The bar –frame work misfit: Review article

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https://doi.org/10.54361/ljmr.12.2.03

ABSTRACT:

Implant overdenture withAttachment were used to improve the stability and function of the prostheses and increases patient satisfaction.A passive fit between the metal framework and the bar attachment is required for successful restoration. Framework-bar misfit is a common problem observed in overdentures, which might result in prosthetic and biological complications.In the present article was reviewed the literature concerning on the causes, complication and overcome of misfit.

Key word: implantoverdenture, bar attachment, misfit

INTRODUCTION:

Implant assisted overdentures have been widely used to increase low retention and stability of complete dentures(1) and also improves neuromuscular activity and adaptation and thereby substantially improves masticatory function in edentulous patients.(2) used implants with Attachment to the improves the stability and function of the prostheses and increases patient satisfaction. (1)

The commonly used abutment types for connections between the denture and inter foraminal implants are (Bar-clip, Ball attachments, Locator, Magnets and Telescopic crowns), which offer different biomechanical features.(3)

The bar-clip retention system provides the highest retention for the prostheses.[4] When compared to the other attachments. This system also provides a more favorable stress distribution due to splinting. Still, the rotation of the clip over the bar allows the forces from chewing to be better distributed in the implants and in the denture bearing area. [5] The long-term success of overdentures with a bar-clip system is closely related to the passive fit between the bar- framework and the implants. [6] A passive fit between the metal framework and the bar/implants is required for successful restoration.[7]Passivefit of prosthetic frameworks on dental implants has been considered to be critical to avoid more problems.[8] The other authors defined passive fit as the absence of strain development following framework insertion.[9]Also, the Passive fit is assumed to be one of the important prerequisites to maintain bone level around the implants. It should be simultaneous and even contact between the whole inner surface of frame work with all implant abutments without inducing any strain on the supporting implant components and surrounding bone structure in the absence of occlusal loads.[10]

Acceptable levels of fit:

In 1983, Brånemark was the first to define passive fit and he proposed that it should exist at the 10 µm level to enable bone maturation and remodeling in response to occlusal loads. [11] In 1985, Klineberg and Murray suggested that castings with discrepancies greater than 30 µm -over more than 10% of the circumference of the abutment interface were unacceptable.[12] In 1991, Jemtdefined passive fit as levels that did not cause any long-term clinical complications and suggested misfits smaller than 150 µm were acceptable. It was proposed that an unacceptable level of framework misfit existed when greater than half-a-turn was needed to completely tighten the gold screw after its initial seating resistance was encountered. Although the preceding values were reported and

subsequently highly quoted, they are of empirical origin.[13]

Methods for evaluating framework fit:

Methods for evaluating implant framework fit can be categorized according to the assessment method.

Clinical Assessment: There are different methods to evaluate the fit of the framework; but, none of these methods is accepted as the standard test. The accuracy of these methods can be affected by implant distribution and number, margin location, framework rigidity, eyesight, lighting, angle of vision, and experience of the dentist. [14]

The alternate finger pressure technique is a simple technique to detect a gross misfit by applying pressure in an apical direction alternatively at each end of the framework to detect the presence of any fulcrum.[15]

2. **Laboratory Assessment**:

The lab technician should check the fit of framework on the cast before the dentist tries it in the patient's mouth. A framework that does not fit on the master cast will not fit in the mouth. Several different methods may be used to assess the fit of framework in the laboratory.[14]

Photogrammetric technique: it was introduced by Lie and Jemt to analyze the fit of implant frameworks. This technique measures the three dimensional orientation of the abutment cylinders on the implant analogs. It involves the use of a small standard camera with a wide angle lens modified and it can measure a gap as small as 30 µm. It is a technique sensitive procedure that requires standardization of the position of the camera.[16]

b-Coordinate measuring machine: this machine consists of a probe which can travel in the X,Y,Z axes and record the dimension of the framework or inter-implant analogue distances and height when it touches a surface. The distance that the probe travels is calculated by computer software and transformed into measurable data.[17]

Strain gauge analysis: strain gauges consist of fine wires or foils arranged in

a grid pattern which are attached to the framework. They are also sensitive to temperature.[18]

.Finite element analysis (FEA): is a computer-based technique for calculating strength and behavior of structures. It is a good tool to evaluate the behavior of peri implant structure and stresses affecting screws and implant bone interface caused by metal framework fitting and occlusal loading.[19]

Factors affecting the framework fit accuracy

Several authors have found that routine procedures such as impression making, cast pouring, framework waxing, investing, polishing, and veneering will induce misfit of several hundreds of microns, which might be missed clinically.[20,21] Consequently, vertical, horizontal, and angular misfits of significant magnitude can be potentially introduced.

a- Impressionmaterials:

Theyare used to record a negative form of the intraoral structure for the fabrication of stone casts that replicate the intraoral structure where the prosthesis is fabricated. Ideal dental implant impression should produce an accurate impression, resist tearing, enough working time, biocompatible, easy to use, dimensionally stable, compatible with die materials [22]

b- Impressions technique:

Kim et al. compared the accuracy of implant impression in-vitro and found that the non-splinted technique showed less three dimensional linear displacements than the splinted technique during impression making while the splinted technique showed less three dimensional linear displacement than the non-splinted group during cast fabrication.[23]The other study evaluated the accuracy of pick-up impressions made with an acrylic resin splint and without on a model with four internal connection implants using polyether impression material. It was found that splinting

impression copings with acrylic resin produced more accurate casts [24]

Assunaco et al. they found that open tray impressions with splinted impression coping produced better results compared with open tray without splinting and closed tray impression. [25] Del Acqua et al reported in his study that both splinted and un-splinted open-tray impressions are more accurate compared with closed-tray impression. When there are three or less implants, most studies showed no difference between closed-tray and open tray impression techniques [26] Digital impression techniques at the implant level have become available and have played an important role in the development of a fully digital workflow for implant restorations [27]and could offer some advantages over traditional implant impression procedures with elastomeric impression materials, such as reduced risks of distortion during impression and cast fabrication, improved patient comfort and acceptance [28]. One recent study showed that angulated implants diminish the accuracy of the impressions created with an active wave front sampling technology based digital impression system. [29].The iTero System (Cadent iTero, Cadent Ltd) was introduced in 2007 using parallel confocal imaging technology to capture the digital impression. [30]

c. Cast materials:A

definitive cast is the positive reproduction of the intraoral structure recorded by the impression material. Desirable qualities of cast materials are accuracy, dimensional stability, ability to reproduce fine details, strength, resistance to abrasion, ease of adaptation to the impression material, color for contrast, and safety [31] than definitive casts made from traditional transfer and pickup techniques. [32] The Encode restorative system provides an alternative method for cast fabrication by means of digitally coded healing abutment to transfer the information about implant diameter and position to a robotcast, which places a corresponding implant analog in the definitive cast. However, the initial results with this

system demonstrated that definitive casts were less accurate.

d. Implant framework fabrication technique:

Conventional casting:technique shows technical complications caused by misfit between the prosthetic structure and the abutment.[33] The fit of a cast implant framework is affected by pattern fabrication material, investment material, investing technique and casting [34] Base metal alloys such as cobalt-chrome (Co–Cr) and nickel-chrome (Ni-Cr) are less expensive compared with noble alloys and have superior physical properties. However, they are difficult to cast, finish, and polish. For base metal casting accuracy, titanium (Ti) alloy casting is more accurate than Ni-Cr and Co-Cr alloys, and Co-Cr alloy casting is worse than Ni-Cr. Single base alloy casting are not acceptable for implant frameworks and additional refinements to improve their fit are needed before they can be inserted [35]

Potential distortion can be created at any step of the fabrication process. Errors are due to changes occurring during indirect procedures, including taking impressions, gypsum casts, waxing frameworks, investing wax patterns, and casting frameworks. If all the materials are carefully handled, then the compounded errors are still relatively small. [36]

Complicationof misfit

There are many complications could be caused by a misfit in the prosthetic metal framework. They may include mechanical complications: are such :The misfit in implant connections can result in intense oblique loads and concentration of stresses at prosthetic and implant structures.[37]as fractures in bone tissue are not only observed when occlusal loads are applied. Stresses are also created when ill-fitting prostheses veneering material, framework, fixation screws and abutment screws, as well as loosening of the screws. The Other biological complications were also observed, such as gingival inflammation, pain, fistula and per implant bone loss [38]The stresses on prosthetic structures and

are installed [38], and the values of these generated stresses vary with the stiffness of the framework material [39]. Also,

microbial proliferation.it will cause ;Perimucositis- a reversible inflammation of the soft tissues surrounding functional implants. Peri-implantitis- an inflammatory reaction with the loss of supporting bone in the tissues surrounding a functional implant. Finally the microbial proliferation leads to crestal bone loss. [40]

Outcomes of framework misfit:

For multiple-unit implant assisted dental prostheses, it is critical that a passive fit be achieved between the superstructure and the bar/ implants. Failure to meet this requirement may result in biologic and technical complications [41]. Due to the rigidity of the connection between osseointegrated implants and surrounding bone, any stress caused by framework misfit will be transmitted to implant components and implant bone interface [42]When misfit of the cast bar occurs, cutting and reconnecting the bar segments through soldering or welding is performed in an attempt to achieve a passive fit [43]**.** also the lack of accurate adaptation of the denture base to the bar superstructure can be avoided by Electrical Discharge Machining and spark erosion which can be used to improve the fitof overdenture framework, but this procedure is costly and sensitive technique [44]The inaccuracies of framework fabrication have been greatly minimized by techniques that eliminate distortion-introducing steps, such as computer-aided design/ computer-assisted manufacture. Computer numeric controlled (CNC) milling has proven to be a reliable and consistent fabrication method for titanium implant frameworks.[45]

A finite element study showed that the presence of 111 µm vertical gaps had a significant impact on stress distribution in implant components and surrounding bone. The presence of a cantilever or excessive force increased the effect of the misfit. When passive fit is achieved a lower peak stress is produced in each component due to widely distributed stress in all components. Also, when the prosthesis has a misfit, the gold screw and the abutment screw bore more

stress than when a passive fit is present. (46)

Conclusions:

1-The Passive fit is considering one of the important prerequisites to maintain bone level around the implants.
2-Framework-bar misfit is more stress to bone and causes some complications that lead to failure in implant.

References

1. Kuoppala R, Näpänkangas R, Rustia A.Outcome of implant-supported overdenture treatment-a survey of 58 patients. Gerodontology. 2012; 29:577-84.
2. Bilhan H, Mumcu E, Dayan C, Yabul A, Tuncer N. Comparison ofpatient satisfaction, quality of life, and bite force between elderly edentulous patients wearing mandibular two implant-supported overdentures and conventional complete dentures after 4 years. Spec Care Dent. 2012; 32:136-41.
3. Abouseta F, Elsyad M, Samir A.Effect of Different implant angulations on peri- implant strain under locator retained mandibular overdenture. An In-vitro Study.J Mansoura Dent .2015;2:79-83
4. Trakas T, Michalakis K, Kang K, Hirayama H. Attachment systems for implant retained overdentures: a literature review. Implant Dent. 2006; 15:24–34.
5. Allen EP, Bayne SC, Brodine AH, Cronin RJ , Donovan TE, Kois JC et al Annual review of selected dental literature: report of the Committee on Scientific Investigation of the American Academy of Restorative Dentistry. J Prosthet Dent. 2003; 90:50–80 .
6. Al-Turki L, Chai J, Lautenschlager E, Hutten M. Changes in prosthetic screw stability because of misfit of implant-supported prostheses. J IntProsthodont. 2002 15:38–42.
7. Kan J, Rungcharassaeng K, Bohsali K, Goodacre C, Lang B. Clinical methods for evaluating implant framework fit. JProsthodont .1999; 81: 7-13.

8. Laverty D, Green D, Marrison D, Addy L, Thomas M. Implant retention systems for implant-retaindedoverdentures. J Bri Dent. 2017;2:347-359

9. Karl M, Rosch S, Graef F, Taylor T, Heckmann S. Strain situation after fixation of three-unit ceramic veneered implant superstructures. Implant Dent. 2005;14:157–65

10. Sahin S, Çehreli M. The significance of passive framework fit in implant prosthodontics: current status. Implant Dent. 2001; 10: 85-92.

11. Brånemark PI. Osseointegration and its experimental background. J Prosthet Dent 1983;50:399-410.

12. Klineberg IJ, Murray GM. Design of superstructures for osseointegrated fixtures. J Swed Dent 1985;28:63-9

13. Jemt T. Failures and complications in 391 consecutively inserted fixed prostheses supported by Brånemark implant in the edentulous jaw: a study of treatment from the time of prostheses placement to the first annual check up. J Int OralMaxillofac Implants. 1991;6:270-6.

14. Alqahtani AS. Comparing the Vertical Misfit of Casts Produced By Two Verification Jigs. Marquette University. 2014: 6,7.

15. Kan J, Rungcharassaeng K, Bohsali K, Goodacre C, Lang B. Clinical methods for evaluating implant framework fit. J prosthodent. 1999; 81: 7-13.

16. Jemt T, Lie A. Accuracy of implant-supported prostheses in the edentulous jaw. Analysis of precision of fit between cast gold-alloy frameworks and master casts by means of a three-dimensional photogrammetric technique. Clin Oral Implants Res 1995; 6: 172-180.

17. Mulcahy C, Sherrif M, Walter JD, Fenion MR. Measurement of misfit at the implant-prosthesis interface: an experiment method using a coordinate measuring machine. J Intorallmaxillofac implant.2000;15:111-8.

18. Brosh T, Pilo R, Sudai D. The influence of abutment angulation on strains and stresses along the implant/bone interface: comparison between two experimental techniques. JProsthodont. 1998; 79: 328-34

19. Abduo J, Bennani V, Waddell N, Lyons K, Swain M. Assessing the fit of implant fixed prostheses: a critical review. J Int oral lmaxillofac implant. 2010; 25:506-515.

20. Del'Acqua MA, Arioli-Filho JN, Compagnoni MA, MolloFde A Jr. Accuracy of impression and pouring techniques for an implantsupported prosthesis. J Int orallmaxillofac implant .2008;23:226–36.

21. Abreu RT, Spazzin AO, Noritomi PY, Consani RL, Mesquita MF. Influence of material of overdenture-retaining bar with vertical misfit on three-dimensional stress distribution. J Prosthodont. 2010;19:425–431.

22. Power JM, Sakaguchi RL, Cragi s. Restorative Dental Material. 12th ed. St Louis: Mosby. 2006

23. Kim S, Nicholls J, Han C, Lee K. Displacement of implant components from impressions to definitive casts. J Int OralMaxillofac Implants, 2006; 21: 747-55.

24. Vigolo P, Majzoub Z, Cordioli G. Evaluation of the accuracy of three techniques used for multiple implant abutment impressions. JProsthodont. 2003; 89: 186-2.

25. Assuncao W, GennariFilho H, Zaniquelli O. Evaluation of transfer impressions for osseointegrated implants at various angulations. Implant dentistry 2004; 13: 358-66

26. Del'Acqua MA, Chávez AM, Amaral ÂL, Compagnoni MA. Comparison of impression techniques and materials for an implant-supported prosthesis. J Int Oral Maxillofac Implants. 2010; 25:211-6

27. Lee SJ, Gallucci GO. Digital vs. conventional implant impressions: efficiency outcomes. Clin oral implants Res. 2013; 24: 111-5.

28. Schaefer O, Decker M, Wittstock F, Kuepper H, Guentsch A. Impact of digital impression techniques on the adaption of ceramic partial crowns in vitro. J Dentist 2014; 42: 677-683

29. Gimenez B, Ozcan M, Martinez-Rus F, Pradies G, Accuracy of a Digital impression system based on active wave front sampling technology for implants considering operator experience, implant angulation and depth. Clin implant Dentist related res.2015;17:55-58.

30. Birnbaum NS, Aaronson HB. Dental impression 3D Digital scanners: virtual becomes reality. compendium of continuing education in dentistry.2008;29:494-505

31. Kadam P.Digital and conventional impression die accuracy: the university of Alabama at brimingham;2009

32. Lee YJ, Heo SJ,Koak JY, Kim SK: Accuracy of Different impression techniques for internal-connection implants. Int J OralMaxillofac Implants. 2009;24: 155-8.

33. Pereira J, Morsch C, Henriques B, Nascimento R, Benfatti C, Silva F, *et al*. Removal torque and biofilm accumulation at two dental implant-abutment joints after fatigue. Int J OralMaxillofac Implants 2016;31:813-9

34. Carr AB, Stewart RB.Full arch implant framework casting accuracy: preliminary in vitro observation for in vivo testing. J Prosthodont.1993;2:2-8

35. Spazzin AO, Spazzin WO, Schuh C, Bacchi A, TostaVB,Marcaccini AM. Technique of framework cemented on preparedabutments to obtain passive fit at fixed complete denture:a 2-year follow-up report. J Braz 2014;25:565-70.

36. Chun HJ, Cheong SY, Han JH, SJ, chung JP, Rhyu IC, et,al. Evaluation of design parametres of osseointegrated dental implants using finite element analysis. J oral Rehab.2002;29:565-74

37. Macedo JP, Pereira J, Vahey BR, Henriques B, Benfatti CA, Magini RS, *et al.* Morse taper dental implants and platform switching: The new paradigm in oral implantology. J EurDent 2016;10: 148-54.

38. Monteiro DR, Goiato MC, GennariFilho H, Pesqueira AA. Passivity in implant-supported prosthesis. J craniofaci surg.2010;21:413-23

39. Brunski JB Biomechanical factors affecting the bonedental implant interface. Clin Mater. 1992; 10: 153-201.

40. Norowski PA, Bumgardner JD. Biomaterial and antibiotic strategies for peri-implantitis: A review. J Bio Mater Res Part B: Applied Biomaterials. 20091;88:530-43

41. Jendresen M, Allen E, Klooster J, McNeill C, Phillips R, Preston J. Report of the committee on scientific investigation of the american academy of restorative dentistry. J Prosthodont1991; 66: 84-131.

42. Haselhuhn K, MarottiJ, tortamano P, wesis C, suleiman I wolfart S. assesstment of the stress transmitted to dental implants connected to screw-retained bars using different casting techniques. J oralimplantogy.2014; 40:641-8.

43. Abduo J, Lyons K, Bennani V, Waddell N, Swain M. Fit of screw-retained fixed implant frameworks fabricated by different methods: a systematic review. J Int Prosthodont. 2011; 24:120-5

44. Alqahtani AS. Comparing the vertical misfit of casts produced by two verification jigs. Marquette University. 2014.

45.. Ortorp A, Jemt T, Back T, Jalevik T. Comparisons of precision of fit between cast and CNC-milled titanium implant frameworks for the edentulous mandible. Int J Prosthodont 2003;16:194–200.

46. Kunavisarut C, Lang L, Stoner B, Felton D.finite element analysis on dental implant supported prostheses without passive fit.J Prosthodont.2002;11:30-34.