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THE EFFECT OF TWO DIFFERENT ATTACHMENTS WITH IMPLANT RETAINED MANDIBULAR OVERDENTURES ON PATIENT SATISFACTION AND MASTICATORY FUNCTION

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ABSTRACT

Background: Dental implants have solved all of the problems of retention and stability of conventional complete dentures. The improved retention and stability of overdentures retained by two, three or four implants have resulted in an improvement in overall patient satisfaction, together with improvement in the chewing ability and biting force. The choice of selection of the type of attachment will mainly depend upon the need for stabilization against horizontal forces. Rigid attachments have been advocated to provide optimum stabilization against horizontal forces.

Materials and Methods: Three interforaminal implants have been installed in the edentulous mandible of twelve completely edentulous patients. After 3 month from implant installation the patients were randomly divided into two equal groups; the first group received a ball attachment, while the second group received a parallel wall telescopic attachment. All patients received new complete dentures fabricated with a chroum-cobalt framework embedded in the fitting surface of the denture. Satisfaction, masticatory ability and the biting force were recorded for all patients in both groups at the following intervals; before implant installation, 2 weeks after loading, 3 month after loading and after a 1 year follow up.

Results: There was a statistically significant improvement in patient satisfaction between the conventional complete denture before implant installation and the implant supported overdenture after implant installation, with in each group of patients. When comparing between the two groups, there was no statistically significant difference with regards to patient satisfaction , chewing ability and biting force after a 1 year follow up, with a slightly higher mean score value in the telescopic attachment group.

Discussion: Placement of 3 interforamenal implants with ball attachment with a chrome-cobalt framework embedded in the fitting surface of the complete dentures have limited the resiliency of the ball attachment and so decreased the liability of movement or fracture of the overdenture. When comparing the splinted ball attachment with the rigid splinted parallel wall telescopic attachment,

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there was no statistically significant difference in patient satisfaction, chewing ability and biting force after a one year follow up. Both the ball attachment and the parallel wall telescopic attachment are viable option for an overdenture attachment.

KEYWORDS: overdenture, telescopic attachment, ball and socket attachment, completely edentulous patients.

INTRODUCTION

Patients wearing conventional complete denture usually suffer from many problems and complications that has its bad consequences. Bone resorption is one of these consequences, which is further accelerated by poorly fitting denture [1]. The decrease in bone volume causes a reduction in stability and retention of the denture, especially in the mandible where bone resorption is more pronounced. In addition, lower denture movement during function often cause trauma to the underlying mucosa resulting in flabby tissues, fibrous tissue hyperplasia, sore spots and ulcers [2]. Therefore, several treatment modalities have been proposed to overcome the complete denture problems. These include vestibuloplasty, ridge augmentation, distraction osteogenesis, and dental implants[3].

The use of dental implant for managing edentulous patients had been integral treatment modality in prosthetic dentistry. Implant prosthesis have shown dramatic improvement in chewing efficiencies, esthetic, confidence, quality of life and patient satisfaction[4].

The evidence, according to McGill consensus, currently available suggests that the restoration of the edentulous mandible with a conventional denture is no longer the most appropriate first choice prosthodontic treatment. There is now overwhelming evidence that a 2implant overdenture should become the first choice of treatment for the edentulous mandible[5].

A wide variety of implant overdenture designs with various numbers of implants and different attachment types for the connection of implants and removable dentures have been described. Commonly used abutment types included round or milled bars, ball attachments, magnet attachments, and rigid (cylindrical) and non-rigid (resilient) telescopic coping[6,7,8].

It was assumed that bars and parallel-walled telescopic crowns are considered the most suitable prosthetic option in cases with the advanced atrophy of the alveolar crest providing stability, to resist the horizontal forces[9].

Telescopic crowns on four implants provided an optimal restorative concept of overdenture with the bridge-like design of the removable superstructure. The telescopic crowns ensured a stable denture and facilitated oral hygiene especially in patients with impaired manual dexterity. They stated that this kind of removable superstructure might be designated as “Perio-overdenture”. Moreover it ensures good accessibility for cleaning in the context of oral hygiene homecare procedures which might reduce the risk for hyperplasia and peri-implantitis[8].

It was stated that the two-implant overdenture is not the gold standard of implant therapy, it is the minimum standard that should be sufficient for most people, taking into account performance, patient satisfaction, cost and clinical time[10].

Increasing the number of supporting implants decreases the potential for single-axis fulcrum movement between attachment points and lessens the effect of a specific retention release period during functional movements [11]

Krennmar et al. 2006 conducted a study which indicated that both ball attachments and resilient telescopic crowns used on isolated implants in the

edentulous mandible are viable treatment options. Implant success and peri-implant conditions did not differ between ball attachments and telescopic crowns used as retention modalities for implant overdentures, but the frequency of technical complications was significantly higher with ball attachments than with resilient telescopic crowns[12,13].

METHODOLOGY

This study was conducted on twelve completely edentulous patients with an age range of 55-65 years. **Inclusion criteria for the study included**: **1-**Completely edentulous patients with sufficient bone height inter-foraminally to accommodate three implants* 10 mm in length and 3.7 mm in diameter as ensured from a cone beam CT**. **2**. Inter-arch distance should be at least 12 mm with no tempro-mandibular disorders. **3.** Patients with no systemic disease that might affect bone quality or post-operative healing. **4.** Patients with no history of clenching or bruxism.

Oral information about the dental implant surgical and prosthetic procedures was given to the patient and a written approval was signed by each patient. Only motivated patients who show cooperation participated in the study.

A thorough intra and extra oral visual and clinical examination was carried out for all patients to ensure that the patients fulfilled the inclusion criteria for the research.

For all patients an upper and lower conventional complete dentures were constructed with the usual steps and delivered to the patient. After a period of adjustment and adaptation of 6 weeks patients were asked to fill the "Patient satisfaction questionnaire[14] after functioning with the upper and lower dentures. The masticatory function was recorded by filling out a Masticatory chart[15] and by measuring the patients biting force using the Iload star device***, which was used to measure both right and left sides and the peak values in newton.

The lower denture was then duplicated to construct a radiographic stent for cone beam imaging to ensure the presence of sufficient bone inter-foraminally to accommodate the chosen implant size. All patients had pre-operative cone beam CT for proper implant planning.

The radiographic stent was then modified to be used as a surgical stent. All patients received 2gm amoxicillin 2 hours before surgery. All implants were installed under local anesthesia****. Three implants were installed in the mandibular edentulous jaw at the canine areas bilaterally, and one in the midline or in the central incisor region. A crestal incision was made, then the drilling sequence was followed using the Dentis surgical kit, all implants were of diameter 3.7mm and length 10mm.

After implant installation, patients were randomly divided into two equal groups; each group consisted of 6 patients. Patients of the **First group** received 3 inter-foramenal implants to support and retain an overdenture with ball and socket attachment while patients of the **Second group** received three inter-foramenal implants to support and retain an overdenture with telescopic attachment. All Patients were instructed not to wear their dentures for 1 week, pain killers were also prescribed to reduce post-operative pain and to follow a soft diet.

A week after surgery, the patients were recalled to remove the sutures and to modify the patient denture with soft liner.

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* DENTIS dental implant system, KOREA
** Planmeca, Helsinki, Finland
*** Iload star digital USB sensor, load star sensor Mountain View, CA.
**** Ubistesin Forte, 3M ESPE AG, Geramny

After 3 months, the second stage surgery started where a small crestal incision was done to expose all of the three implants in both group of patients with the aid of the surgical stent to identify the exact position of the implants. The covering screw was removed and replaced with the healing abutment which was left for 10 days to allow for adequate healing.

After complete healing, the healing abutment was removed, then a new metal reinforced mandibular complete dentures were constructed for all patients in both groups, following the conventional steps.

N.B: After reaching the try in stage, a putty index was made on the master cast with the waxed up denture base..

Frame work fabrication for all groups of patients

For the patients receiving a ball attachment; the three ball attachment with their nylon caps (metal housing) were screwed to the implant analogues, and then a framework was waxed up on the three ball abutments with their nylon caps, and then casted into a chrome cobalt framework to be finally embedded within the acrylic fitting surface of the denture.

For the patients receiving telescopic attachments, the three abutments was then screwed to the implant analogues and all of the abutments will be milled to of parallel using a milling machine. A frame work was waxed up over the three telescopic abutments and then casted into a cobalt-chromiuim alloy to be embedded to the fitting surface of the acrylic complete denture.

After the framework fabrication, it was returned to the master cast, and using the putty index, the teeth were set over the framework. The framework with the teeth set were then tried in the patients mouth, to check the centric relation, vertical dimension, and the proper teeth arrangement of the teeth.

Flasking, packing and curing of the waxed up metal framework was carried out in the conventional manner, then finishing and polishing of the processed lower dentures was carried out, and delivered to the patients.

Pick up of the attachments

First group: patients receiving a ball and socket attachment (Figure 1).

Three ball abutments were screwed to the implants with their nylon caps (metal housing). The lower denture with the chrome-cobalt framework embedded in the fitting surface was seated in the patient mouth, proper seating of the denture was checked. The upper denture was then seated and the centric relation was checked. The nylon caps (metal housing) was picked up in the fitting surface of lower denture, using a primer* and a resin adhesive Cement Relay X**. **(Figure 2).**

Retention and stability of the lower and upper denture was strictly evaluated, and any premature contacts was removed by selective grinding.

Second group: patient receiving a telescopic attachment (Figure 3, 4).

The three telescopic parallel wall abutments were screwed to the implants in the patients mouth. The three telescopic abutments in this clinical study were considered to be primary copings while the embedded framework in the fitting surface of the lower denture was considered as a secondary coping. The lower denture was seated in the patients mouth, and proper seating was ensured. The upper denture was seated, and the centric relation was checked.

All patients were recalled after 3 days for occlusal adjustment. Patients were recalled in the assigned follow-up periods to record satisfaction and biting force (immediately after delivery, 3 and 12 months later).

* Primer silane, 3M, ESPE, Germany
** Self adhesive universal resin cement, Relay X, 3M, ESPE

Fig. (1) Ball abutments intra-orally

Fig. (2) Fitting surface of the lower denture with the embedded frame-work.

Fig. (3) Telescopic abutments intraorally

Fig. (4) fitting surface of lower denture with embedded telescopes.

RESULTS

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. Data showed non-parametric (not-normal) distribution. Mann Whitney 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.

When comparing the mean patient satisfaction scores with in each group of patients , it was a found that in the group of patients receiving a ball attachment, there was a statistically significant difference in patient satisfaction scores before implant installation, after 3 month from loading (P=0.004), and after 1 year from loading (p=0.003). While there was no statistically significant differences in patient satisfaction before implant installation and after 2 weeks from loading (P=0.157). Similarly in the group of patients receiving a telescopic attachment it was found that there was a statistically significant difference in the patient satisfaction scores throughout all the periods of measurement, before implant installation and after 2 weeks from loading (P=0.046), after 3 month from loading (P=0.005), and after 1 year from loading (P=0.004).

When comparing the patient mean satisfaction scores during the different intervals in both groups of patients, it was found that there was no significant difference in patient satisfaction scores between the ball attachment and the telescopic attachment during the 1 year follow up , but the telescopic attachment showed a slightly higher mean score through out the different intervals. **(Table 1), (Fig 5).**

TABLE (1) The mean, standard deviation (SD) values of Satisfaction in both groups

Variables	Satisfaction				*p-value*
	Ball attachment		Telescope attachment		
	Mean	SD	Mean	SD	
Before application	1.42 ^{aA}	0.67	1.75 ^{aA}	0.75	**0.178ns**
After 2 weeks	1.25 ^{aA}	0.45	1.42 ^{bA}	0.67	**0.443ns**
After 3 months	0.58 ^{bA}	0.51	0.83 ^{cA}	0.58	**0.378ns**
After 1 year	0.33 ^{bA}	0.49	0.50 ^{dA}	0.52	**0.514ns**
p-value	**≤0.001***		**≤0.001***		

Superscripts with different small letters indicate statistically significance difference within the same column. Superscripts with different capital letters indicate statistically significance difference within the same row.

****; significant (p≤ 0.05) ns; non-significant (p>0.05),***

The masticatory function in this trial was recorded both objectively and subjectively. A patient masticatory chart was used, and also the patient biting force was recorded using the iload star device in newton.

When comparing the scores of the masticatory chart with in each group of patients, in both groups it was found that there was no statistically significant difference between all of the interval periods after a 1 year follow up.

When comparing the masticatory chart scores between the two groups, it was found that there was no statistically significant difference in masticatory chart score between the two groups, but a slightly higher mean score in the telescopic group was observed **(Table 2, fig 6)**

TABLE (2) The mean, standard deviation (SD) values of Masticatory ability in both groups.

Variables	Masticatory ability				*p-value*
	Ball attachment		Telescope attachment		
	Mean	SD	Mean	SD	
Before application	1.78 ^{aA}	1.86	2.56 ^{aA}	1.94	**0.436ns**
After 2 weeks	1.78 ^{aA}	1.86	2.56 ^{aA}	1.94	**0.436ns**
After 3 months	1.33 ^{aA}	1.73	1.89 ^{aA}	1.90	**0.605ns**
After 1 year	1.11 ^{aA}	1.76	1.89 ^{aA}	1.90	**0.436ns**
p-value	**0.801ns**		**0.194ns**		

Superscripts with different small letters indicate statistically significance difference within the same column. Superscripts with different capital letters indicate statistically significance difference within the same row.

****; significant (p≤ 0.05) ns; non-significant (p>0.05),***

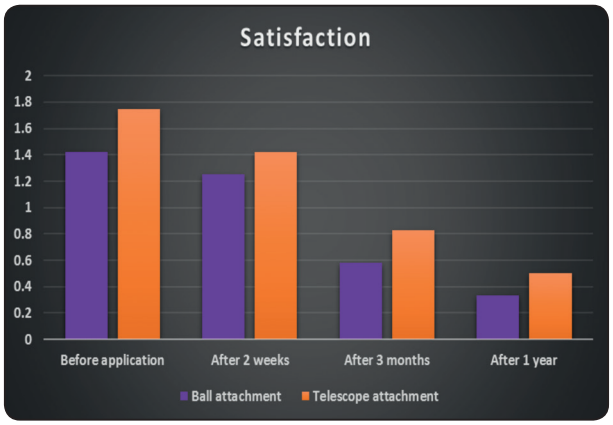

Fig. (4): Bar chart representing scores of Satisfaction

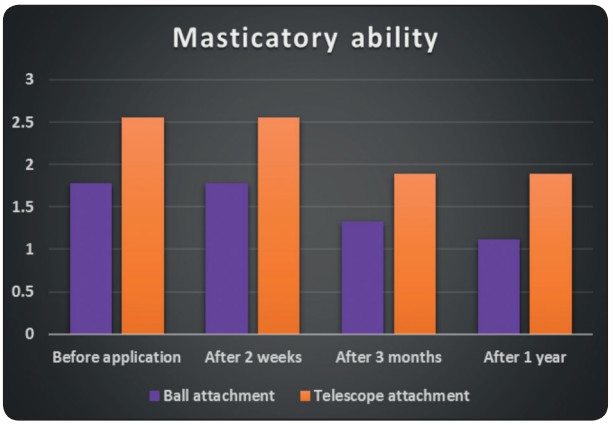

Fig. (5): Bar chart representing scores of Masticatory ability

The biting force in newton recorded in this trial has shown a statistically significant difference with in each group of patients through out the different intervals. In the group of patients with the ball attachments there was a statistically significant difference before implant installation, after 2 weeks from loading, after 3 month from loading, and after 1 year from loading (p=0.004). The highest mean value was found after one year of loading (79.83 ± 7.72), followed by after 3 months from loading (64.70 ± 8.42), the lowest mean value was found in before implant installation (32.95 ± 2.64). A statistically significant difference was also found within each of the time interval in the telescopic attachment group, there was a statistically significant difference before implant installation , after 2 weeks from loading, after 3 month from loading, and after 1 year from loading ($p \leq 0.001$). The highest mean value was found after one year of loading (92.20 ± 6.64), followed by after 3 months from loading (77.20 ± 6.64), the lowest mean value was found in before implant installation (38.37 ± 3.15).

When comparing the mean score of biting force in newton there was no statistically significant difference in the mean biting force between the two groups, with a slightly high mean value in the telescopic attachment group (**Table 3. Fig 7**)

TABLE (3) The mean, standard deviation (SD) values of Biting force in both groups.

Variables	Masticatory ability				*p-value*
	Ball attachment		Telescope attachment		
	Mean	SD	Mean	SD	
Before application	32.95 ^{aA}	2.64	38.37 ^{aA}	3.15	**0.256ns**
After 3 months	64.70 ^{bA}	8.42	77.20 ^{bA}	6.64	**0.102ns**
After 1 year	79.83 ^{cA}	7.72	92.20 ^{cA}	6.64	**0.051ns**
p-value	**≤0.001***		**≤0.001***		

Superscripts with different small letters indicate statistically significance difference within the same column. Superscripts with different capital letters indicate statistically significance difference within the same row. *; significant (p≤ 0.05) ns; non-significant (p>0.05),

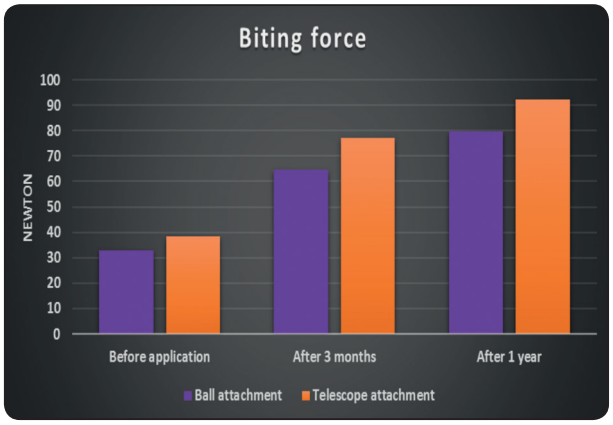

Fig. (6) Bar chart representing scores of Biting force

DISCUSSION

Recently dental implants have solved most of the problems of completely edentulous patients, stabilization of conventional complete denture by the installation of two implants have improved the masticatory function ***(Van der Bilt et al 2012 , Boven 2015)***[16,17], together with improving the maximum bite force, and an overall increase in patient satisfaction ***(Slagter et al 1993)***[18], when compared to conventional complete dentures. This will all come in agreement with the results of the present study, as there has been a significant improvement in both patient satisfaction, the chewing ability and biting force for all the patients in both groups immediately after implant installation and through the whole follow-up periods. This general improvement in patient satisfaction together with an improvement in masticatory function could mainly be due to the improved retention and stability of the prosthesis after attachment placement ***(Van der Bilt et al 2006)***[19].

The selection of the type of attachment mainly depended upon the degree of stabilization that was required by the prosthesis, especially when considering horizontal forces. A parallel walled telescope attachment would provide optimum stabilization against horizontal forces (***Heckmann et al 2001b, 2004)***[7,9]. Telescopic crowns have the

advantages of improving retention, mastication and phonation ***(Hoffmann et al 2006)[20]***. On the other hand, one of the most common type of resilient attachment used to support a two implant retained over denture is ball attachment ***(Naret et al 2004)[21]***. Ball attachment is considered to be a resilient attachment that would allow for rotational movement.

In the present study; two types of attachments were being used a ball attachment and a rigid parallel walled telescopic attachment and both attachments were picked up in a chromium cobalt framework that is embedded in the fitting surface of the denture, which was mainly used for the reinforcement of the denture to limit the probability of fracture. The presence of a chromium cobalt framework has limited the resiliency of the ball attachment, and so when comparing between the two types of attachments with respect to the patient satisfaction, chewing ability and biting force after a 1 year follow up, there was no significant difference between the ball and parallel wall telescope, because both attachments are acting as rigid attachment so providing better stabilization and retention against horizontal forces (***Heckmann et al 2001b, 2004)[7,9]***. Although there was no statistically significant difference between the ball and telescopic attachment, but the parallel wall telescopic attachment has shown a slightly higher mean value with regards to patient satisfaction, chewing ability and biting force after a 1 year follow up, this is mainly because telescopic over-denture would have the advantage of limiting the movement of denture base away from the ridge ***(Hoffmann et al 2006)[20]***, and thus further increasing the horizontal stability of the denture in patients with increased ridge resorption ***(Heckmann et al 20001b, 2004)[7,9]***, also due to its self-finding mechanism it will be easily inserted by patient with manual dexterity ***(Heckmann et al 2004, Hoffmann 2006)[9,20]***.

Another important factor for determining the selection of an overdenture attachment is the prosthetic maintenance, which would really influence the prosthesis retention and patient satisfaction, but this was really out of the scope of this clinical trial due to the short follow up period. ***Krennmair et al 2011[13]*** have concluded in his study that the ball attachment required an increase in prosthetic maintenance when compared to resilient telescopic crowns, due to the continuous changing of the nylon caps.

Both the parallel walled telescopic attachment and the ball attachment are viable options for an overdenture attachment, with rigid telescopic attachment showing a slight non-significant improvement in masticatory function.

REFERENCES

1. MacEntee MI, Nolan A and Thomason JM (2004). "Oral mucosal and osseous disorders in frail elders*." Gerodontology 21: 78-84.
2. Gendreau L and Loewy ZG (2011). "Epidemiology and etiology of denture stomatitis." J Prosthodont 20: 251-260.
3. LaBarre E, Giusti L and Pitigoi-Aron G (2007). "Addressing problems in complete dentures." Compend Contin Educ Dent 28: 538-542.
4. Mahmoud A and Ahed A (2005). "Satisfaction with dental implants: a literature review." Implant Dent 14: 399-408.
5. Feine J, Carlsson G, Awad M, Chehade A, Duncan W, Gizani S, Head T, Lund J, MacEntee M and Mericske-Stern R (2002). "The McGill consensus statement on overdentures. Mandibular two-implant overdentures as first choice standard of care for edentulous patients. Montreal, Quebec, May 24-25, 2002." Int J Oral Maxillofac Implants 17: 601-602.
6. Heckmann SM, Wichmann MG, Winter W, Meyer M and Weber HP (2001). "Overdenture attachment selection and the loading of implant and denture-bearing area. Part 1: In vivo verification of stereolithographic model." Clin Oral Implants Res 12: 617-623.
7. Heckmann SM, Winter W, Meyer M, Weber HP and Wichmann MG (2001). "Overdenture attachment selection and the loading of implant and denture-bearing area. Part 2: A methodical study using five types of attachment." Clin Oral Implants Res 12: 640-647.

8. Frisch E, Ziebolz D, Ratka KP and Rinke S (2015). "Double Crown Retained Maxillary Overdentures: 5 Year Follow Up." Clin Implant Dent Relat Res 17: 22-31.

9. Heckmann SM, Schrott A, Graef F, Wichmann MG and Weber HP (2004). "Mandibular two-implant telescopic overdentures." Clin Oral Implants Res 15: 560-569.

10. Thomason J, Kelly S, Bendkowski A and Ellis J (2012). "Two implant retained overdentures—A review of the literature supporting the McGill and York consensus statements." J Dent 40: 22-34.

11. Williams BH, Ochiai KT, Hojo S, Nishimura R and Caputo AA (2001). "Retention of maxillary implant overdenture bars of different designs." J Prosthet Dent 86: 603-607

12. Krennmair G, Weinländer M, Krainhöfner M, Piehslinger E (2006). Implant-supported mandibular overdentures retained with ball or telescopic crown attachments: a 3-year prospective study. Int J Prosthodont. 19(2):164-70.

13. Krennmair G, Seemann R, Weinländer M, Piehslinger E (2011)Comparison of ball and telescopic crown attachments in implant-retained mandibular overdentures: a 5-year prospective study. Int J Oral Maxillofac Implants. 26(3):598-606

14. Yu-Haw Pan, Tai-Min Lin, Chao-Hua Liang 2014 Comparison of patient`s satisfaction with implant supported mandibular overdentures and complete dentures. BioMed J. 37: 156-162.

15. Pocztaruk, R. D. L., Roberto, P., Mattia, C., Vidal, R. A., Fernandes, E., Beatriz, M., & Gavião, D (2006). Satisfaction level and masticatory capacity in edentulous patients with conventional dentures and implant retained overdentures. Braz J Oral Sci. 5(19), 1232–1238.

16. Van Der Bilt, A., Speksnijder , C.M. de Liz Pocztaruk, R., & Abbink, J.H (2012) Digital image processing versus visual assessment of chewed two-colour wax in mixing ability tests. Journal of Oral rehabilitation. 39:11-17.

17. Boven, G.C. Raghoebar, G.M. Vissink , A. & Meijer H.J (2015) Improving masticatory performance , bite force, nutritional state and patient satisfaction with implant overdentures: a systematic review of literature. Journal Of Oral Rehabilitation. 42;220-233.

18. Slagter, A.P., Bosman, F. Van der Glas, H.W. &Van Der Bilt , A. Human (1993). jaw-elevator muscle activity and food comminution in the dentate and edentulous satate. Archives of Oral Biology. 38;195-205.

19. Van Der Bilt , A. Van Kampen F.M. &Cune, M.S (2006). Masticatory function with mandibular implant supported overdentures fitted with different attachment types. European Journal Of Oral Science. 114:119-196.

20. Hoffmann, O., Beaumont C., Takakis , D.N. &Zafiropoulos , G.G (2006). Telescopic crowns as attachemnts for implant supported restorations : a case series. The Journal Of Oral Implantology. 32:291-299.

21. Naret I, Alsaadi G, Van Steenberghe D, Quirynen M (2004). 10 Year randomized control trial on the influence of splinted and unsplinted oral splint retaining mandibular overdentures : peri-implant outcome. Int J Oral Maxillo-Fac Implants. 19:695-702.