

## COMPARATIVE STUDY OF PATIENTS' SATISFACTION AND BITING FORCE BETWEEN RIGID AND RESILIENT TELESCOPIC ATTACHMENTS IN IMPLANT OVER DENTURE

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### ABSTRACT

**Purpose:** The aim of this study was a comparative effect of using rigid and resilient telescopic attachments in two implant tissue supported mandibular overdentures on the patients' satisfaction and biting force.

**Material and methods:** Twelve edentulous patients (6 males, 6 females) who were unsatisfied with the retention and stability of their existing mandibular dentures were sorted into two equal groups at random. An implant tissue supported mandibular overdentures with a rigid telescopic attachment was given to Group I and an implant tissue supported mandibular overdentures with a resilient telescopic attachment was given to Group II. Patients' satisfaction and biting force were measured at 3 months after overdentures pickup, and all data was gathered and tabulated.

**Results:** The obtained data revealed that the parameters of VAS for group II were higher for Functional complain about denture, Overall masticating ability, Masticating ability for different types of food and Overall satisfaction than those treated with Mandibular over denture by rigid telescopic attachment (group I) However, the ratings for the same group were lower for Effect on mental and daily life as compared with the group I, but the higher and lesser readings were insignificant between both groups as (P value > 0.05). The biting force for Group II was shown significant higher readings with total biting force and peck biting force when compared with Group I as (p<0.001). However, the ratings showed insignificant difference between both groups at low biting force as (p=0.476)..

**Conclusion:** Within the limitations of this study caused by small patient sample and short evaluation period. The current study concluded that both rigid and resilient telescopic mandibular overdentures achieve great patients' Satisfaction and a proper biting force. However, the mandibular implant overdentures with the resilient telescopic attachment might be selected over rigid telescopic attachment when designing a two implant retained mandibular overdentures since it is more superior at the biting force from this study point of view.

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## INTRODUCTION

Mandibular overdenture attachments include bar, magnet, ball, and telescopic. Telescopic overdentures cover any remaining natural teeth, natural tooth roots, or dental implants. <sup>(1)</sup> Telescopic rigid attachments terminate between the inner and outer copings. While low friction enables easy removal of the overdenture, high friction inhibits movement during function. Resilient telescopes have non-rigid parallel-wall copings with no fixed apical end positions, but they have a space between the inner and outer copings to allow for vertical movement under load, dispersing pressures to the mucosal rest zones. <sup>(2)</sup> Patient satisfaction with healthcare is a concept that enables researchers to evaluate a facility's capacity to meet the requirements and expectations of patients. As a result, satisfied patients are more likely to follow their dentist's advice, resulting in a more successful treatment. <sup>(3)</sup>

Bite force is one of the indications of the masticatory system's functioning status. It is generated by jaw elevator muscles and modified by cranio-mandibular biomechanics. Numerous studies have established a linear relationship between the effectiveness of the masticatory system and maximal chomping (MBF). Improper complete denture treatment might accelerate alveolar bone loss and lower patient self-esteem. <sup>(5,6)</sup> Patients' satisfaction with their lower dentures, denture retention, stability, mastication, and speech all play a critical role in determining the effectiveness of rehabilitation therapy. <sup>(7)</sup>

Overdenture wearers, like dentulous individuals, have masticatory problems. This benefit is critical for edentulous individuals to receive adequate nourishment and enjoy a higher quality of life. <sup>(8)</sup> Telescoping crowns offer greater implant placement mobility and easier access for dental hygiene than bars. <sup>(10,11)</sup> The existence or lack of gap between primary and secondary copings and end position determines whether a telescopic overdenture is rigid

or non-rigid (resilient). The rigid type has a termination between the inner and outer copings. The overdenture is easily removed, however the friction prevents movement during function. The resilient type of parallel walled telescopic copings do not have defined apical end positions, but do have a space between the inner and outer copings to allow for some vertical movement under load and thus spreading pressures to the mucosal rest zones. <sup>(1)</sup> As a result of the fulcrum action of denture saddles, the amount of force transmitted from the implant to the bone is determined by the rigidity of the attachment and the thickness of the mucosa. Reduces loading of denture-bearing areas, and minimises posterior mandibular ridge resorption when compared to rigid attachments <sup>(12)</sup> it also improves the stability, comfort, and chewing capacity of the prosthesis. <sup>(13)</sup>

Oral function improves markedly after rehabilitation with a mandibular. Implant overdenture. <sup>(14,15)</sup> Overdenture wearers experience similar masticatory problems to dentate individuals. This is a critical advantage for optimal nutrition circumstances and a higher quality of life for persons who are edentulous. <sup>(16,17)</sup>

Biting force and surface electromyographic (EMG) recordings were used to evaluate the masticatory system's efficiency. <sup>(18,19)</sup> Bite force is determined by the action of jaw elevator muscles, which is influenced by Cranio-mandibular biomechanics. <sup>(20,21)</sup> Bite force affects the masticatory system. It has been shown that slight changes in bite force can result in 50% changes in chewing efficiency. The magnitude of biting force has also been associated to patient satisfaction. Dentures, patient diet, and food intake. Of prosthetic bone resorption. When assessing contentment. <sup>(22,23)</sup>

When evaluating satisfaction. With dentures to assist dentists in making this assessment, a detailed self-evaluation questionnaire was created. <sup>(24)</sup>, however: Boerrigter's technique takes into account three factors: (1) denture-related is-

sues: Any issue or complication. Arising from denture use; (2) masticating ability: Chewing performance when patients eat a variety of foods; and (3) overall denture performance: The physical and life impacts of the denture on the patient. Scores are assigned to different answers to each question, and the total score can be generated for additional examination and analysis. <sup>(25,26)</sup> Grandmont describes the Visual Analogue Scale (VAS) in detail. The greatest and worst are represented by the two endpoints (anchors) in a line about 10 cm apart. For each question, patients sketch a spot between two anchors to represent their feelings. The distances between the location and the anchors could be calculated and measured. Scores can be used to represent patient satisfaction after quantification. <sup>(27)</sup> The aim of this study was a comparative effect of using rigid and resilient telescopic attachments in two implant tissue supported mandibular overdentures on the patients' satisfaction and biting force.

## MATERIAL AND METHODS

### Patient enrollment

Twelve edentulous patients (6 males, 6 females) age ranged (55-60 year) with previous complete denture experience were enrolled in this study from the Outpatient clinic, Removable Prosthodontics Department, Faculty of Dentistry, Fayoum University. The inclusion criteria of the selected patients are: 1) Patients presented clear preference for a stable prosthesis, 2) sufficient remaining bone in height, width and thickness in the interforaminal area to allow installation of at least 3.4mm diameter implants in canine region 3) Adequate amount of interarch space of at least 12mm. Patients with the following conditions were excluded: 1) systemic and metabolic diseases that may affect osseointegration such as diabetes mellitus and hyperparathyroidism, 2, blood disorders, 3) patients under radiotherapy or chemotherapy. After the patients were informed about the line of treatment and the need for regular

and frequent recalls, they all signed a written consent. The patients were categorized by age, gender, and bone height in the mandibular anterior region and were randomly assigned into 2 groups using balanced randomization, then comparison of baseline criteria between groups was made to ensure that there is no difference in age, gender, and bone height between groups to avoid selection bias. Patients were randomly allocated into one of 2 groups using random numbers generated using Excel program. Group I included 6 patients (3 males and 3 females) who received 2 implants and overdentures with rigid telescopic attachments, Group II included 6 patients (3 males and 3 females) who received 2 implants and overdentures with resilient telescopic attachments.

### Surgical and prosthetic interventions

Preoperative panoramic radiograph (1:1) was done to exclude patients with remaining roots or abnormal pathological condition then a diagnostic Cone Beam Computed Tomography (CBCT) images using i-CAT was done to evaluate bone volume (width) at the proposed implant site (canine region).

All the steps of acrylic complete denture construction were done starting with primary impression, secondary impression, followed by jaw relation, try-in for artificial teeth and final delivery of the acrylic complete denture. The mandibular denture was duplicated to be used as a radiographic template. Gutta purcha were fixed to the polished (buccal, labial and lingual) surfaces of the denture <sup>(31)</sup>. Each patient was scanned using double scan protocol. The first scan was for the denture alone while the second scan was for the patient while wearing his/her denture. A mucosal supported surgical guide was constructed by prototyping technology using 3D image-based software (OnDemand3DApp Software; CyberMed Inc). A surgical kit including sleeves and standardized drills (supplied by the radiologist) was used for osteotomy preparation.

All Patients should be under an umbrella of broad spectrum antibiotic (Augmentin 1g- Beecham MUP) 24 hours before surgery and analgesics non-steroidal anti-inflammatory (Ibuprofen, Knoll, Ludwigshafen, Germany) those were taken every 12hours after surgery for 5 days.

Surgical procedure of implant (Dentium super line implants system Co., Ltd., Gangnam-gu, Seoul, Korea) size 3.4x13mm insertion were done until completion of the osteotomy sites, platform was done using counter sink drill at a speed of 1000 RPM and a torque of 30-45 N/cm. The actual diameter of the countersink drill is 0.1mm larger than the fixture platform. So that the top level of fixture needs to be located 0.5mm below the marginal crestal bone level, moreover the drilling depth of the countersink was done. The implant was threaded until the implant top located 0.5mm below the marginal crestal bone level. (Fig 1, 2&3)

After three months from implant insertion, each patient was recalled for the insertion of super structure, fixture position was detected with the help of the surgical stent; a diagnostic probe was inserted through the hole of the surgical stent to make a bleeding point on the mucosa covering the proposed implant site. A surgical punch was used to expose the implant covering screw in the oral cavity then the covering screw was unthreaded, the healing abutment was threaded into the implant and tightened well using hex screw driver and the patient was given 1 week as a healing period. The healing abutments were removed after verification of Ossteointegration, the field was properly cleaned using sterile saline solution.

Open tray impression was made. Special tray was constructed with perforations on the implant positions. Long impression posts were tightened to the implants and the verification jig (Duralay, Reliance Dental MFG Co, Worth, IL, USA) was made to transfer the exact abutments position of the implants during impression making. Rubber base impression

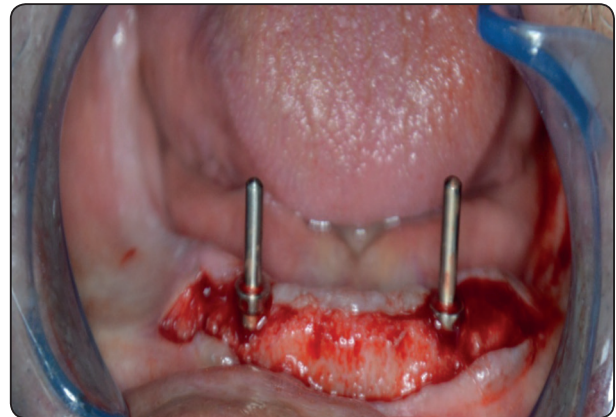


Fig. (1): Parallism between the two osteotomy

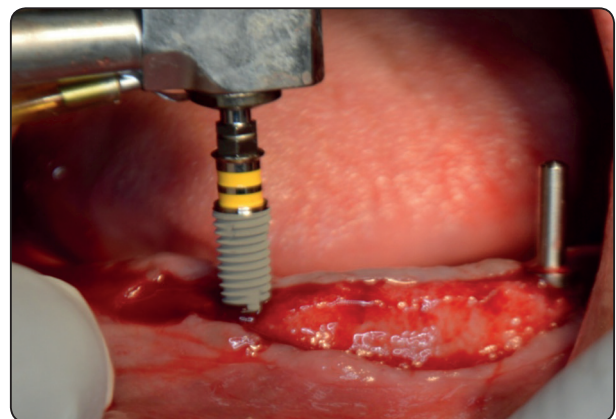


Fig. (2): Second fixture insertion



Fig. (3): Fixtures inserted in the canine area

with light consistency was loaded around the impression posts and the overall impression was made using putty material (Zhermack®, Badia Polesine, Rovigo, Italy). Once the impression has been taken, the gingival mask was fabricated directly on the impression. The impression was poured with hard stone. On the model, 2 straight titanium abutments were threaded to the implant analogues. The plastic portions of the abutments were waxed and the wax was milled with special burs using by the help of a milling machine (Confident, Bangalore, India) to give the primary (inner) copings (6mm in height and 5mm in diameter). The 2 wax patterns were milled to make their circumferential walls parallel to each other's in mesiodistal and buccolingual direction regardless implant inclination. The wax was invested, cast in cobalt chromium alloy<sup>(28,29)</sup> (Heraenium Pw, Heraeus-Kulzer GmbH, Hanau, Germany) and refined by milling again and tried in patient mouth. (Fig 4)

CAD/CAM device (Ceramill Map400, Amann Girrbach AG. Koblach, Austria) was used to scan the cast with primary copings in place. Using the software of the device, two secondary copings were designed with a 1.0 mm-thickness to cover the primary copings and saved as STL file. The designed

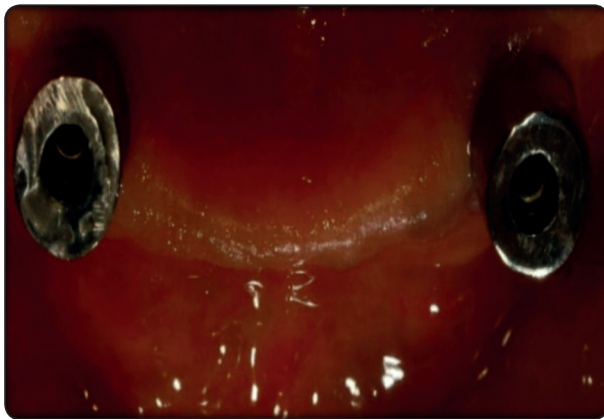


Fig. (4): Primary copings fastening inside patient mouth

copings were printed (using additive method) in castable resin (GC Pattern Resin, GC Corp, Tokyo, Japan) using a laser sintering device (EOSINT, Germany). The castable resin patterns were invested and casted with cobalt chromium alloy (group I). For resilient telescopic attachments a tiny amount of circumferential play as well as an occlusal space between the parallel walls of the primary and secondary copings (0.3 to 0.5 mm) were made using a disclosing material (Fit Checker). These tiny spaces compensate for soft tissue resilience<sup>(1)</sup>. For both attachments secondary copings had metal tags for retention into the denture base.

Direct pick-up of the secondary copings was done in the patient mouth using methyl methacrylate monomer free chair side self-curing rebase material (Chair side hard denture. Relining material Promedica, dental material GmbH, Germany).

The denture was removed, trimmed and polished with the secondary copings picked up in its fitting surface of the lower denture. (Fig 5)

Patients' satisfaction through the visual analogue scale (VAS) and biting force were evaluated at 3 months after over denture pickup.



Fig. (5) : Secondary copings picked up in its fitting surface of the lower denture

## Methods of evaluation

### A) Patients' satisfaction

The questionnaire's framework was composed of five main parameter (Functional complain about mandibular denture, Overall masticating ability, Masticating ability for different types of food, Effect on mental and daily life, Overall satisfaction). The questionnaire's content was examined and the questions were classified into five categories. To arrive at the final score, the scores for each question were calculated individually and then averaged. The answers of the patients were recorded by means of VAS of 100 mm. at 3 months after over denture pickup.

### B) Maximum bite force evaluation

The patient was instructed to sit upright, comfortably, and unstrained on a dental stool without a head support. The maximum bite force (vertical inter-occlusal bite forces) was determined bilaterally using a Loadstar sensor (Load. star sensor, 453, Ravental .Drive, Mountain View, CA .94043, USA) and an I-Load digital sensor. The sensor is connected to the computer through a USB cable. The load sensor was horizontally positioned in the first molar area (right and. left). For a few seconds, patients were encouraged to bite as hard as possible on the load sensor. Each second, a new

record, the highest, was set. From the recording table, ten readings were chosen. This technique was done three times on each side with a two-minute interval, and the mean for each side was recorded as MBF. The maximum bite force was determined in Newtons. (Fig 6)

### Statistical analysis

The mean and standard deviation values were calculated for each group in each test. Data were explored for normality using Kolmogorov-Smirnov and Shapiro-Wilk tests, satisfaction data showed non-parametric (not-normal) distribution while biting force data showed parametric (normal) distribution. For non-parametric data, Mann Whitney test was used to compare between two groups in non-related samples. For parametric data, independent sample t-test was used to compare between two groups in non-related samples. The significance level was set at  $P \leq 0.05$ . Statistical analysis was performed with IBM® SPSS® Statistics Version 20 for Windows.

## RESULTS

The survival rate of the implants was 100% in each group. No implant failures occurred. The follow up period was short (3 months). There was no patient who discontinued to wear the dentures or dropped out from the study for any reason.

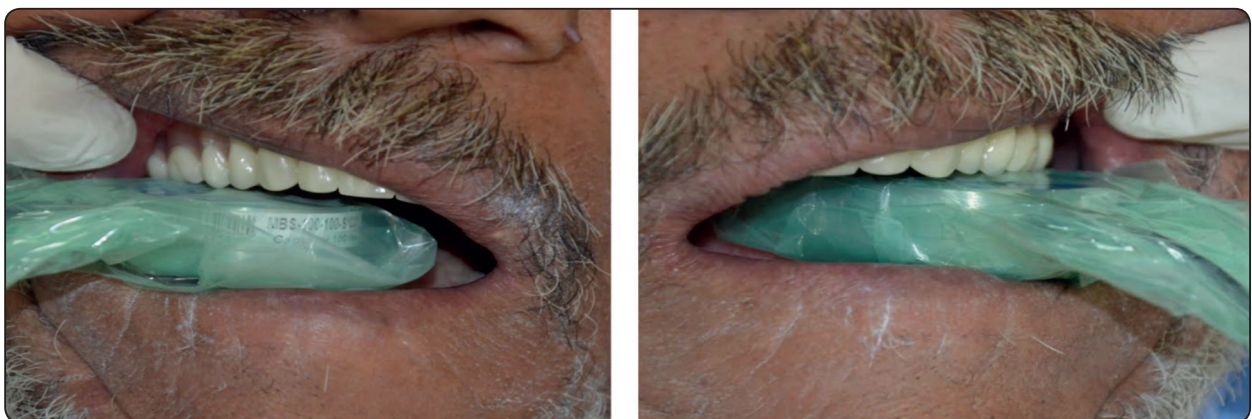


Fig. (6): Recording biting force using load digital sensor

**A) Satisfaction**

The obtained data revealed that the parameters of VAS for group II (Mandibular Overdenture retained by resilient telescopic attachment) were higher for Functional complain about denture, Overall masticating ability, Masticating ability for different types of food and Overall satisfaction than those treated with Mandibular over denture by rigid telescopic attachment (group I) However, the ratings for the same group were lower for Effect on mental and daily life as compared with the group I, but the higher and lesser readings were insignificant

between both groups as (P value > 0.05), as listed in table (1) and (Fig 7).

**B) Biting force**

The biting force for Group II (Mandibular Overdenture retained by resilient telescopic attachment) was shown significant higher readings with total biting force and peak biting force when compared with Group I (Mandibular Overdenture retained by rigid telescopic attachment) as (p<0.001). However, the ratings showed insignificant difference between both groups at low biting force as (p=0.476), as listed in table (2) and (Fig. 8).

TABLE (1): The mean and standard deviation (SD) of satisfaction scores for different groups.

|   | Telescopic overdentures | Mean | SD   | p-value |
|---|-------------------------|------|------|---------|
| Functional complain about denture               | Resilient               | 1.82 | 0.19 | 0.415   |
|   | Rigid                   | 1.37 | 0.17 |         |
| Overall masticating ability                     | Resilient               | 1.4  | 0.22 | 0.457   |
|   | Rigid                   | 1.33 | 0.2  |         |
| Masticating ability for different types of food | Resilient               | 1.93 | 0.15 | 0.249   |
|   | Rigid                   | 1.2  | 0.3  |         |
| Effect on mental and daily life                 | Resilient               | 1.35 | 0.08 | 0.478   |
|   | Rigid                   | 2.14 | 0.36 |         |
| Overall satisfaction                            | Resilient               | 3.1  | 0.11 | 0.31    |
|   | Rigid                   | 2.7  | 0.19 |         |

\*; significant (p<0.005) ns; non-significant (p>0.05)

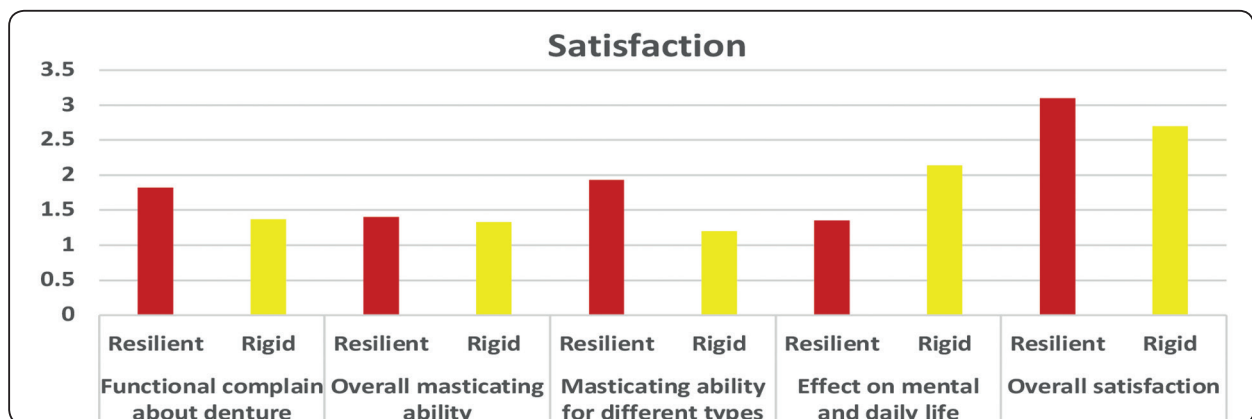


Fig. (7): Bar charts illustrating levels of satisfaction among various groups

TABLE (2): The mean, standard deviation (SD) values of biting force of different groups.

| Measurement        | Telescopic overdentures | Mean | SD   | p-value |
|--------------------|-------------------------|------|------|---------|
| Total biting force | Rigid                   | 1.5  | 0.12 | <0.001* |
|                    | Resilient               | 3.95 | 0.66 |         |
| Peak biting force  | Rigid                   | 4.32 | 0.59 | <0.001* |
|                    | Resilient               | 9.05 | 0.89 |         |
| Low biting force   | Rigid                   | 0.6  | 0.05 | 0.476ns |
|                    | Resilient               | 0.56 | 0.08 |         |

\*; significant ( $p < 0.005$ ) ns; non-significant ( $p > 0.05$ )

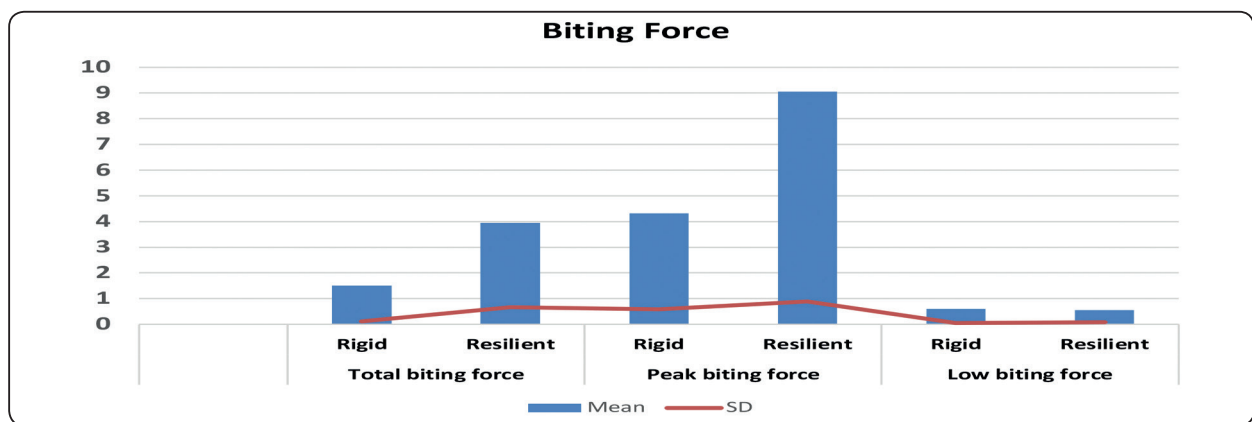


Fig. (8): Bar charts illustrating the biting force of various groups

## DISCUSSION

In this study the age of the selected patients ranged from 55 to 60 years. Patients outside the range were excluded to avoid extreme variations especially in the power of biting force and muscle activity.<sup>(30)</sup> Patients older than 65 years were not included, to eliminate the effect of senility. Senile patients usually suffer from muscle atrophy, decreased neuromuscular coordination, stomatitis, as well as, age related limited manual dexterity.<sup>(31)</sup>

Selection criteria excluded patients with systemic diseases that may interfere with bone quality, normal healing mechanism, osseointegration of the implants and proper bone response to applied forces.<sup>(32)</sup>

Smokers were excluded as smoking is considered

an important factor in early implant failure due to anoxia of the oral cavity together with significant increase in plaque formation and calculus deposits.<sup>(33)</sup> Diabetic patient also were excluded as they could experience disturbed metabolism and delayed wound healing that may affect Osseointegration.<sup>(34)</sup>

The interarch space not less than 12mm which is the minimum space required to accommodate for the denture teeth and acrylic resin base strength and attachment retainer.<sup>(34)</sup>

The selected patients were with Angle class I were included in the study as in Angele class II and III cases the geometrical center of the upper and lower ridges are not coincide which leads to occlusal forces fallen on abnormal directions which could lead to implants overloading.<sup>(35)</sup>



In both groups, the direct pickup of rigid and resilient telescopic attachment was performed directly in patient's mouth to avoid any changes in the adaptation, fitting and polished surfaces of the prosthesis and to maintain the vertical dimension and the centric relation since the same denture was used.<sup>(36,37)</sup>

The procedure started by placing small pieces of rubber dam and rubber ring around the ball or telescopic abutments to protect the gingiva and to block the space under the metal housing, thereby preventing the prosthesis from locking into the undercuts.

The self-cured acrylic resin used for the direct pick up technique was methyl methacrylate-free to reduce heat and chemical irritation. Moreover, this type of acrylic resin showed minimum polymerization shrinkage, therefore reducing distortion and ensuring fit of denture without affecting the position of the picked up housings.

The success of implant supported overdentures depends on the patient's ability to maintain oral hygiene, since loss of alveolar bone increases with decreased oral hygiene measures. Proper oral hygiene regimen including plaque control and frequent recall visits were followed throughout the study.<sup>(38)</sup>

In both groups the survival rate of the implants was 100%. The high survival rate of implants was attributed to the high bone quantity and density in the interforaminal area of the mandible and location away from vital structures which give good implant prognosis.<sup>(39)</sup>

With respect to patient satisfaction, no significant differences appeared between attachment types was noted regarding Functional complain about denture, Overall masticating ability, Masticating ability for different types of food, Effect on mental and daily life, Overall satisfaction. The lack of significant difference between the rigid and resilient telescopic attachments may be attributed to the increased

denture retention and stability for both types of telescopic attachments which make the patients feel that their prosthesis is similar to natural dentition and feel that the prostheses a part of them.<sup>(40, 41)</sup> This result was not surprising and is in agreement with published reports on patient satisfaction with different implant attachment types.<sup>(9, 40, 41)</sup>

Bite force is an important variable to investigate proper oral function which is related to occlusal factor, dentition, dentures, and treatment with implants, orthognathic surgery, temporomandibular disorders and neuromuscular changes.<sup>(22, 23)</sup>

Regarding biting force there was statistically significant difference between rigid and resilient telescopic mandibular over denture in total and peak biting force, in group II treated by Mandibular over denture retained by resilient telescopic attachment recorded more than those treated with Mandibular over denture retained by rigid telescopic attachment (group I), this increase may be attribute to the resiliency of the non-rigid telescopic attachments however there was no statistically significant difference in low biting force between the both types of attachments as it was not enough force to evaluate the resiliency of the non-rigid telescope.<sup>(42,43)</sup>

The limitations of this study include the small sample size, the short follow up period, and the lack of control group. Therefore, future randomized controlled clinical trials with sufficient follow up period (to test the effect of time on patient satisfaction and biting force) are recommended to ensure the long term finding of this study. Also, inclusion of conventional denture group as a control may be needed to compare patient satisfaction and biting force of the tested attachments with conventional complete denture. Finally, future long term randomized clinical trials are required to evaluate prosthetic maintenance services regarding: corrosion, abutment loosening, occlusal screw retightening, retainer problems or attachment fracture during the tested period.

## CONCLUSION

Within the limitations of this study caused by small patient sample and short evaluation period. The current study concluded that both rigid and resilient telescopic mandibular overdentures achieve great patients' satisfaction and a proper biting force. However, the Mandibular implant overdenture with the resilient telescopic attachment might be selected over rigid telescopic attachment when designing a two implant retained Mandibular over dentures since it is more superior at the biting force from this study point of view.

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