbil, Iraq.
kaife.wali@hmu.edu.krd

Abstract
Background and objectives: Conventional complete denture (CCD) has been used for many years, and in spite of the benefits it offers, it possesses many drawbacks. In recent years, implant-supported overdentures (ISOD) have been introduced into the dentistry field with various benefits compared to conventional complete dentures. The objectives of the current study were to assess the impact of four different types of innovative ISOD and CCD on mandibular residual alveolar bone and evaluation of bone resorption.
Methods: Forty patients (25 males and 15 females) were recruited. The volunteers had a completely edentulous maxilla and mandible. They were divided into five groups, as follows: 8 patients were divided for conventional complete dentures: 8 patients with two-pieces implant ball and socket overdenture; 8 patients with two-pieces implant locator overdenture; 8 patients with a single-piece implant ball and socket overdenture; and 8 patients with an innovative implant overdenture by locator system. The construction of the lower (CCD and ISOD) and upper complete dentures was carried out. Then, the CBCT was taken to assess the bone resorption in four consecutive visits.
Results: The results of left and right Buccal bone test that the results of single ball from right and left sid[e] from 0 month were 2.6 and in 18th month increased to 3.2 and two piece ball in the 0 month were 2.2 and in the 18th month increased to 3.5) which both not significantly (P=0.4) increased. While in other implants bone resorption significantly increased which might be the reflect of the negative effect of the implants. Furthermore, in the ligual bone resorption rate the data showed that only two ball piece showed significant (P<0.05) difference from 0 month to 18 month; right side increased from 2.6 to3.1 and left side 2.2 to 3.2. Other implant types were not significantly different. Similar results were seen in the **Occluso-Cervically bone resorption rate**
Conclusions: The study findings indicate that the use of implant-supported over-dentures with the single piece implant resulted in improved of underline alveolar bone and less bone resorption with other types of overdentures and conventional complete dentures, particularly during the third and fourth visits. These overdentures offered superior result compared to conventional complete dentures (CCD).

Keywords: Bone resorption, conventional complete denture CCD, implant-supported overdenture ISOD and CBCT.

***Author of correspondence: Email:** kaife.wali@hmu.edu.krd*

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Introduction and Background

An overdenture is a removable dental prosthesis that forms a covering and rests on one or more of the remaining natural teeth. A dental prosthesis is that covers and provides partial support to natural teeth, their roots, and/or dental implants[1].

Patients with significantly resorbed mandibles sometimes experience difficulty using conventional dentures (CD) because of insufficient retention and stability. Common issues include discomford during mastication, diminished of texture and tactile perception of food, decreased ability to chew nutritious vegetables and fruits, overall weakness, and decreased social interaction due to embarrassment of wearing dentures. Stabilization of the mandibular prosthesis by osseointegrated implants leads to enhanced oral function by promoting greater electrical activity of the masseter muscles. Moreover, a consistent chewing pattern, improved mandibular border movements, and decreased pain during mastication typically enhance patient satisfaction with implant-supported prosthesis in comparison to traditional complete dentures. Only the interforamenal segment can be used for dental implantation without bone grafting or nerve lateralization surgery due to the atrophy of the alveolar ridge of the mandible. Inserting implants in the interforamenal region has a high success rate because of its high bone density and location away from vital structures. One treatment option is to place at least four implants in the interforamenal area parallel to each other to support fixed cantilevered screw-retained prosthesis or flanged implant-supported overdentures[2].

Literature review

Resorption of residual ridges (RRR) in individuals wearing complete dentures (CD) is a persistent and unavoidable phenomenon that is influenced by the specific prosthesis that cover and oppose the remaining ridge. According to Elsyad et al. (2013), many studies have demonstrated that the anterior maxilla has higher rates of residual ridge resorption (RRR) when a maxillary denture is opposed by a mandibular two-implant-retained overdenture (IOD) compared to when it is opposed by a mandibular denture. In contrast, several studies have reported no difference in the risk of (RRR) between the two treatment methods, or even a higher RRR in the case of traditional CD therapy due to inadequate retention and stability [3].

RRR associated to IOD may be attributed to the increased biting force produced due to the enhanced stability and retention of the overdenture [4]. Primarily, this focused force impacts the premaxilla. In 1998, Fontijn-Tekamp and colleagues reported measuring biting forces ranging from 20 to 40 N with a mandibular CD, and increasing to 45 to 70 N with an IOD. In their study, Ahmad et al recorded an average biting force of 110 ± 32 N for patients who received opposing maxillary IODs, and 63 ± 15 N for those who received (CDs) [5]. A study by Shah et al demonstrated a substantial increase in muscular activity among individuals with IOD after 12 months. Moreover, the increased contact distortion caused by dentures results in higher cumulative stress on the mucosa and the underlying supporting bone, contributing to increased risk of RRR. The relative thickness of the oral mucosa is crucial in reducing the stress caused by the denture base and the resulting RRR [6].

A higher hydrostatic pressure was seen to be irregularly distributed in the mucosa beneath a mandibular IOD compared to a lower and uniform pressure under a mandibular CD. Regions characterized by high hydrostatic pressure exhibited a significant rate of RRR [7]. The results of this clinical investigation indicate that the conversion strategy of a new CD into a 2IOD greatly enhanced the ORLQoL for mandibular ridges with sufficient bone height and those with insufficient bone height.

The current study investigated the biomechanical basis of bone remodelling by using several denture treatments, namely conventional complete dentures and two or four implant retained overdentures, specific to patients. The hydrostatic pressure Generated in the soft tissue mucosa, this factor was shown to be a significant biomechanical predictor of bone resorption by comparing the findings of in-silico modelling with in-vivo measurements. The presence of the cantilever effect resulted in the concentration of hydrostatic stress at the posterior ends of the implant-retained overdentures. Furthermore, the load bearing capacity of the implants increased proportionally with heavier occlusal stresses. The mechanical loading distributed among the implants rises as the occlusal force increases, but its contribution stabilizes at approximately 50 percent when the force is raised up to 140N in a particular scenario. Through the use of this hyperelastic finite element (FE) technique, it is possible to evaluate various denture designs. This allows for the optimization of implant configuration and denture structure in order to reduce posterior bone recession for a particular patient [7].

Currently, the available evidence indicates that using a traditional denture to restore the edentulous mandible is no longer the preferred prosthodontic treatment. Instead, a two-implant overdenture should be considered as a potential alternative treatment for the complete edentulous mandible [8]. Implant-supported mandibular overdentures can be secured using several types of precise attachments (ball, locator, telescopic, magnetic attachments) on individual implants or onto a bar connected between implants.

The efficacy of implant rehabilitation depends on the proper integration of the implants inside both hard and soft tissues. Consequently, marginal bone loss (MBL) is a crucial determinant of the clinical result [9]. Although MBL of less than 0.2 mm per year is considered normal, excessive MBL, especially during the first year after implant placement, is linked to a higher risk of perimplantitis and tissue collapse. This not only impacts the survival rates of oral implants but also affects their aesthetics, particularly in the anterior visible zone [10]. While multifactorial causes for early excessive MBL are proposed; however, they are not fully understood. Both the infection hypothesis, mostly supported by periodontists, and the overload theory, supported by prosthodontists/restorative dentistry, have been the primary hypotheses [11]. Nevertheless, there is clear evidence that several contributing variables influence MBL, and a simplistic explanation for bone loss is not enough. Qian et al. published a review which concluded that overloading alone does not provide evidence to be the only determinate for marginal bone resorption surrounding oral implants [11]

In addition, the involvement of aseptic foreign body reactions and strong and inflammatory responses of the host immune system is crucial in the development of MBL [12]. MBL predominantly manifests during the initial phase following implant placement. Although an initial marginal bone loss (MBL) of 1.0–1.5 mm in the first year has traditionally been considered typical, recent evidence indicates that losses of 0.459–0.55 mm occur in the first year following implant placement [13]. The positive causal variables for early implant crestal bone loss have been identified as surgical trauma, occlusal overload, peri-implantitis, microgap biologic width, and implant crest module. One criterion for implant success, as stated by [14], is bone loss of less than 0.2 mm per year following the insertion of the implant. A recent study proposed that an early marginal bone loss (MBL) measure more than 0.44 mm within the first 6 months of prosthetic loading is a risk factor for the advancement of peri-implant bone loss [15].

Elsyad et al (2014) was concluded that the Immediate loading of two implants supported by a locator-retained mandibular overdenture results in more vertical bone resorption compared to delayed loading implants after one year. There is no substantial difference in clinical treatment results across loading procedures with Significant correlation was seen between probing depth and marginal bone resorption. Based on clinical and radiographic findings of peri-implant tissues, it is more advisable to connect a resilient liner to the bar of an implant-retained mandibular overdenture rather than employing clip attachment. Nevertheless, further research investigations are need to confirm this finding in the long term prospective[16].

Implant imaging intraoral radiographs were generated utilizing the long cone paralleling technique and a film holder particularly built for this purpose (Hawe Neos Dental CH-6934, Bioggio, Switzerland). In order to ensure consistent film-implant distance and cone-implant distance across successive film exposures, a modification was made by precise drilling of a hole in the film holder directly above the implant orifice. The holder was secured to the implant by means of an elongated screw within the impression coping. Standardised intraoral radiographs were acquired by this modification. Radiography was performed using Ultraspeed film from Kodak Co. in Rochester, NY, USA. The X-ray equipment used was the ORIX-70s Ardet Srl from Buccinasco, Italy. The exposure factor was set at 70 kVp, 8 mA, 0.144 Kw, and the exposure period was 0.25 seconds. All films were processed using a Velopexs Extra-X automated system manufactured by Medivance in Harlesden, London, UK.

The peri-apical films were processed using a black and white transparent scanner, and the radiographic images were then enlarged by around 15 times beyond their original size. Lines and reference points were subsequently drawn using the Corel draw software, namely CorelDRAWs version 8TM developed by Kodak Digital Science. An analysis was conducted to identify magnification errors by comparing the implant measurements in the radiographs with the real implant dimensions. The apparent assessment of peri-implant bone levels in the radiographs was adjusted by utilizing the ratio between the implant dimensions in the radiographs and the real implant dimensions to arrive at the actual values.

Evaluation of peri-implant crestal alveolar bone alterations was conducted using the vertical and horizontal planes, following the guidelines of [17].

Objectivity was ensured by having a periodontist (A) evaluate clinical and radiographic data without knowledge of the research groups, after training and calibration with two other dentists (B and C). Data from examiners were gathered both at the interpersonal and intra-personal levels, three times on the same day [16].

Methodology

In this study, a comparison was made between the five groups of mandibular implant supported overdenture ISOD and conventional complete denture CCD. Forty patients were selected with completely edentulous patients. The selected patients were aged from 45 to 65 years old, and 15 of them were females and 25 were males. The patients were selected based on the special inclusion criteria of a normal skeletal Class I relationship, no severe undercuts, no history of systemic diseases, no previous trauma, and no bone grafting required. The exclusion criteria encompassed individuals with systemic diseases and xerostomia, people experiencing psychiatric issues, parafunctional habits, and bony undercuts in the edentulous region [18].

Conventional complete dentures were fabricated for eight patients, thirty-two ISODs were fabricated for four implant-supported overdenture groups, and the patients worn of the mandibular overdenture or conventional complete dentures with the maxillary conventional CD. the study design as shown in (Figure 1). In this study, the mandibular overdenture was supported by a two-piece' implant (ImplantSwiss), single-piece implant (MonoImplant) in Switzerland, and a newly innovative implant (NTS) in Italy

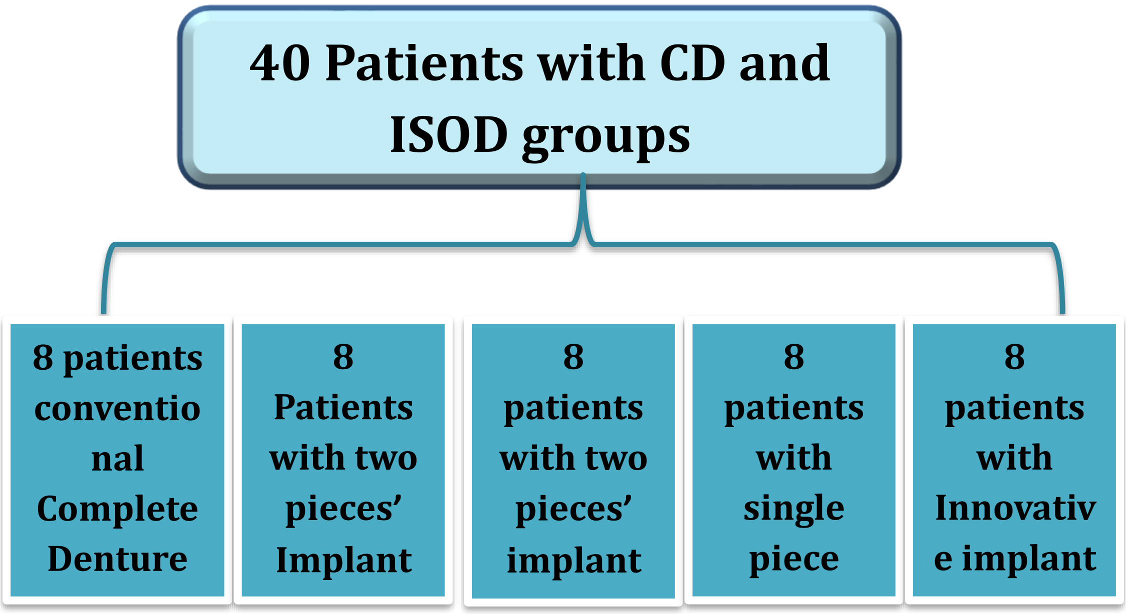


Figure 1: The study design used for bone resorption of the patients.

The experimental study design was divided into five study groups. In the first group, the patients were treated with conventional mandibular dentures. In the second group, the patients utilized implant-supported dentures anchored by two typical two-piece implants with ball and socket. In the third group, the patients were worn ISOD with two conventional two-pieces implants with locator attachments; in the fourth group, the patients were worn ISOD supported by two single-piece compressive implants with ball and socket attachments; and finally, in the fifth group, the patients were worn ISOD with two newly innovative implants with locator attachment systems.

The CBCT was used for implant placement and bone resorption test was conducted for patients at five distinct time intervals: (I) before implant placement; (2) after implant placement; (3) 6 months after denture insertion; (3) 12 months' post-denture insertion; and (4) 18 months' post-denture insertion.

After the implant placement using guided stent, another CBCT is taken using dual arch protocol with the patient's denture with radiographic markers attached to it as a reference as (Figure 2). The CBCT data from the denture and patient was introduced to the specific X.ray program (Blue Sky Bio 4.11) is a computer program designed for the purpose of examining and reformatting pictures generated by computed tomography. It may also be utilized for virtual implant treatment planning and for the making of surgical guides, surgical guided module. Matching of both data was performed using denture markers as a reference. Tracing for each segment was checked using the outline option of the denture.

The initial measurements for 1st CBCT were taken after the implant placement from the inside of the denture to the collar of the implant from the buccal and lingual surface for each implant. Periodic follow-up at 6 months, 1 year and 1.5 year was performed with the same mentioned protocol above.

Figure 2: Radiographic markers on the denture

Radiographic examination

By the use of the radiographic markers on the lower denture and scanned by the machine before insertion in the patient's mouth as shown in (Figure 3).

Figure 3: Radiographic examination.

After that the denture was inserted in the patient's mouth to take a CBCT for determining the bone resorption level in the molar, incisor and around implant area. The head of the patient was fixed by the X. Ray machine to be take an x-ray by the standard way and the procedure was taken by the same technician was shown in (Figure 4).

Figure 4: Overdenture in the patient's mouth by CBCT

Also compare the bone height in surrounding the implant and inter implants area, and first molar area at 6 months, 12
months and 18 months follow up. Vertical and horizontal bone loss was measured at buccal, lingual and cervical as mesial and distal surface of each implant.

Novelty of the research

According the author's best knowledge this was the first newly designed implant in collaboration with NTS Company (NTS Company based in Italy, Milan). This was specially design of implant that was inserted into the bone and then opened on the lower part by an appropriate screw this way to open the apical end of the implant by 1-2mm and to increase of primary stability.

NTS – SN (Salih Nawfal): The main benefit of a dental implantation is the possibility to give a firm foundation for the prosthesis reconstruction, not to compromise the adjacent teeth and to preserve the jawbone. The dental implantation replaces the tooth root which has gone lost and works as abutment for the implant crown. The feature of the NTS SN implantation is that to re-create, once opened, the morphology of the original tooth root in order to give the bone an anchorage and an even more substantial integration. The implantation is inserted into the bone and then opened on the low part by an appropriate screw and this way the seal is firmer as shown in (Figure 5).

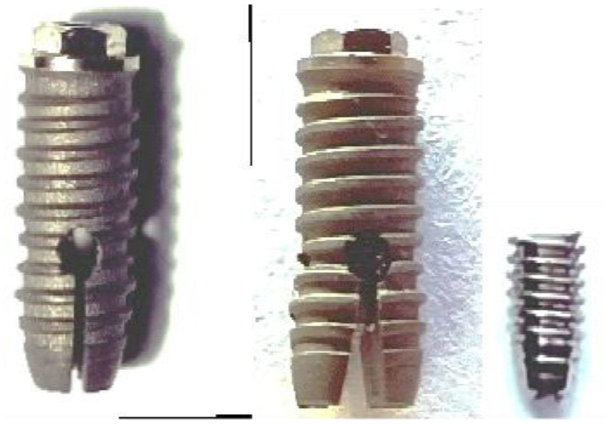


Figure 5: Innovative new design implant NTS-SN.

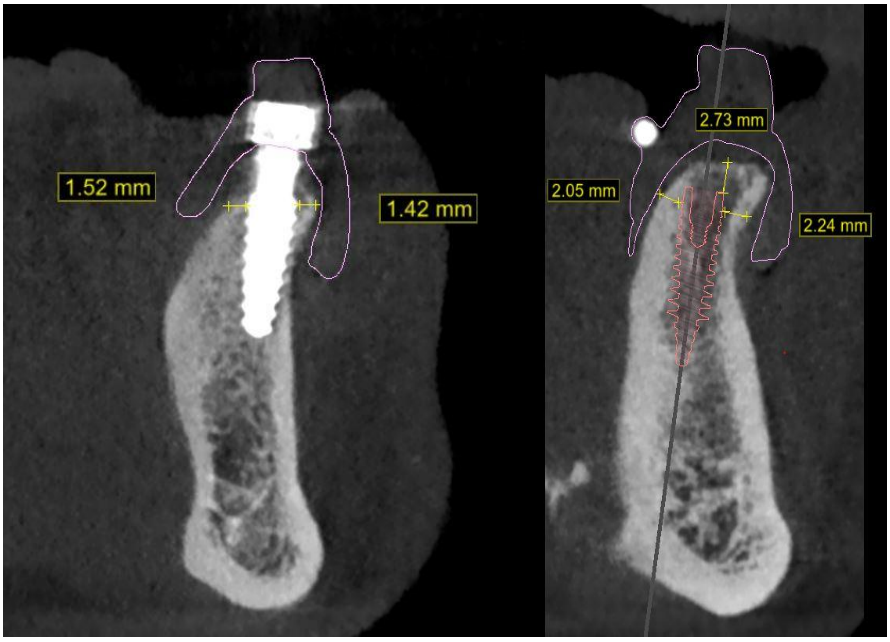
Statistics

The statistical analysis and graphs were performed with GraphPad Prism Software (version 9.0). D'Agostino-Pearson test, Shapiro-Wilk normality test and Kolmogorov-Smirnov test were used to determine whether the data were normally distributed or not. For comparison among groups, Ordinary One-Way ANOVA was performed for normally distributed data and Kruskal-Walli's test was performed for abnormally distributed data and data presented as Means±SEM (Standard Error). p-values<0.05 were considered statistically significant for all analyses.

Results

At all observation times, for all patients were examined the level of the bone with CBCT in different time periods for anterior edentulous area in conventional complete denture and implant area in implant retained overdentures displayed the level of bone resorption in buccal, lingual and occlusocervically from the base of the denture to the top of the cervical region of the implants as shown in (Figure 6).

This test the Ordinary One-Way ANOVA was performed for normally distributed data and Kruskal-Walli's test was performed for abnormally distributed data.



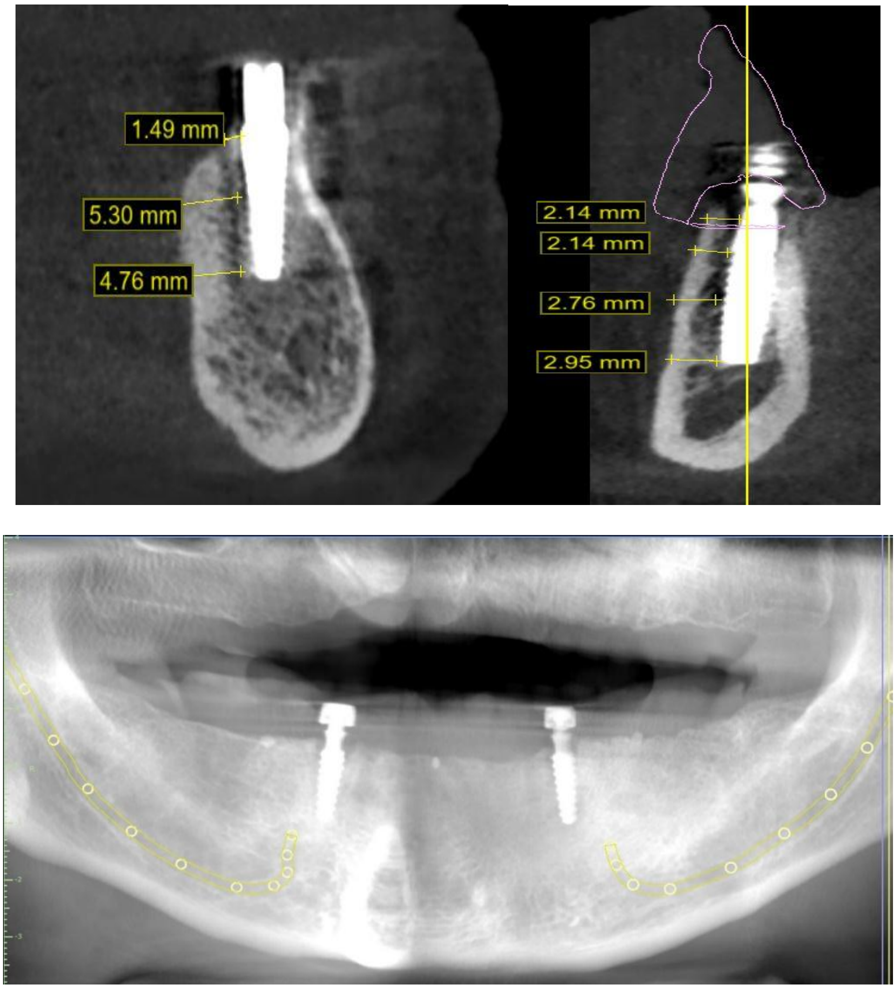


Figure 6: CBCT to determine the level of the bone resorption.

In this study, the effect of time per month on bone resorption in buccally was investigated and it was found that a longer stay per month affected the improvement of the bone level and decreased the bone resorption in buccal side of the implants, as explained in (Table 1). In all cases, except single ball implant, at 6, 12, and 18 months on both right and left sides showed significant differences when compared to the beginning of the implant (zero month). In the case single ball implant, the buccal implant made no significant difference between months at both the right and left sides (p-value=0.4691 and 0.4739), respectively (Figure 7).

Table 1. Mean±SEM of **Buccal bone** resorption rate among of CD and all types of ISOD in different times (0, 6, 12, and 18) months.

Parameters		**0 month**	**6st month**	**12th month**	**18th month**	**p-value**
Complete Denture	Right	2.8±0.4[a]	4.7±1.4[b]	4.9±1.4[b]	5.1±1.4[b]	0.04*
	Left	2.2±0.2[a]	3.8±1.2[ab]	4.1±1.1[a]	4.2±1.2[b]	0.04*
Single Ball Implant	Right	2.6±0.4[a]	3.3±0.5[a]	2.9±0.5[a]	3.2±0.6[a]	0.46
	Left	2.6±0.4[a]	3.3±0.5[a]	2.9±0.5[a]	3.2±0.6[a]	0.47
Two Piece Ball Implant	Right	2.3±0.3[a]	2.6±0.3[ab]	3.4±0.43[b]	3.5±0.4[b]	0.04*
	Left	2.2±0.2[a]	2.6±0.2[a]	3.4±0.3[ab]	3.5±0.3[b]	0.02*
Two Piece Locator Implant	Right	2.7±0.7[a]	3.5±0.7[ab]	4.2±0.8[b]	4.5±0.7[b]	0.03*
	Left	2.0±0.7[a]	2.9±0.7[a]	3.7±0.9[b]	3.8±0.9[b]	0.04*
Innovative Implant	Right	3.6±0.4[a]	5.08±0.9[b]	5.6±0.8[b]	5.8±0.8[b]	0.04*
	Left	3.7±0.6[a]	4.1±0.6[ab]	5.1±0.7[b]	5.2±0.7[b]	0.03*

*significant difference at P<value 0.05

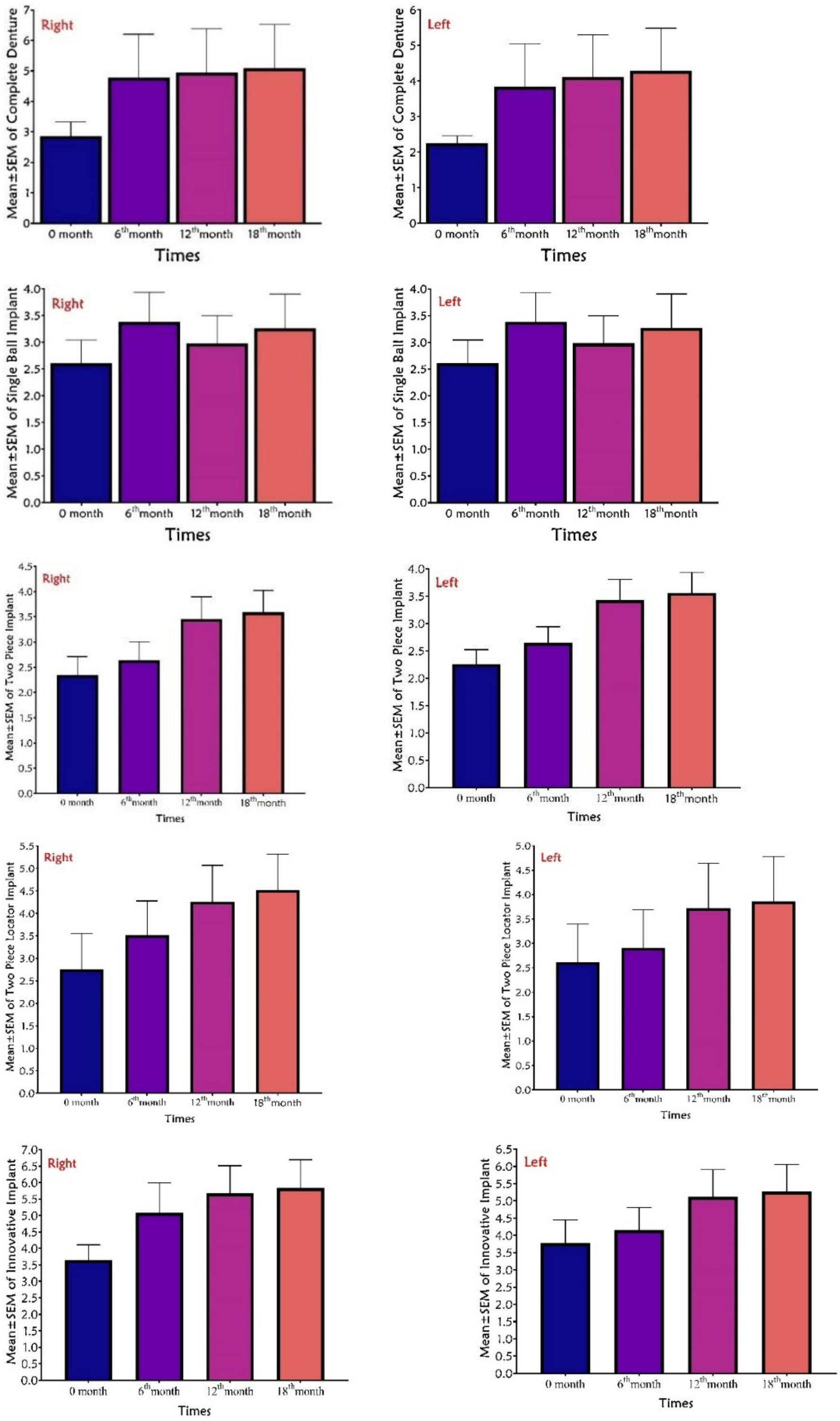


Figure 7: Histogram of **Buccal bone** resorption rate among of CD and all types of ISOD in different times (0, 6, 12, and 18) months.

The ANOVA test was conducted to compare between the visits of bone resorption of each group. In the present investigation, the consequence of time per month on bone resorption in lingually dental implants was explored. The findings of the current research revealed that a longer stay per month had some consequences for the improvement of the implant overdentures, as is explained in (Table 2). In every single instance, except for the two-piece ball implant, there were no discernible alterations observed on either the right or left side after 6, 12, or 18 months after the implant was placed in comparison to the initial period (zero months). The lingual surface of the implant established a substantial variance between months at both the right and left sides of the mouth in the case of the two-piece ball implant (p-value = 0.0173 and 0.0283, respectively; (Figure 8).

Table 2: Mean±SEM of **Lingual bone** resorption rate among of CD and all types of ISOD ant in different times (0, 6, 12, and 18) months.

	Parameters	0 month	6st month	12th month	18th month	p-value
Complete Denture	Right	2.4 ± 0.2^{a}	2.9 ± 0.3^{a}	3.3 ± 0.3^{a}	3.2 ± 0.3^{a}	0.17
	Left	2.2 ± 0.2^{a}	3.0 ± 0.2^{a}	3.0 ± 0.2^{a}	3.2 ± 0.2^{a}	0.06
Single ball	Right	2.4 ± 0.2^{a}	2.9 ± 0.3^{a}	3.3 ± 0.3^{a}	3.2 ± 0.3^{a}	0.14
	Left	2.2 ± 0.2^{a}	3.0 ± 0.2^{a}	3.0 ± 0.2^{a}	3.2 ± 0.2^{a}	0.06
Two Piece Ball	Right	2.6 ± 0.4^{a}	2.8 ± 0.4^{a}	2.9 ± 0.4^{a}	3.1 ± 0.4^{b}	0.01*
	Left	2.2 ± 0.2^{a}	2.6 ± 0.2^{a}	3.1 ± 0.2^{ab}	3.2 ± 0.2^{b}	0.02*
Two Piece Locator	Right	2.1 ± 0.4^{a}	2.6 ± 0.4^{a}	3.2 ± 0.4^{a}	3.1 ± 0.5^{a}	0.21
	Left	2.0 ± 0.2^{a}	2.3 ± 0.2^{a}	2.7 ± 0.2^{a}	2.6 ± 0.3^{a}	0.24
Innovative Implant	Right	3.4 ± 0.6^{a}	3.6 ± 0.6^{a}	3.9 ± 0.5^{a}	4.1 ± 0.5^{a}	0.72
	Left	2.9 ± 0.4^{a}	3.2 ± 0.4^{a}	3.5 ± 0.4^{a}	3.7 ± 0.4^{a}	0.49

*significant difference at level of p<0.05

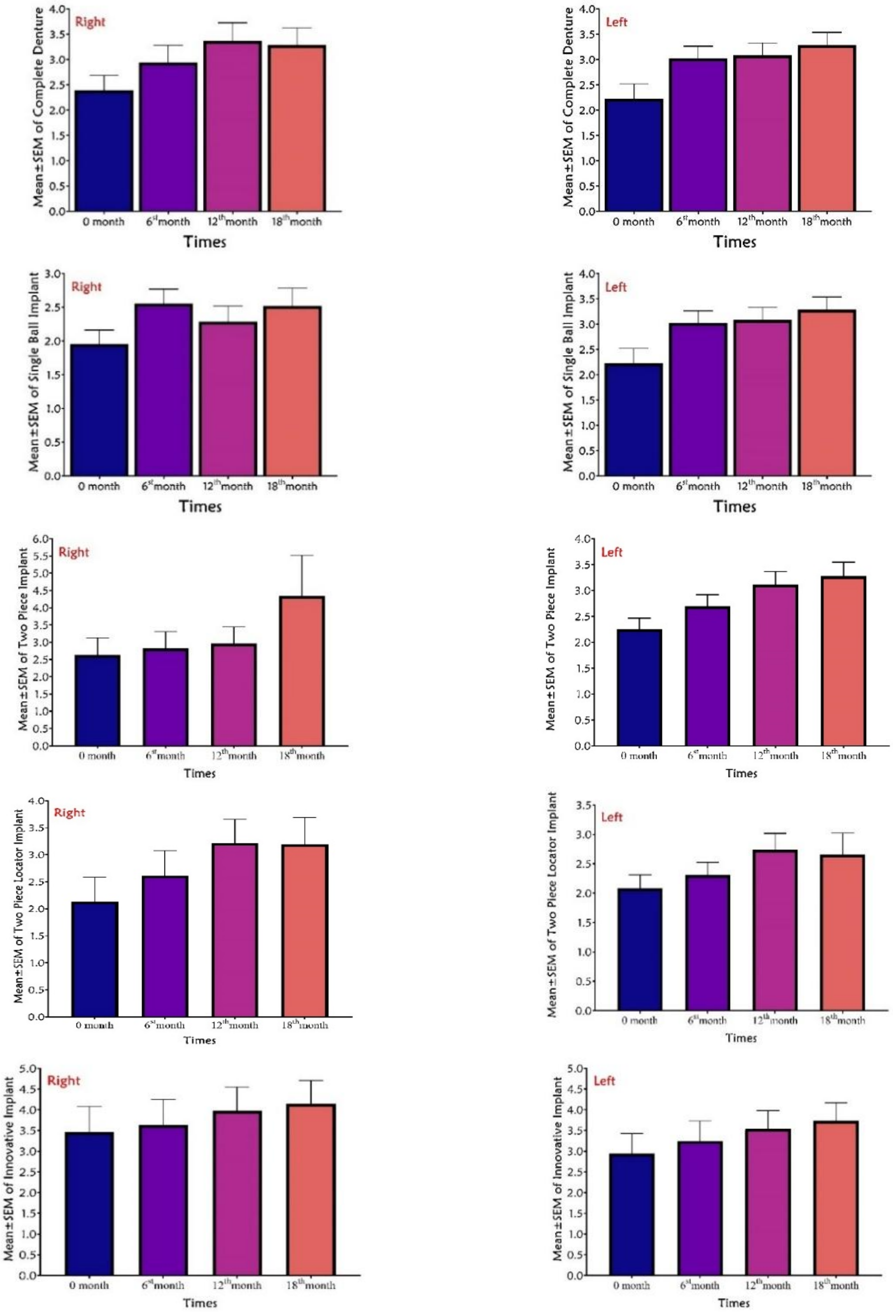


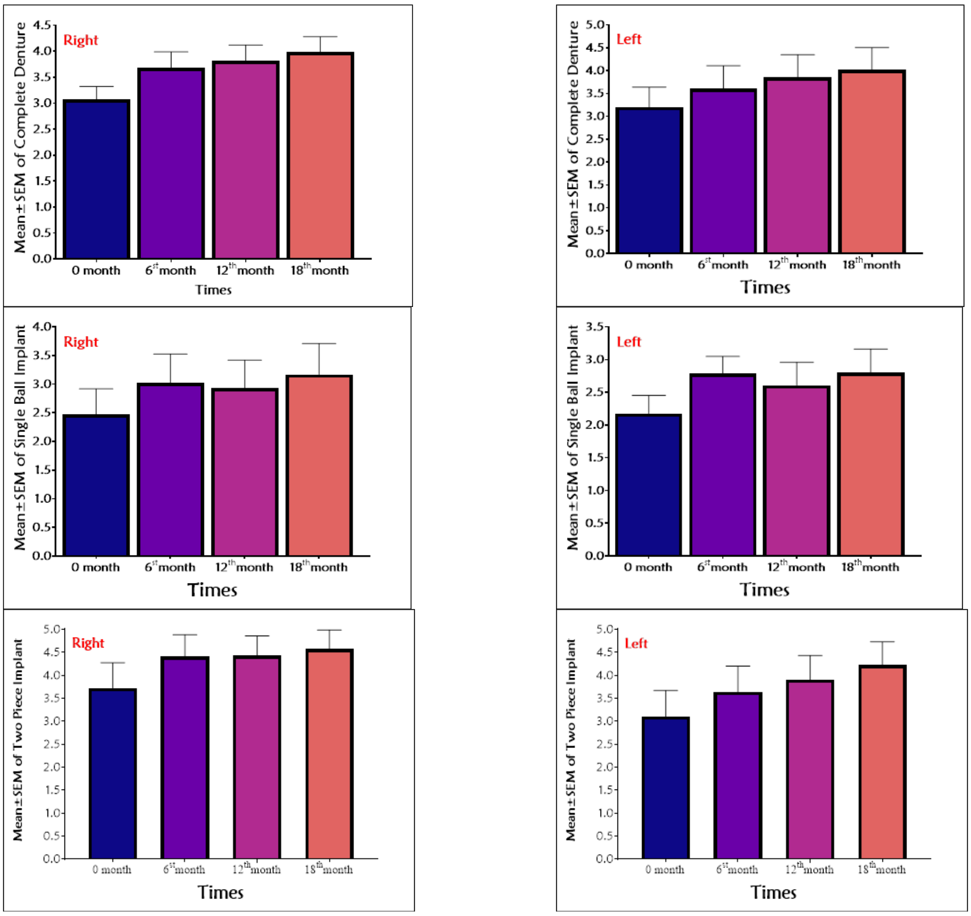
Figure 8: Histogram of **Lingual bone** resorption rate among of CD and all types of ISOD in different times (0, 6, 12, and 18) months.

The purpose of this study was to investigate the impact that the amount of time spent every month has on the occluso-servically of the denture base to the cervical region of dental implants. According to the results of the current study, a longer stay per month has various outcomes for the improvement of the level of the bone in implant supported overdentures. These consequences are discussed in (Table 3), which illustrates the outcomes of the study. Except for the right and left sides of the two-piece locator implant and the right side of the innovative implant, no discernible alterations were observed on either the right or left side after 6, 12, or 18 months from the implant's placement in comparison to the initial period (zero month) in every single instance. In the case of the two-piece locator implant and the right side of the innovative implant, the occluso-cervically implant demonstrated a significant variation between months at both the right and left sides of the dental arch (p-value = 0.0447, 0.0488, and 0.0451 correspondingly; (Figure 9). This variation was found to be significant.

Table 3: Mean±SEM of **Occluso-Cervically bone** resorption rate among of CD and all types of ISOD in different times (0, 6, 12, and 18) months.

Parameters		**0 month**	**6th month**	**12th month**	**18th month**	**p-value**
Complete Denture	Right	3.07±0.2a	3.6±0.30a	3.810.30a	3.9±0.29a	0.07
	Left	3.2±0.43a	3.60±0.5a	3.8±0.49a	4.0±0.48a	0.30
Single Ball Implant	Right	2.4±0.43a	3.02±0.5a	2.9±0.49a	3.1±0.54a	0.74
	Left	2.1±0.27a	2.7±0.2a	2.6±0.35a	2.8±0.35a	0.44
Two Piece Ball Implant	Right	3.7±0.55a	4.41±0.47a	4.4±0.42a	4.5±0.41a	0.36
	Left	3.1±0.56a	3.64±0.56a	3.9±0.52a	4.2±0.51a	0.18
Two Piece Locator Implant	Right	2.8±0.57a	3.3±0.54ab	4.1±0.5b	4.3±0.55b	0.04*
	Left	3.1±0.56a	3.6±0.5a	3.9±0.52a	4.2±0.51b	0.04*
Innovative Implant	Right	4.7±0.50a	4.9±0.54a	5.7±0.71b	5.8±0.70b	0.04*
	Left	4.2±0.7a	4.6±0.7a	5.3±0.80a	5.5±0.79a	0.37

*significant differences



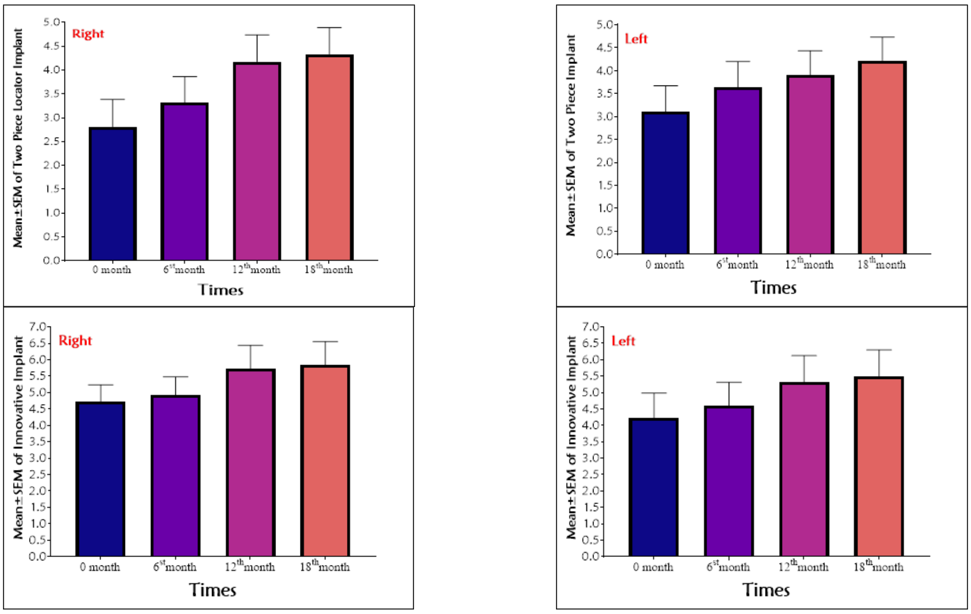


Figure 9: Histogram of **Occluso-Cervically bone** resorption rate among of CD and all types of ISOD at different times (0, 6, 12, and 18) months.

Discussion

The study's findings indicate that the duration of implant placement significantly influences the improvement of bone quantity and reduced of bone resorption, particularly in cases of the single piece implant with ball and socket attachment. The results suggest that longer retention periods correlate with enhanced outcomes, as evidenced by significant differences observed at 6, 12, and 18 months compared to baseline measurements.

In the CBCT evaluation of buccal bone area in mandibular overdenture the best result provided in a single piece implant with ball-socket overdenture may be due to the design of the implant geometry, "Single-piece implants are associated with less bone resorption, likely because they are constructed as a monoblock, which there is no movement in the implant neck area. In contrast, two-piece implants, which feature a screwed abutment, allow micromovement. This movement can result in microbial leakage, contributing to bone resorption around the implant. The two pieces implant with ball-socket attachment was provided the second result of buccal bone resorption level may be due to the design of the ball attachment or implant placement location, after that the two pieces implant with the locator attachment system may be due to the design of locator system because mostly they provide of rigid fixation and may affect of buccal bone resorption. While the CCD cases and innovative implant overdentures revealed more bone resorption in buccal area may be due to more occlusal forces of the prosthesis and bone quality of the patient.

Implants retained for extended periods showed notable improvements in marginal bone loss and buccal bone thickness, aligning with findings from studies that emphasize the importance of time in achieving optimal outcomes [19,20]. The lack of significant differences in the single ball implant group (*p*-values of 0.4691 and 0.4739) suggests that this type may not benefit from prolonged retention, contrasting with other implant types that do [21]. Techniques like GBR have been shown to enhance outcomes in implants with buccal dehiscence, supporting the notion that time and technique are critical for success [22]. The Pink Esthetic Score (PES) remains stable or improves with time, particularly in cases with adequate buccal bone, reinforcing the importance of initial conditions and subsequent management. While the study highlights the positive correlation between duration of time and implant success, it also raises questions about the specific mechanisms at play, particularly for single ball implants, warranting further investigation into their unique characteristics and treatment protocols[23].

In the CBCT evaluation of lingual bone area in mandibular overdenture the best result provided in two pieces implant with locator overdenture may be due to the design of the implant geometry, implant placement location or occlusal load of the prosthesis. The two pieces implant with ball-socket attachment was provided the second result of lingual bone resorption level may be due to the design of the ball attachment or implant placement location, after that the single piece implant with the ball-socket attachment may be due to the design of the implant because mostly they provide of resilient fixation and may effect of lingual bone resorption. While the CCD cases and innovative implant overdentures revealed more bone resorption in lingual area may be due to more occlusal forces of the posterior edentulous area and the prosthesis may effect of the lingual bone of the implants due to of bone quality of the patient.

The investigation into the impact of time on lingually bone in dental implants reveals significant insights, particularly regarding the two-pieces ball implant. The findings indicate that while most implants showed no notable changes over time, the two-piece ball implant exhibited substantial differences after 6, 12, and 18 months, suggesting a unique response to prolonged retention. The study found that the two-piece ball implant demonstrated significant variance in stability, with p-values of 0.0173 and 0.0283 for the right and left sides, respectively [24]. In contrast, other implant types did not show discernible changes, indicating that the two-piece ball implant may require different management strategies over time [25]. The results align with previous studies that emphasize the importance of monitoring implant stability, particularly in patients with specific occlusal schemes [26]. Long-term follow-up is crucial, as evidenced by the need for periodic assessments to ensure optimal outcomes. While the findings highlight the effectiveness of the two-piece ball implant, they also suggest that individual patient factors and implant types may influence outcomes, necessitating tailored approaches in clinical practice [27].

The purpose of this study was to investigate the impact that the amount of time spent every month has on the occlusion of dental implants placed in the cervical region. According to the results of the current study, a longer stay per month has various repercussions for the improvement of the implant. These consequences are discussed in Table 4.3, which illustrates the outcomes of the study. The findings indicate that, with the exception of the right and left sides of the two-piece locator implant and the right side of the innovative implant, no discernible alterations were observed on either the right or left side after 6, 12, or 18 months from the implant's placement when compared to the initial period (zero month) in every single instance. This suggests that, for the majority of the implants studied, the time elapsed since placement did not significantly affect occlusal stability or alignment in the cervical region.

However, in the cases of the two-piece locator implant and the right side of the innovative implant, a significant variation in occlusion was observed. Specifically, the occlusion of these implants demonstrated a marked difference between the months at both the right and left sides of the mouth, with p-values of 0.0447, 0.0488, and 0.0451 respectively. These findings indicate that, for these specific implant types, the time spent each month may have a more pronounced effect on occlusal outcomes, highlighting the importance of monitoring these implants closely over time.

The implications of these results suggest that while many implants may maintain stability over time, certain designs, particularly the two-piece locator and the innovative implant, may require additional attention and potentially modified care protocols to ensure optimal occlusal function. The result may be due to the two-pieces implant are associated with more bone resorption, likely because they are constructed as a connection of locator abutment with root form fixture, which there is a micromovement in the implant neck area. The feature of a screwed abutment, allow movement and some time screw loosening. This movement can result in microbial leakage and contributing to bone resorption around the implant.

Future studies could further explore the underlying mechanisms contributing to these variations and assess whether specific patient factors or implant characteristics influence the observed outcomes. Overall, this study contributes valuable insights into the relationship between time and occlusal loading in dental implants, emphasizing the need for on-going research in this area to enhance clinical practices and patient outcomes. The results of this study provide valuable insights into the relationship between the duration of time spent with dental implants in the cervical region and the effects on occlusion. The findings indicate that the amount of time spent with the implants has a measurable impact on their occlusal stability, particularly in certain implant types and locations.

The significant differences observed in occlusion for the two-piece locator implant and the right side of the innovative implant suggest that these designs may be more susceptible to changes over time. Specifically, as shown in Table 4.3, the p-values of 0.0447, 0.0488, and 0.0451 signify statistically significant variations in occlusion over the study period. These results are in line with previous research suggesting that implant design and positioning play critical roles in occlusal outcomes [28]. Interestingly, the lack of discernible changes in occlusion on the right and left sides for the majority of the implants after 6, 12, and 18 months indicates that not all implant types respond similarly to prolonged exposure to occlusal forces. This finding may point to the stability of certain implant designs under functional loading, suggesting that their structural integrity remains intact over time. In contrast, the two-piece locator implant's variation highlights the potential need for periodic evaluations and adjustments to maintain optimal occlusal relationships, especially in the cervical region where anatomical complexities can influence implant performance [29].

Clinicians should be aware that while some implants may show stability, others might require closer monitoring and potential modification to address occlusal discrepancies [7]. Furthermore, the implications of these findings extend to patient education. Patients should be informed about the importance of regular follow-up appointments to assess the status of their implants, particularly for those with designs that have shown variability in occlusion over time. This proactive approach could lead to earlier interventions, minimizing the risk of complications that can arise from maladjusted occlusion [24,30]. The findings advocate for tailored monitoring strategies based on implant characteristics and patient-specific factors to enhance long-term outcomes.

Conclusions

When compared with the CBCT baseline data, the results revealed no significant change in marginal bone level in a single piece implant with the ball and socket attachment types of overdenture while in other types of two pieces implant with attachment system which affected of more bone resorption in 18 months of patient follow up period. The study demonstrated that the marginal bone level is affected by many factors (age of the patient, muscle efficiency, occlusal forces and attachment types of the overdenture).

Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent forms. In the form the patient(s) have given their consent their images and other clinical information to be reported in the journal. The patients understood that their names and initials will not be published and their identity will be concealed

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