ASDJ
AINSHAMS DENTAL JOURNAL

Print ISSN 1110-7642
Online ISSN 2735-5039

AIN SHAMS DENTAL JOURNAL
Official Publication of Ain Shams Dental School
March 2021 • Vol. XXIV

Accuracy of Different Impression Techniques on The Fit of Screw-Retained Bar Joining Two Interforaminal Implants

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Abstract

Purpose: To evaluate the accuracy of two different impression techniques on the fit of screw retained bar in implant assisted overdentures.

Methodology: Ten completely edentulous patients were selected from Removable Prosthodontics Department, Ain Shams university according to the inclusion and exclusion criteria. All patients received implant assisted mandibular overdenture with a screw retained bar. Two bars were made for each patient by two different impression techniques. In the first technique, open top impression was used to fabricate the screw-retained bar. However, in the second technique intraoral digital impression was used. Passive fit of each bar was then evaluated.

Results: The results of this study showed non statistically significant difference between both impression techniques.

Conclusion: Within the limitations of this study it may be concluded that the results for both impression techniques on the fit of the screw-retained bar in implant assisted overdentures.

Keywords: Intra oral scanning, Open top impression, Implant retained overdenture.

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Introduction:

Dental implants can be used to enhance oral function and quality of life for completely and partially edentulous patients who have maladaptive responses to conventional removable prostheses. They had been advocated as a way to improve retention, support and stability hoping for improved function in such patients[1].

Attachments can be defined as mechanical devices used for retention and stabilization of prosthesis. There are three types of attachments stud, bar and magnetic attachment[2].

Bar attachments widely distribute forces antero-posteriorly, provide even support over a great surface area, help with abutments' splinting and stress distribution, offer high retention capacity and minimize prosthesis movement during function. This helps to reduce the load on the soft tissues especially in friable or sensitive mucosa[3]

Moreover, overdentures with bar attachments are easy to clean. However bar design requires more interocclusal space than other attachments[4] Computer aided design/computer aided manufacturing "CAD/CAM" technology helped with fabrication of accurate and passively fitting dental prosthesis. Such technology offered a number of advantages as time effectiveness, reduced labour and quality control[5].

Evolution in this technology helped with intraoral scanning of implant sites and fabrication of milled bar with a superstructure overlying it. This helped to produce a passive fit between both structures. Furthermore, patient discomfort associated with the fabrication of implant supported overdenture in a conventional way was reduced[6].

Bar attachments can be either cement retained or screw retained. Screw retained ones can be easily retrieved allowing easier hygiene maintenance and repair. Passive fit of such bars is important for implant survival. Yet, such fit necessitates sophisticated prosthetic procedures; they require prosthetically driven implant placement. Moreover, its technique of fabrication is more demanding and technique sensitive in comparison to cement retained ones[7].

So, the aim of this study was to evaluate passive fit of screw retained bars made by two different impression techniques in overdentures retained by two implants.

Materials and Methods:

Ten edentulous patients were selected from the out-patient clinic of prosthodontics department, Faculty of Dentistry, Ain Shams University. Completely edentulous patients were included in this study. Patients with uncontrolled systematic diseases such as diabetes and heavy smokers were excluded from this study. Patients with bad oral hygiene were also excluded. Each patient received upper and lower complete dentures.

A cone beam computed tomography (CBCT) scan was made for the patients while wearing the denture with radio-opaque gutta percha markers at the proposed implant sites. CBCT was analysed by measuring bone height and width at the proposed implant sites. Suitable implant sites and sizes matching the bone dimensions were then selected. Once the positions of implants were accepted, the virtual surgical guide with two holes was designed on the software. Additional three channels were added during the virtual planning for installation of anchoring screw installation.

Patients were instructed to rinse with 0.2% Chlorhexidine mouthwash three times daily prior to surgery. Prophylactic 1 gm combination of Amoxicillin and Clavulanic acid, 8 mg Dexamethasone and 50 mg Diclofenac Sodium were given to the patient.

During the surgical procedure, the surgical guide was inserted into the patient's mouth and stabilized against the upper denture using silicone index. Three fixation screws were inserted into the previously prepared holes in the surgical guide to allow fixation of the surgical guide into bone. cortical drill was utilized at first, then drill of a 2.3 mm diameter and 8 mm length was used to drill the initial pathway in an up and down motion. Fig(1).

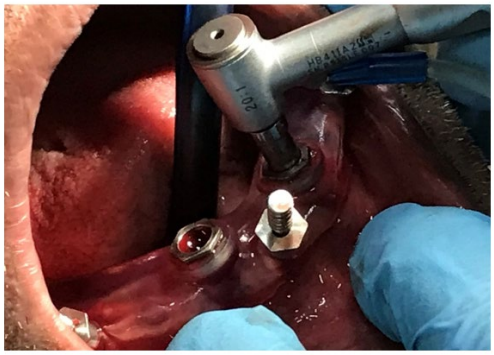

Fig. (1): Sequential drilling at proposed implant sites

Each patient received cast co-cr screw-retained bar and milled co-cr screw-retained bar.

For cast bar fabrication using open top impression technique, primary impressions were taken using one step putty and light rubber base impression material and customized special trays were fabricated. Special trays were fabricated on the primary casts after splinting the open-top impression posts with duraliner. A window was made in the top of the special tray in the implant region. A disc was used to cut the splint into two parts that were rejoined inside the patient's mouth by adding duraliner. Secodary impression was made by border molding the special tray using green stick compound and overall medium consistency polyvinyl siloxane impression material.Fig.(2).

Fig. (2): Secondary impression using green stick compound for border molding and overall medium consistency polyvinyl siloxane impression material

Three months after implant installation, patients were recalled for second stage surgery where implants were exposed with the aid of surgical stent and healing abutments were screwed to the implants and the patient had to wait for 15 days.

For bar construction using digital impression, healing abutments were unscrewed from the patient's mouth. Then scanning of the lower arch was done using intraoral scanner. Scan bodies were then screwed to the implants, a second scan was then made and superimposition of both

scans took place. Fig.(3).

Fig. (3): Scan bodies screwed to the implants for intraoral scanning

An STL file was now ready to be exported to exocad software. Implant system and corresponding titanium bases were selected from software library. Similarly, the bar design was selected and its position was adjusted in accordance to the titanium bases and gingiva. Then, STL file was exported to the milling machine and milling of co-cr bar was done. Cementation of the milled bar to the titanium bases then took place on the master cast using resin cement.

Plastic clip attachments were secured over the bar on the delivery day. Pickup of the clip was made directly in the patient's mouth. Blocking out the undercuts beneath the bar using putty rubber base was essential before the pickup procedure. A recess was made in the fitting surface of the prostheses opposite to the clip and conditioned with acrylic monomer. Autopolymerizing acrylic resin was mixed and applied in the recess. The prostheses was seated in the patient's mouth and the patient was guided in occlusion. Then, the prostheses was removed from the patient's mouth and any excess material was removed.

Passive fit evaluation of each bar was made intraorally. First, Cast Co-Cr bar was inserted inside the patient's mouth. Left screw was tightened manually using torque ratchet to 20NCm according to manufacturer's instructions ensuring full tightening of the screw. Afterwards, right screw was tightened using motor driven screw driver after adjustment of motor settings. The right screw was tightened till no more tightening occurred at 5Ncm. Then a higher torque was set gradually. Full tightening of the right screw was reached when taper lock of the screw driver occurred where no more tightening occurred and alarm was heard from the motor. At this point, the torque at which full tightening of the right screw occurred was known.
The cast bar was then unscrewed from patient's mouth and gingiva allowed to relief for one minute. Then, the milled co-cr bar was inserted in patient's mouth and previously described procedure with cast bar was done.

Results:

Accuracy measurements were tested for normality using Shapiro-Wilk test. The significant level was set at $P \leq 0.05$. Torque measurement readings were described in terms of Mean and standard deviation values. Paired T test was used for statistical analysis. The mean value of torque measurements for bars made by open top impression was 13 (± 4.47), while for the digital impression the mean value was 10 (± 3.54) The P-value was 0.4. This change was statistically insignificant ($p \leq 0.05$). Fig. (4). Table (1)

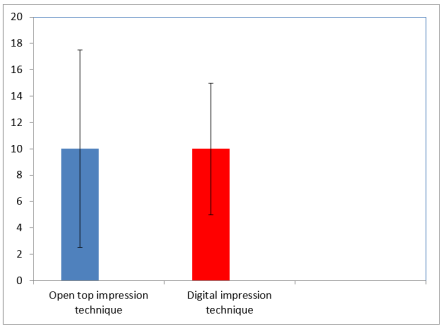

Fig. (4): Mean values and standard deviation of open top impression group and digital impression group

Table (1): Mean and Standard deviation of open top and digital impression

	Open top impression	Digital impression
Mean±SD	13±4.47	10±3.54
Median	10	10
Interquartile range	7.5	5
Quartile (25th-75th)	10-17.5	5-10
Minimum value	10	5
Maximum value	20	15
Test value	8	
P- value	0.4	

Discussion:

Overdentures provide daily access for hygiene measures of implant abutments helping to minimize peri implant soft tissue problems[8]. Non-smoking subjects were selected in this study as smoking affects oral mucosa and delays the process of osseointegration. It was also reported to be a significant risk factor for implant failure[9]. Good oral hygiene was mandatory, as presence of plaque is associated with increased risk of periimplantitis. Amount and consistency of saliva were evaluated. Xerostomia is accompanied by decreased tissue tolerance and chewing score as well[10].

A radiographic stent with Gutta-percha as radio-opaque marker was fabricated for each participant. A marker was placed at each proposed implant site. Cone-beam CT scan was used for planning the implant sites as it was reported to be a reliable method for preoperative assessment of bone dimensions regarding length, width and height. This helped with proper selection of implant size and accurate positioning in accordance to anatomical considerations[11].

Preoperative and postoperative medications in the form of broad spectrum antibiotics, anti-inflammatory drugs and chlorhexidine mouth wash were prescribed to all patients to minimize the risk of implant failure as well as postoperative infection and edema. It was reported that administration of antibiotics has a significant positive correlation with implant survival rates as bacterial contamination during implant surgery negatively affects the process of osseointegration[12].

Sequential drilling of the osteotomy site under refrigerated copious irrigation was essential to reduce heat generation that may affect postoperative wound healing and osseointegration. Heat was reported to impair the turnover activity of bone tissue by causing hyperemia, necrosis and increased osteoclastic activity[13]

Vertical intermittent pressure was applied to allow the refrigerated saline to reach the entire wall of the osteotomy site. Moreover, it allows escape of bone debris and prevents clogging of the cutting drills[13].

Surgical guides were used during drilling to ensure parallelism between the placed implants. Parallelism was mandatory to allow even distribution of stresses through the longitudinal axis of the implant. Moreover, it helped to avoid challenges during prosthetic stage of bar construction such as achieving passive fit of the bar[14]. Bar attachment was the one of choice in this study. Such attachment widely distributes forces anteroposteriorly, provides even support over a great surface area, helps with implants' splinting, offers high retention capacity and minimizes prosthesis movement during function[3]. In addition to that, bar attachment provides patients with comfort, security and masticatory ability quite similar to fixed partial dentures.

Bar attachments can either be screw or cement retained. However, screw retained bars were used in this study. They can be retrieved easily if biologic or technical complication occurs. So, prosthodontic components can be adjusted easily and fractured components can be repaired with less time in comparison to cement retained ones[7].

Furthermore, such bars have tighter margins than cement retained ones. As a result, cement retained bars are correlated with risk of bacterial colonization, cement dissolution and gingival inflammation[7].

In addition, difficult removal of excess cement from the gingival crevice leads to periimplant inflammation and bone resorption. Positive relationship was reported between excess cement and

periipmlant disease that was later improved following removal of excess cement[7]

Passive fit of screw retained bars were mandatory to avoid biologic and mechanical complication. Non passive fit of the bar results in fulcrum point at the junction of the bar and the abutment with consequent loads that overcome clamping forces of the screw ending up with screw loosening[15].

Moreover, non passive fit may apply additional load to the implant/ attachment system leading to bending moments that are constantly loading the implant and the surrounding bone leading to bone loss and implant failure[15].

Passive fit of the bar depends on accuracy and precision achieved in its fabrication. Such accuracy is dependent on impression procedure, master cast accuracy, fabrication technology and skill of the technician[16]. Two impression techniques were used in this study; open top and digital impression techniques. Non statistically significant difference was found between both techniques on passive fit of screw retained bars. This may be attributed to the precise impression precautions adopted during impression procedures for the open top impression techniques coupled with limitations of intraoral scanning impression technique in completely edentulous patients. Passive fit of each bar has been assessed intraorally by measuring torque at which complete settling of the screws retaining each bar has occurred. Complete settling of screws was done using motor driven screw driver[17]. The results of this study came in line with a study that showed non statistically significant difference between both impression techniques on the passive fit of implant supported zirconia restorations [17]. In addition, it was suggested that that digital impressions appear to have comparable three dimensional accuracy with conventional implant impressions[18].

For open top impression technique, precise three dimensional transfer of abutment position to the working cast was needed to obtain optimum passive fit of the bar. To fulfil such requirement, open top impression technique was followed, impression posts were splinted, splitted and resplinted[19]. Numerous studies reported accurate impressions with the open top impression technique as it provided the most accurate working cast especially when multiple implants were placed[20]. Splinting of the impression posts was reported to improve impression accuracy as it prevented individual coping movement. Moreover, stabilization against rotation during impression procedure and securing the laboratory analogs was achieved by the help of splinting[21]. Polyether impression material produced better outcomes when compared to other impression materials in several studies. This was attributed to the rigidity of polyether that prevented movement of impression coping within the impression[20].

Acrylic custom made tray was used. Studies showed lower percentage of permanent distortion of the impression material on removal of the impression with custom made rather than stock trays. The less the distortion of the impression material, the reduced displacement of the impression post, the better accuracy of the impression and master cast thus, the increased passive fit of the bar [20].

On the other hand, intraoral impression technique has its own limitations especially in completely edentulous patients. Saliva, humidity of the oral cavity and head movements during scanning are factors difficult to control in the intraoral scanning impression technique [22]

Conclusion

Within the limitations of this study it may be concluded that the results of passive fit of the screw-retained bar of both open top and digital impression techniques is clinically comparable

References

1. The glossary of prosthodontic terms. J Prosthet Dent 2005;94(1):10-92.
2. Chaware S, Thakkar S. A systematic review and meta-analysis of the attachments used in implant-supported overdentures. J. Indian Prosthodont. Soc.2020;20(3):255–68.
3. Anas M, Fayyad EA, Amal DDS, Dds K, Nabhan A. Bar versus ball attachments for implant-supported overdentures in complete edentulism : A systematic review. 2018;(August 2017):243–50.
4. Slot W, Raghoebar GM, Van Dijk G, Meijer HJA. Attachment of clips in a bar-retained maxillary implant overdenture: A clinical report. J Prosthet Dent 2012;107(6):353–7.
5. Prajapati A, Prajapati A, R.Mody D, B.Choudhary A. Dentistry Goes Digital: A Cad-Cam Way- A Review Article. IOSR J Dent Med Sci 2014;13(8):53–9.
6. Lin WS, Chou JC, Metz MJ, Harris BT, Morton D. Use of intraoral digital scanning for a CAD/CAM-fabricated milled bar and superstructure framework for an implant-supported, removable complete dental prosthesis. J Prosthet Dent 2015;113(6):509–15.
7. Garg A, Shenoy Kk, Shetty S. Principles of screw - retained and cement - retained fixed implant prosthesis: A critical review. J Interdiscip Dent 2014;4(3):123.
8. Karabuda C, Yaltrk M, Bayraktar M. A clinical comparison of prosthetic complications of implant-supported overdentures with different attachment systems. Implant Dent 2008;17(1):74–81.
9. Rodriguez-Argueta OF, Figueiredo R, Valmaseda-Castellon E, Gay-Escoda C. Postoperative complications in smoking patients treated with implants: A retrospective study. J Oral Maxillofac Surg 2011;69(8):2152–7.
10. Visch LL, Van Waas MAJ, Schmitz PIM, Levendag PC. A clinical evaluation of implants in irradiated oral cancer patients. J Dent Res 2002;81(12):856–9.
11. Jacobs R, Salmon B, Codari M, Hassan B, Bornstein MM. Cone beam computed tomography in implant dentistry: Recommendations for clinical use. BMC Oral Health 2018;18(1).
12. Veitz-Keenan A, Keenan JR. Antibiotic use at dental implant placement. Evid. Based. Dent.2015;16(2):50–1.
13. Sener BC, Dergin G, Gursoy B, Kelesoglu E, Slih I. Effects of irrigation temperature on heat control in vitro at different drilling depths. Clin Oral Implants Res 2009;20(3):294–8.
14. Pellizzer EP, Falcón-Antenucci RM, De Carvalho PSP, Sánchez DMIK, Rinaldi GAT, De Aguirre CC, et al. Influence of implant angulation with different crowns on stress distribution. J Craniofac Surg 2011;22(2):434–7.
15. Manawar A, Dahansekar B, Aparna I and Naim H: Factors influencing success of cement versus screw retained implant restorations: a clinical review. J Osseointeg 2012;3:43-47.
16. Buzayan MM, Yunus NB. Passive fit in screw retained multi-unit implant prosthesis understanding and

achieving: A review of the literature. J Indian Prosthodont Soc 2014;14(1):16–23.
17. Rutkunas V, Larsson C, Vult von Steyern P, Mangano F, Gedrimiene A. Clinical and laboratory passive fit assessment of implant-supported zirconia restorations fabricated using conventional and digital workflow. Clin Implant Dent Relat Res 2020;22(2):237–45.
18. Papaspyridakos P, Vazouras K, Chen Y wei, Kotina E, Natto Z, Kang K, et al. Digital vs Conventional Implant Impressions: A Systematic Review and Meta-Analysis. J Prosthodont 2020;29(8):660–78.
19. Alikhasi M, Siadat H, Monzavi A, Momen-Heravi F. Three-dimensional accuracy of implant and abutment level impression techniques: Effect on marginal discrepancy. J Oral Implantol 2011;37(6):649–57.
20. Moreira AHJ, Rodrigues NF, Pinho ACM, Fonseca JC, Vilaça JL. Accuracy Comparison of Implant Impression Techniques: A Systematic Review. Clin Implant Dent Relat Res 2015;17:e751–64.
21. Prithviraj DR, Pujari ML, Garg P, Shruthi DP. Accuracy of the implant impression obtained from different impression materials and techniques: Review. J Clin Exp Dent 2011;3(2):106–11.
22. Kachhara S, Nallaswamy D, Ganapathy D, Sivaswamy V, Rajaraman V. Assessment of intraoral scanning technology for multiple implant impressions – A systematic review and meta-analysis. J Indian Prosthodont Soc 2020;20(2):141.