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Digital Bite Force and Peri-Implant Bone Loss Evaluation with Attachments Used in Implant-Retained Mandibular Overdentures

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ABSTRACT

It has been recognized that attachments used with implant overdentures improve function and extend the longevity of the prosthesis in completely edentulous patients. **The objective** of this study was to compare the difference between two different attachments, Locator and OLS (One-piece Locator abutment System) used with implant-retained mandibular overdentures, regarding the bite force and peri-implant marginal bone loss. **Materials and methods:** 20 completely edentulous patients were categorized into two groups, (group I) received two implants with Locator attachments retaining mandibular overdentures, (group II) received the same treatment but the attachments were OLS. Peri-implant bone loss using cone beam computed tomography (CBCT) was evaluated as the primary outcome, and bite force using T- Scan was assessed as a secondary outcome, and both records were compared between the two groups. **Results:** The difference in bone height changes between the two groups, was not statistically significant at 3 and 6 months but there was a significant difference after 12 months, in which (group II) had marginal bone loss significantly higher than (group I). At all times of evaluation, there was no significant difference in all the parameters tested by the T-Scan (maximum occlusal force, number of contacts, and bilateral difference in occlusal force) between the two groups. **Conclusion:** Locator attachments exert less stress on peri-implant bone than OLS attachments, thus less peri-implant bone loss. As for digital occlusal analysis, both Locator and OLS attachments have comparable results on occlusal force distribution and the number of tooth contacts.

Keywords: Overdenture, Locator attachment, OLS attachment, CBCT, Digital occlusal analysis

1. Introduction

Complete dentures, especially the mandibular, have encountered several limitations. The mandibular denture-bearing area is confined, and its load-bearing capacity is limited, leading to compromised denture support, stability, and retention. This leads to psychological and functional limitations such as hindered chewing function and diminished quality of life (Kutkut *et al.,* 2018; Possebon *et al.,* 2020). Based on recent evidence, complete dentures are not the recommended line of treatment anymore (Thomason *et al.,* 2012).

Clinical research has shown that implant mandibular overdenture is an economic alternative for the manipulation of edentulous patients, with enhanced chewing efficiency and patients' quality of life (Emami *et al.,* 2009). High patient satisfaction rates, bone maintenance, implant survival rates, and superior stability and function of two-implant mandibular overdentures are already proven (Feine *et al.,* 2002; Thomason *et al.,* 2009; Zhang *et al.,* 2019). Even though the several merits of implant overdentures, they are used in only a few situations, like elderly patients, those with systemic diseases that limit extensive surgical procedures and time, or when the expense is a limiting factor (Mundt T. *et al.,* 2015).

Bending forces on implants can be controlled by attachments because of their stress-breaking action (Boven *et al.,* 2015; Scherer *et al.,* 2014). The type of attachment utilized is the main factor that

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affects the amount of stress transmitted to the implants (Elkerdawy M. W. & Radi., 2011). The attachment design should provide excellent stress distribution on the peri-implant bone to grant loading within its physiological limits (Manju & Sreelal., 2013).

Stud attachments are the most popular type of attachments used with overdentures, because they are easily manipulated, cost-effective, have less technique sensitivity, better force distribution, and have good retention qualities (Passia *et al.,* 2014). Selecting the type of attachment should be planned early in the treatment process, considering implant alignment, the amount of retention needed, and the characteristics of the edentulous ridge(Stafford, 2019).

One of the most recently used stud attachments is the Locator since it is simple to use and is compatible with implants from a variety of manufacturers. It has a dual retention characteristic, due to the inner and outer contact surfaces between the female and male parts, as well as the frictional retention from the male part being a bit bigger than the inner ring of the abutment (Evtimovska *et al.,* 2009). Also, its self-aligning capability owing to the abutment having round edges assisting the denture during insertion, enhancing durability, and reducing wear. Furthermore, it has innate angulation compensation for unparallel implants. It is easy and swift to replace its components, and convenient to be inserted intra-orally by the patient (Evtimovska *et al.,* 2009.).

The OLS (One-piece Locator abutment System) attachment has parallel walls and a PEEK (Poly Ether Ether Ketone) retentive matrix. The PEEK matrix has a slot and a hole on top, this slot and hole extend when connecting them together and act as a buffer, preserving the matrix surface and resulting in reduced wear. PEEK has shown flexibility, good mechanical resistance to wear, high tensile, fatigue, and flexural strength to be used as attachment matrix (Passia *et al.,* 2016.).

Cone beam computed tomography (CBCT) precisely pinpoints vital structures and assesses the surgical site, making it possible to pre-surgically determine with 3D views the best position and inclination for implant placement, also allow to measure the bone height of all implant surfaces with great accuracy (Rossi *et al.,* 2010; Viegas *et al.,* 2010).

The bite force is known as the force exerted by masticatory muscles on the occlusal surfaces of teeth, having a substantial significance on masticatory ability. Instead of complete dentures, if implant-supported overdentures are provided to edentulous patients, the maximum bite force is almost doubled, corresponding to about two-thirds of the value obtained for dentate subjects (Fontijn-Tekamp *et al.,* 2000; Youssef, 2022). Many instruments can be utilized in recording the biting force. The majority of these devices employ force transducers such as strain gauges, piezoresistive, piezoelectric, optical fiber, and pressure-sensitive films (Alam & Alfawzan, 2020).

T- Scan can digitally and accurately record the occlusal contact time, force, and area, it can also dynamically analyze the occlusal contact conditions. The patients' occlusal dynamics are accurately recognized by computer analysis software, simultaneously with a three-dimensional map of the dynamic alterations in the patients' bite force, and the patients' bizarre occlusal force distribution areas and occlusal contact points can be precisely marked (Gozler, 2018.).

T-scan is made of thin film, which does not interfere with the occlusion when measuring the bite force. However, after repeated use of the T-Scan film, its accuracy will be reduced, so its repeatability is questionable (Gu Y. *et al.,* 2021).

Studies on stud attachments with PEEK retentive matrices are scarce in the literature; thus, we have chosen this point to investigate in the present study.

This study was aimed to compare the difference between two different attachments, Locator and OLS (One-piece Locator abutment System) used with implant-retained mandibular overdentures, regarding the bite force and peri-implant marginal bone loss.

The null hypothesis was that there would be no significant difference in marginal bone loss and bite force between the OLS attachment and Locator attachment.

2. Materials and Methods

The present study was conducted according to the principles embodied in the Helsinki Declaration, revised in 2008, for biomedical research involving human subjects ("World Medical Association. WMA Declaration of Helsinki - Ethical Principles for Medical Research Involving Human Subjects. 2008.," ; World., 2008.). The study was approved by the ethical committee of the faculty of dentistry Ahram Canadian University (Approval No IRB00012891#33).

2.1. Patients' selection

In this randomized clinical trial, 20 completely edentulous patients were enrolled from the outpatient clinic of removable prosthodontics department, Faculty of Dentistry, Ahram Canadian University.

Inclusion criteria: patients eligible for this study were males, completely edentulous patients with age ranging between 55 to 65 years, with bone height and width more than 12 mm and 5 mm, respectively, in the anterior region of the mandible, and good oral hygiene awareness.

Exclusion criteria: maxillomandibular skeletal discrepancy, abnormal oral habits, TMJ disorders, smokers, history of head & neck radiation, systemic disorders that may prevent surgery, and psychological or neuromuscular incompetence.

The sample size calculation was conducted by the program (G. Power program, University of Düsseldorf, Düsseldorf, Germany). Eighteen patients (Metwally., 2019) will give the power of 80%, two more patients were enrolled to account for the 20% dropout; thus, the total number was twenty patients.

Each patient who agreed to participate in the study was informed in detail about the procedures to be conducted before signing the informed consent form.

2.2. Prosthetic procedure

Each patient received a conventional complete denture for the maxillary and mandibular arches constructed by the conventional technique by the same prosthodontist and the same laboratory technician to decrease the margin of difference between the constructed dentures.

Any necessary adjustments were carried out to eliminate occlusal interference and obtain balanced occlusion, then the dentures were delivered to the patients. A follow-up period of three months was given to conduct any adjustments needed and to allow for patient accommodation with the new dentures.

Following denture placement and patient adaptation, the mandibular denture was duplicated in clear acrylic resin (Vertex Rapid Simplified; Vertex-Dental B V, Zeist, The Netherlands) to create a radiographic stent with a gutta percha radiopaque markers at the proposed implant sites, then turned into surgical guide for implant positioning to assure proper implants installation.

Patients were randomly divided into two equal groups according to the type of attachments they received.

Group (I): received Locator (Zest Anchors Inc. Escandido, CA, USA) attachments, the standard range type.

Group (II): received OLS (Osteoseal dental implant, California, USA) attachments as shown in Figure (1).

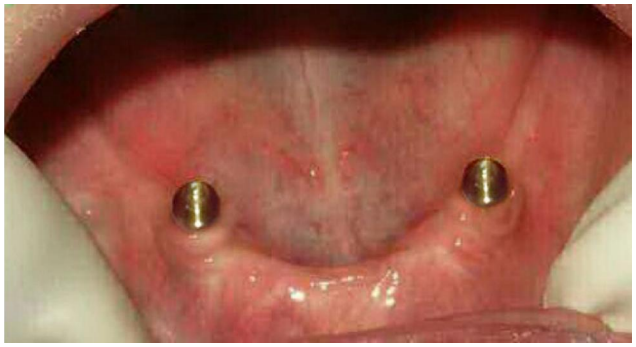

Fig. 1: Shows OLS attachments

2.3. Surgical procedures

Two implants (Neobiotech Dental implant Korea) were inserted for each patient in both groups, with dimensions 3.5 mm in diameter and 10 mm in length, bilaterally in the canine region parallel to each other and perpendicular to the occlusal plane. A flapless technique was adopted. The surgical stent was placed in position and the implants' sites were drilled through the preprepared holes, then the implants were inserted, and the stent was removed to secure the implants in position so that the threads were covered by bone. To avoid implant overloading during the osseointegration period, the

areas of the denture's fitting surface corresponding to implants were relieved, then lining the fitting surface with tissue conditioning material (Visco-gel, Dentsply, Weybridge, Surrey, UK). The implants were left to heal for three months and the osseointegration of the implants was verified by digital panoramic radiographs.

2.4. Pick-up Stage

In both groups after the healing period, the housing cap assemblies were placed over the attachments; then the tissue conditioning material was removed, and the fitting surfaces of the mandibular dentures were marked for the positions of attachments. Thus, a closed mouth technique and direct pick-up was adopted. Relieved areas corresponding to the housing cap assembly were made in the fitting surface of the denture if needed, and small vent holes were made in the lingual surface for escape of the excess resin. A chemical cured acrylic resin was added to the relived areas of the fitting surface and the denture was inserted in the mandible with the patient closing in centric position, after setting the excess was removed. Figure (2) shows the PEEK matrix of OLS attachments.

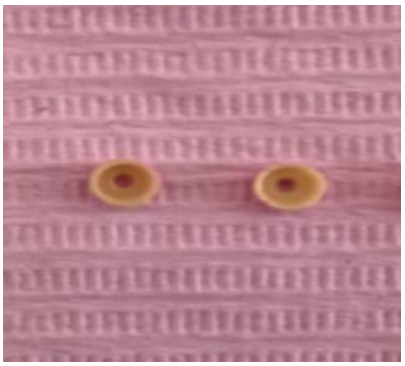

Fig. 2: Shows the PEEK matrix of OLS attachments

Necessary adjustments were carried out to eliminate occlusal interference and the denture was delivered to the patient and checked after 24 and 72 hours for any needed adjustments, and to ensure that the patient was satisfied with esthetics, stability, and retention of the denture.
Evaluations were scheduled at the overdenture loading time, three, six, and twelve months following denture insertion. At these intervals, patients return for assessment of the implants, prothesis's function and standardized evaluation of the oral health.

2.5. Bone height evaluation

For each patient, peri-implant crestal bone height was measured using cone beam computed tomography CBCT (Scanora 3D, Sorredex-Finland) with the images displayed as shown in Figure (3).

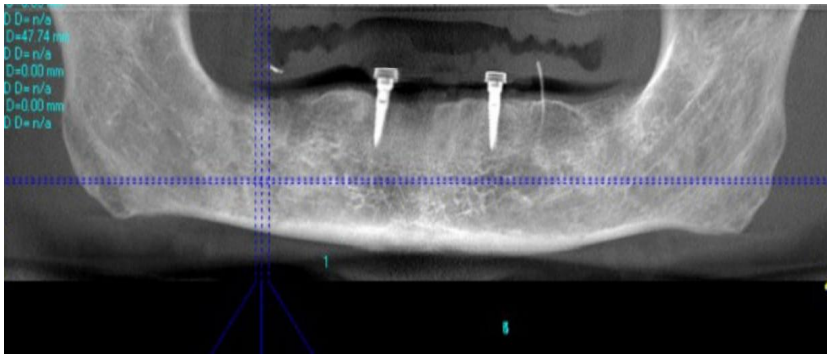

Fig. 3: Shows the CBCT of two implants with Locator attachments

CBCT was performed immediately after implant overdenture insertion, three, six, and twelve months after implant loading to assess peri-implant marginal bone height changes.

The CBCT images were obtained while the patient was in a standard upright position. The patient's head was positioned within the circular gantry housing of the x-ray tube, to ensure consistent orientation of the images. CBCT images were adjusted at standardized settings focal spot of 0.3 mm; effective dose of 99 uSv, 10 mA, 120 kVp, 14-bits grey scale and 36s exposure time and the field of view (FOV) was limited to the mandible. Digital Imaging and Communications in Medicine (DICOM) data was moved to another workstation after image acquisition; images were displayed using Blue Sky Plan software (Blue Sky, IL, USA). Reconstructed panoramic images were created by drawing the panoramic curve on the axial image and then used to measure the bone level on the buccal, lingual, mesial, and distal aspects of each implant. After that, the cross-sectional images were created parallel to the implant long axis to measure bone level. To measure the amount of marginal bone loss, the distance from highest bone contact with the implant (as a first point), to the implant apical end (as a second point) was measured using the ruler measuring tool of the software to give bone height. Two horizontal lines were drawn and a vertical line between them is a measuring line as shown in Figure (4).

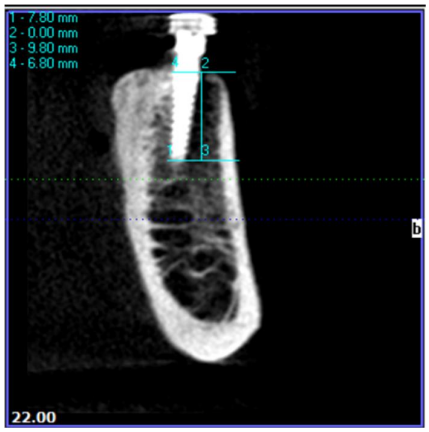

Fig. 4: Shows linear measurements of buccal and lingual per-implant bone height

For each implant 4 measurements of the 4 surfaces were recorded and an average for each patient was calculated, then the mean difference between each measurement at each time interval was recorded for each surface of all patients and the average of the 4 surfaces was labeled as total. Comparing the measurements from each measuring time to the other was conducted by subtracting the height of bone from the two successive measurements.

2.6. Digital occlusal analysis

A T-Scan III system (Tekscan Inc., South Boston, MA, USA) was used for digital occlusal analysis. The equipment is composed of a sensor with a handle, the system unit that is operated by computer software (T-Scan 8, Software version 8.0.1, Tekscan, Inc.), and a printer. A sensor of suitable size was selected according to the patients' arch size. The patient was asked to sit in an upright position. The sensor was inserted intra-orally between the maxillary and mandibular arches, in which the central line must coincide with the upper central incisors' midline. The sensor's sensitivity was adjusted by instructing each patient to bite in maximal intercuspation two to four times before starting the records. Each patient was instructed to bite on the sensor until maximum intercuspation was reached and to keep this position for one to three seconds before releasing. This process was repeated until occlusal contacts showed on the computer screen, the handle switch was clicked, and therefore the arch model was generated. Recordings were processed for graphical display in two and three dimensions. Each reading was done three times for each patient, and an average reading was taken as shown in Figure (5).

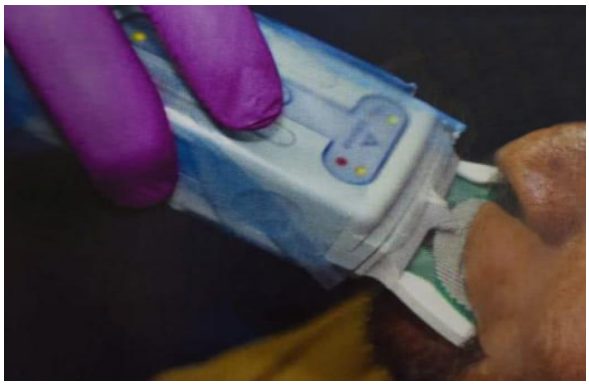

Fig. 5: Shows T-scan in the patient's mouth

T-Scan offered the force distribution and maximum occlusal contact force measurements. The bite force distribution was assessed in three ways: force distribution, number of contacts, and bilateral force difference. For measuring the degree of force distribution, the dental arch was divided into four sections, the cuspids and premolars in one and the molars in the other for each side of the arch. The number of tooth contacts were calculated using the amount of tooth contact that exists between the cuspid and the second molar. The bilateral force difference is the percentage difference in chewing regions between both arch sides from the cuspid to the second molar. Digital occlusal analyses were performed at the time of implant loading, then three months, six months, and twelve months after prosthesis loading.

2.7. Statistical analysis

Data were revealed as the mean difference in (mm) and standard deviation (SD) values. Assessing the normality distribution of the evaluated parameters, using Shapiro-Wilk and the Kolmogorov-Smirnov tests. One-way ANOVA test was used to compare mean difference in (mm) of bone loss and for bite force changes within the same group, followed by Turkey's post-hock test for multiple comparisons. An independent T-test was used to compare between the two groups regarding mean differences in (mm) of bone loss and bite force at each time interval. The software used was Microsoft Excel 2016, Statistical Package for Social Science (SPSS) Ver. 24 and Minitab statistical software Ver. 16. The significant level was set at $P \leq 0.05$.

3. Results

All patients completed the course of the study, with no loss of any implant.

3.1. Radiographic bone loss evaluation results

There was a decrease in bone height throughout the period of the study in both groups, but the bone resorption peak was observed at the first 6 months.

Bone loss was significant at the measurements of the four surfaces and of the total too in both groups at all time intervals. The results are shown in Table (1) as mean difference at each implant surface average and as the total mean difference of all surfaces of all implants in both groups.

As shown in Table (1), peri-implant marginal bone loss mean difference from baseline to 3 months in total was 0.18 ± 0.07mm in group (I) and was 0.23 ± 0.10mm in group (II). Peri-implant marginal bone loss mean difference from 3 to 6 months in total was 0.24 ± 0.08mm in group (I) and was 0.21 ± 0.09mm in group (II). Peri-implant marginal bone loss mean difference from 6 to 12 months in total was 0.37 ± 0.14mm in group (I) and was 0.61 ± 0.15mm in group (II). Peri-implant marginal bone loss mean difference from baseline to 12 months in total was 0.56 ± 0.18mm in group (I) and was 0.75 ± 0.21mm in group (II).

Table 1: Presents the comparison between both groups regarding the mean difference of bone loss at all time intervals.

		Group I (Locator)		Group II (OLS)		P Value
		MD	± SD	MD	± SD	
Baseline – 3 months	Mesial	0.14	± 0.06	0.18	± 0.08	0.13
	Distal	0.13	± 0.04	0.24	± 0.10	0.10
	Buccal	0.26	± 0.02	0.31	± 0.09	0.15
	Lingual	0.18	± 0.03	0.21	± 0.09	0.06
	Total	0.18	± 0.07	0.23	± 0.10	0.07
3 months – 6 months	Mesial	0.16	± 0.06	0.17	± 0.09	0.07
	Distal	0.17	± 0.05	0.21	± 0.08	0.09
	Buccal	0.23	± 0.08	0.27	± 0.10	0.08
	Lingual	0.22	± 0.04	0.20	± 0.07	0.06
	Total	0.24	± 0.08	0.21	± 0.09	0.07
6 months – 12 months	Mesial	0.38	± 0.10	0.51	± 0.14	0.03*
	Distal	0.37	± 0.17	0.54	± 0.09	0.04*
	Buccal	0.45	± 0.10	0.67	± 0.13	0.004*
	Lingual	0.32	± 0.18	0.62	± 0.16	0.002*
	Total	0.37	± 0.14	0.61	± 0.15	0.02*
Baseline – 12 months	Mesial	0.53	± 0.21	0.70	± 0.14	0.04*
	Distal	0.52	± 0.18	0.72	± 0.11	0.04*
	Buccal	1.71	± 0.22	0.01	± 0.06	0.001*
	Lingual	0.46	± 0.16	0.79	± 0.19	0.005*
	Total	0.56	± 0.18	0.75	± 0.21	0.005*

MD= Mean Difference SD= Standard Deviation * Significance difference (P< 0.05)

Upon comparing the two groups (I & II), the difference in bone height changes was not statistically significant at 3, and 6 months, but there was a significant difference in peri-implant bone loss after 12 months of follow-up. At the end of the 12 months, group (II) had marginal bone loss significantly higher than group (I). P-value was < 0.05.

3.2. T-scan occlusal analysis results

The data were represented as mean and standard deviation. During the period of the study there was an increase in level of maximum occlusal force from the time of implant loading till the end of one year of use in both groups (I, II) as shown in Figure (6).

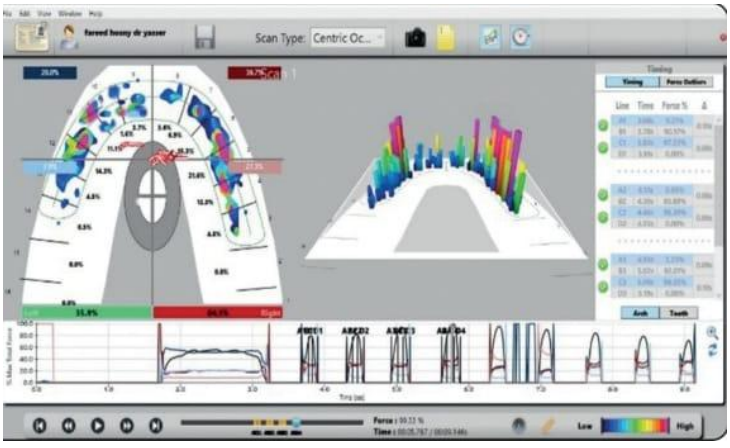

Fig. 6: Shows 3D and 2D distribution of bite force and its percentage on the software

Table (2) shows the percentage of maximum occlusal force at the baseline to be 70.72± 3.01in group (I) and 73.29± 3.37 in group (II). At 3 months occlusal force in group (I) was 77.52± 3.10 and in group (II) was 80.63± 3.49. At the time of 6 months, in group (I) was 80.20± 2.96 and in group (II) was 84.89± 3.01. After 12 months in group (I) was 86.81± 3.02 and in group (II) was 88.52± 2.91.

Table 2: Presents the maximum occlusal force percentage between groups at different times

	Baseline	3 months	6 months	12 months
Group I	70.72± 3.01	77.52± 3.10	80.20± 2.96	86.81± 3.02
Group II	73.29± 3.37	80.63± 3.49	84.89± 3.01	88.52± 2.91
P value	0.431	0.390	0.311	0.182

Table (3) shows the bilateral difference of bite force among both groups, at the baseline in group (I) was 35.82± 8.71 and 33.29± 8.77 in group (II). At 3 months in group (I) to be 37.02± 9.10 and in group (II) to be 35.67± 9.49. At the time of 6 months, in group (I) was 38.99± 9.56 and in group (II) was 36.91± 9.51. After 12 months in group (I) was 41.15± 9.62 and in group (II) was 40.02± 9.58.

Table 3: Presents the percentage of bilateral force difference between groups at different times

	Baseline	3 months	6 months	12 months
Group I	35.82± 8.71	37.02± 9.10	38.99± 9.56	41.15± 9.62
Group II	33.29± 8.77	35.67± 9.49	36.91± 9.51	40.02± 9.58
P value	0.24	0.33	0.19	0.25

Table (4) shows the number of tooth contact in both groups, at the baseline in group (I) was 6.42± 0.71 and 6.29± 0.77 in group (II). At 3 months in group (I) to be 7.62± 0.58 and in group (II) to be 7.28± 0.61. At the time of 6 months, in group (I) was 7.89± 0.66 and in group (II) was 7.59± 0.99. After 12 months in group (I) was 8.05± 1.06 and in group (II) was 7.98± 1.01.

Table 4: Presents the number of tooth contact in both groups at different times

	Baseline	3 months	6 months	12 months
Group I	6.42± 0.71	7.62± 0.58	7.89± 0.66	8.05± 1.06
Group II	6.29± 0.77	7.28± 0.61	7.59± 0.99	7.98± 1.01
P value	0.19	0.28	0.37	0.55

At all times of evaluation there was no significant difference in all the parameters tested (maximum occlusal force, number of contacts, and bilateral difference in occlusal force) between the two groups.

4. Discussion

Numerous aspects influence treatment success, as appropriate denture design, construction, competent tissue support, and stress reduction through routine maintenance (Feine J.S. *et al.,* 2002). These points were taken into consideration during treatment planning and construction of the replacement devices, also during the follow-up appointments to ensure treatment success in the present study.

After inserting new dentures, the muscles of mastication return to their original activity level after a 3-month adaptation time, which was justified as providing satisfactory neuromuscular adaptation period for the users (Eberhard *et al.,* 2018; Van Kampen et al., 2002). Therefore, it was planned in this study to give all the prostheses tested a three-months adaptation period before implants insertion.

Several studies stated that CBCT can provide direct and actual measurements without magnification, thus, using CBCT in measuring the implant alveolar bone changes was advocated with acceptable accuracy (Koutouzis & Ali, 2021; Song *et al.,* 2021.). That was the reason we measured peri-implant bone loss using the linear method of CBCT in the present study.

The total mean value of bone loss in both groups did not exceed 1 mm after a one year follow-up in this study, which is reported and accepted by several authors (Komiyama *et al.,* 2012; Mahrous & Abbas, 2022; Saravi *et al.,* 2020).

When an attachment system with high retention is used, like the Locator, it is advised to use soft material as matrix, to decrease stresses transferred to the bone. As it is known that attachments

transmitting fewer loads on the bone usually are on the expense of retention (Elkerdawy M. W. & Radi., 2011). Previous studies reported that PEEK retentive matrices showed higher retentive characteristics when compared to nylon matrices (Khourazaty, 2017; Mai Diab *et al.,* 2020; Wichmann *et al.,* 2020). That may be the reason that OLS attachment with PEEK matrix exerts more stress than Locator attachment with nylon inserts that was observed in this study, also because OLS attachment has long walls and of course despite the known flexibility of PEEK material used as matrix of OLS attachment, it is less flexible than nylon matrix used with Locator attachment.

The difference in bone loss between the two attachments found in this study can also be supported by an in vitro study approving that attachment type and design have a great influence on the amount of forces transmitted to the implants and peri-implant bone (ELsyad *et al.,* 2017). OLS height is more than Locator with higher friction retention thus its design may transmit more forces to the peri-implant bone. Another study showed that OLS attachment with PEEK retentive matrix had comparable effects with ball attachments on the amount of bone loss after 24 months of function, which was within acceptable levels (Nada El Khourazaty & Nassouhy., 2017.).

On the contrary to the results of our study, another study concluded that, OLS attachment with PEEK matrix recorded less bone resorption on all surfaces in comparison to Locator attachment (Mai H. Diab *et al.,* 2020), and attributed this to the durability and flexibility of PEEK matrix.

A study stated that occlusal analysis to ensure the proper overdenture occlusion is a critical step in implant prosthesis success. To evaluate the different occlusion variables, digital occlusal analysis with a T- scan device can be utilized (Kabbua *et al.,* 2020). Another study stated that T-scan can be beneficial in analyzing the amount of force distribution, bilateral force difference, tooth contact number, and maximum occlusal contact force in overdentures retained by implants (Yasser Shawky & Youssef, 2022). T- Scan digital occlusal analysis also aids in conducting bilateral balanced occlusal contacts in complete dentures (Metwally, 2019). All the previous studies were the reason we evaluated occlusal force distribution using the T-scan system.

In this present study, the occlusal analysis of overdentures was compared after implant loading, then after 3, 6, and 12 months of use. Maximum occlusal bite force was increased in both groups significantly after one year of function. The bilateral balanced occlusion scheme is evaluated by force distribution; thus, patients can use their dentures more efficiently with this occlusal scheme. According to our findings, both types of attachments did not jeopardize the balanced occlusion that was designed during denture construction. T-scan is better at identifying occlusal force position and distribution than articulating paper, and as a result, force distribution patterns on both arch sides are enhanced, with a reduction of the occlusal load mutually between the anterior and posterior regions (Yasser Shawky & Youssef., 2022). The results of this study revealed that tooth contact numbers increased significantly in both groups during the follow-up periods, which could be attributed to occlusal adjustment using T-scan and improved overdenture function following implant insertion as other studies concluded (Kabbua *et al.,* 2020; Yasser Shawky & Youssef., 2022).

The null hypothesis of no significant differences in peri-implant bone loss between the two attachments was denied by the findings of this study, where there was a significant difference between both groups in which overdentures using OLS attachments had higher peri-implant bone loss than Locator attachments. As regards to maximum bite force, the null hypothesis was supported by the findings of this study, in which there was no significant difference between the two groups.

This study was limited by its small sample size, short follow-up period, comparison between only two attachment types; also, T-scan represents the readings as percentages and not actual numerical values in Newton.

5. Conclusion

Within the limitations of this study, use of implant supported mandibular overdentures improves patients' functions as mastication and preserves residual bone. Locator attachments exert less stress on peri-implant bone than OLS attachments, thus less peri-implant bone loss. As for digital occlusal analysis, both Locator and OLS attachments have comparable results on occlusal force distribution and the number of tooth contacts with no significant difference.

The authors declare no conflict of interest.

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