



An Evaluation of Interchangeability of Implant Components among Dentists

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Abstract

With the advent of implants in dentistry several different systems are successfully launched and there is evidence that a few of the systems are interchangeable. The equivalence provided by the Branemark implant system and the tolerance of the design parameters has allowed several recently commercialized dental implant systems, the provision of interchangeability. On one hand, abutment interchangeability allows a flexible working resource when implant fixtures of other systems are to be restored. However, the extent to which such a practice can be adopted should be a subject of critical analysis. It has been shown that a micro-gap at the implant-abutment interface can potentially act as a gateway for bacteria to colonize the interstice, potentially leading to bone loss around the implant. In order to further investigate this, a question was distributed to the teaching hospitals in Islamabad to be filled out by dentists and surgeons who are currently placing implants. The data was gathered and results were accumulated. This study takes a look at the prevalence of implant interchangeability amongst dentists and the factors that lead to it.

Keywords: Implants; Interchangeability; Micro-gap; Abutment; Bone loss.

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1. Introduction

The equivalence provided by the Branemark implant system and the tolerance of the design parameters has allowed several recently commercialized dental implant systems, the provision of interchangeability. On one hand, abutment interchangeability allows a flexible working resource when implant fixtures of other systems are to be restored. However, the extent to which such a practice can be adopted should be a subject of critical analysis. The adequacy of the abutment exchange should ideally be defined by the precision of the fit as verified when the original, prescribed components were used [1].

It has been shown that a micro-gap at the implant-abutment interface can potentially act as a gateway for bacteria to colonize the interstice, potentially leading to bone loss around the implant [1,2]. The problem may be contained in static studies but in clinical trials the misfit may allow for movement of the prosthetic component eventually leading to the widening of the interface gap and can also result in mechanical complications such as screw loosening [1,3,4].

As a consequence of an exhaustive list of implant systems available and being used in the market, the restorative dentist might be faced with the predicament of identifying the type of system previously used. Incidents have been cited in which different types of implants have been placed in the same mouth or even in the same arch[3]. Since there are clear financial and practical advantages to interchanging abutments of different systems when constructing prosthesis, the practice of interchangeability would increase without much considerations to its implications on the long term predictability of the treatment.

After Binon's extensive work on platform switching and its combinations it was proposed that the adequacy of the exchange should be defined by the precision of the fit verified when the original components were used[4]. The use of an abutment and implant from the same company is usually recommended to prevent loosening of the abutment screw[5]. After Binon's work many others attempted to evaluate the Implant-abutment fit and its implications, a few of the prominent ones included Herman who proposed the influence of microgap on crestal bone changes around the implant [6] and Al- Turki who proposed the changes in screw stability due to Implant-abutment misfit [7] articles by Kano also aimed to summarize the works of different authors on this issue[8].

The recent and on-going introduction of implant systems in Pakistan, along with a rise in number of implant placements would translate into an increase in the practice of interchangeability. Studies which compare the precision of alternative and original components are lacking in Pakistan and are scarce. This article takes a closer look at the current status of practicing dentists and focuses on the interchangeability of implant components amongst dentist in Islamabad.

Objectives:

The objectives of this study are twofold:

1. To identify the existence of interchangeability practice amongst the clinicians in the cities of Islamabad and Rawalpindi.

2. To identify micro-gaps at the implant-abutment interface of 02 locally available Korean dental implant systems.

2. Materials and Methods:

This was a cross-sectional, questionnaire based study. In order to increase the response rate of the questionnaire, evidence based recommendation were followed. Ethical approval was granted by the Research Ethics Committee of Riphah International University (Faculty of Dentistry). As this was a questionnaire based study, the respondents implied consent for participation by returning the questionnaire.

2.1 Questionnaire

The questionnaire was designed by the authors in Faculty of Dentistry, Riphah International University.

Before commencing the main study, a pilot study was conducted. For the pilot study, the questionnaire was distributed among ten dental implantologists in the Islamabad and Rawalpindi. The pilot study tested the content, frequency, clarity and timing of the questions. Modifications were made in the design of the questionnaire in the light of the feedback from the pilot study[9,10].

For the main study, the questionnaires were randomly sent by email to 200 dentists all over Islamabad and Rawalpindi. The dentists' names were collected from the PMDC dentists' database[11]. A total of 200 dentists for the study were randomly selected from the PMDC database. All participants were contacted by telephone and requested to kindly fill in the questionnaires and return them promptly. 120 dentists responded to the questionnaire

2.2 Questionnaire Design

The questionnaire was divided into sections: A and B.

The cover page of the questionnaire comprised of a brief introduction to the questionnaire, describing the aims of the study.

Section A consisted of 13 multiple choice questions related to the practice of placing dental implants.

Questions inquiring whether the participants were general dentists or specialists were placed in Section B. This was in accordance with Dill man's recommendations of placing demographic questions at the end of the questionnaire [9].

2.3 Sample Size

A non-probability convenient sample of 120 participants was selected for the purpose of this study.

2.4 Data Analysis

Data analysis was carried out using SPSS v 20.0. All data was anonymised. Descriptive statistics (frequency, mean and standard deviation) were used to describe the participants' answers to the various questions.

Table1: Questions included in the questionnaire.

S.no	Questionnaire	Answers
1	Do you place dental implants?	Yes NO
2.	Do you use surgical drills of one implant system to place an implant of another system?	Yes NO
3.	If you do not, would be okay with using surgical drills of one system to place an implant of another if such a situation arises for any reason	Yes NO
4.	If the answer to the above question was a yes, would be okay using widening drills of one system to place an implant of another system. Please assume that you want to place a 3.8mm diameter x 10mm long bone level, tapered implant and both systems make such an implant.	Yes NO
5.	Do you normally use the profile drill to widen the coronal one third of a mandibular osteotomy?	Yes NO
6.	If you do use a profile drill do you use it in approximately:	100% cases 50%case Less than 25%cases
7.	When placing an implant please assume you encounter high resistance and excessive insertion torque. The implant is already 7/8 th down into the osteotomy. Would you unturn a few times, back out the implant a little bit, wait for the bone to expand and re try hoping that this would help in seating the implant completely?	
8.	If a patient comes to you from abroad with an implant integrated asking for a restoration while you do not have an abutment, would you use an abutment from another implant system if it apparently seats well and torques down to your desired level? Also on x-ray there does not seem to be any mis-match between the abutment and implant	Yes NO
9.	Do you use expansion screws to place implants?	Yes NO
10.	Do you fear that the thinner expansion screws might break after being used a certain number of times?	Yes NO
11.	Do you fear that the expansion screws even in softer bone might be transmitting too many stresses to the adjacent bone?	
12.	After how many procedures should the surgical drills from an implant kit be replaced:	200 100 50 25 I have no idea.
13.	Are you a general dentist?	Yes NO
14.	Are you a specialist?	Yes NO
15.	What is your specialty?	
16.	Do you use one system or a number of implant systems?	Yes NO

3. Results

Out of the sample size of 120 dentists, 72 dentists (60%) were general dental practioners while 48 dentists (40%) were specialist in the field of Implantology. Out of the specialist 72% used multiple implant systems while only 28% of general practioners preferred using single system. 92% of the implantologists used surgical drills of one system for another while only 08% of general practioners used different drills. Similarly 60% of specialists were comfortable with interchangeability of implant systems while only 40% of GPs agreed.

Table2: Sociodemographic data of participants.

Variables	Number	Percentage
Specialists	72	40%
General Dental Practioners	48	60%

Table3: Level of acceptance of interchangeability amongst participants.

Variables	Number	Percentage
Specialists	42	35%
General Dental Practioners	78	65%

Table4: Preferences and interests regarding implants.

Q no16. Do you use one system or a number of implant systems?	
Specialist	72%
General dental practioners	28%
Q no2.Do you use surgical drills of one implant system to place an implant of another system?	
Specialist	92%
General dental practioners	8%
Q no3. Would be okay with using surgical drills of one system to place an implant of another if such a situation arises for any reasons	
Specialist	60%
General dental practioners	40%

4. Discussion

Ever since the implant manufacturers adopted the dimensional standardization by Branemark, interchangeability of abutments manufactured by different companies seems viable and clinically adequate[4]. However the data from Scanning Electron Microscope (SEM) images show that not only the inter changed abutments but even the

original components do not offer a consistent minimum implant/abutment (I/A) gap, statistics also reveal significant differences between the I/A components when the component and company were changed [4,12].

The I/A misfit has severe implications as it is important in maintenance of bone/implant/prosthesis complex when managing the biological and mechanical responses along with bacterial contamination and its effects [13,14]. The I/A micro gaps allow passage of fluids and allows the bacteria to colonize the interstitial space around the implant and eventually leads to bone loss around the implant[15]. The I/A connection can be an area where adverse mechanical and biological consequences occur complications such as microleakage,[18-20] gingivitis [6,16] and bone loss [6,17] have been reported to result from poor I/A interface. Apart from this mechanical complications such as screw loosening, [7] increased incidence of abutment rotation and breakage and preload reduction have also been reported with poor I/A interface [18]. microleakage and bacterial colonization has been known to occur with different types of I/A connections [19]. the presence of inflammatory cells near micro gaps has not clinically been co related to presence of plaque [20] the peaks of inflammatory cells normally occur 0.50mm coronal to the microgap [16]. the microgap at the I/A interface allows the proliferation of microorganisms close to the epithelial attachment which results in bone resorption approximately 2mm apical to the microgap [6].

The mechanical complications of poor fit of abutment includes screw loosening, abutment rotation and abutment fracture[18,21] many studies have proven the importance of I/A fit[22] a standard does not exist for measuring the microgap [23]. This makes comparison between studies really difficult due to the lack of standardization [24,25]. Different techniques normally employed for measuring the marginal fit of I/A components are the same that have previously been used for measuring the marginal fit of conventional restorations. They include the cross-sectional measurement after sectioning, the direct view, the impression technique and the use of explorer with visual examination[1,26,29,30]. A standardized classification for I/A interface has not yet been established and needs to be decided to characterize the I/A interface as it will be beneficial and will facilitate in understanding the potential complications related to implant- abutment interface[8].

According to literature search it seems that interchangeability of implant abutments is a common practice amongst implantologists and general practioners this is contributing to potential precision problems [26]. However the potential for significant precision problems may be even greater than expected for implants and abutments from the same manufacturer [26,27] even in the absence of any discrepancy , the finite element models have indicated a potential lateral displacement of I/A set [28] when such a disparity is inherent to original components or when components are interchanged the I/A stability maybe compromised [29].

The questionnaire also substantiates the fact that interchangeability exists amongst Pakistani practicing dentists and the majority of dentists are not very well aware of the implications of the interchangeability of the I/A component. However this field requires more studies to support and verify the actual accuracy of fit between the implant and abutment. There is a research gap in this particular area and requires more clinicians to actually check and verify the degree of fit and the I/A gap by scanning electron microscopes or by more advanced technologies such as Finite element analysis as this would clear the doubts and help clear the disparity. It would also be beneficial for Pakistani practicing dentists in making a wiser decision with no long term implications.

5. Conclusion

With the questionnaire the general trend of Pakistani dentists is evident and since implants are a comparatively newer treatment modality the level of awareness regarding implants and abutments need to be increased so that the clinicians can benefit from it. The need to identify a standardized method for evaluation of implant-abutment microgap is imperative. There is need for further research in this area.

References

- [1]. Do Nascimento C, de Albuquerque Jr RF. Bacterial Leakage Along the Implant-Abutment Interface. *Implant Dentistry—The most promising discipline of dentistry*. Rijeka: Intech 2011:335-46.
- [2]. Steinebrunner L, Wolfart S, Bößmann K, Kern M. In vitro evaluation of bacterial leakage along the implant-abutment interface of different implant systems. *International Journal of Oral & Maxillofacial Implants* 2005;20(6).
- [3]. Meffert R. personal communication.
- [4]. Zanardi PR, Costa B, Stegun RC, Sesma N, Mori M, Laganá DC. Connecting accuracy of interchanged prosthetic abutments to different dental implants using scanning electron microscopy. *Brazilian dental journal* 2012;23(5):502-07.
- [5]. English CE. Externally hexed implants, abutments, and transfer devices: a comprehensive overview. *Implant dentistry* 1992;1(4):273-82.
- [6]. Hermann JS, Schoolfield JD, Schenk RK, Buser D, Cochran DL. Influence of the size of the microgap on crestal bone changes around titanium implants. A histometric evaluation of unloaded non-submerged implants in the canine mandible. *Journal of periodontology* 2001;72(10):1372-83.
- [7]. Al-Turki LEE, Chai J, Lautenschlager EP, Hutten MC. Changes in prosthetic screw stability because of misfit of implant-supported prostheses. *International Journal of Prosthodontics* 2002;15(1).
- [8]. Kano SC, Binon PP, Curtis DA. A classification system to measure the implant-abutment microgap. *International Journal of Oral & Maxillofacial Implants* 2007;22(6).
- [9]. Dillman DA. *Mail and Telephone Surveys: The total design method*. New York: Wiley Publications, 1978.
- [10]. Edwards P, Roberts, I., Clarke, M., DiGiuseppi, Pratap, S., Wentz, R., Kwan, I. Increasing response rates to postal questionnaires: A systematic review. *British Medical Journal* 2002;324(7347):1183.
- [11]. *Doctors Directory PMDC 2013: PMDC*.
- [12]. Karl M, Graef F, Schubinski P, Taylor T. Effect of intraoral scanning on the passivity of fit of implant-supported fixed dental prostheses. *Quintessence International* 2012;43(7).
- [13]. Piattelli A, Scarano A, Paolantonio M, Assenza B, Leghissa GC, Bonaventura GD, et al. Fluids and microbial penetration in the internal part of cement-retained versus screw-retained implant-abutment connections. *Journal of periodontology* 2001;72(9):1146-50.
- [14]. Gross M, Abramovich I, Weiss EI. Microleakage at the abutment-implant interface of osseointegrated implants: a comparative study. *International Journal of Oral & Maxillofacial Implants* 1999;14(1).
- [15]. do Nascimento C, Miani PK, Watanabe E, Pedrazzi V, de Albuquerque Jr RF. In vitro evaluation of bacterial leakage along the implant-abutment interface of an external-hex implant after saliva

- incubation. *International Journal of Oral & Maxillofacial Implants* 2011;26(4).
- [16]. Broggini N, McManus L, Hermann J, Medina R, Oates T, Schenk R, et al. Persistent acute inflammation at the implant-abutment interface. *Journal of dental research* 2003;82(3):232-37.
- [17]. King GN, Hermann JS, Schoolfield JD, Buser D, Cochran DL. Influence of the size of the microgap on crestal bone levels in non-submerged dental implants: a radiographic study in the canine mandible. *Journal of periodontology* 2002;73(10):1111-17.
- [18]. Carr AB, Brunski JB, Hurley E. Effects of Fabrication, Finishing, and Polishing Procedures on Preload in Prostheses Using Conventional Gold and Plastic Cylinders. *International Journal of Oral & Maxillofacial Implants* 1996;11(5).
- [19]. Jansen VK, Conrads G, Richter E-J. Microbial leakage and marginal fit of the implant-abutment interface. *International Journal of Oral & Maxillofacial Implants* 1997;12(4).
- [20]. Ericsson I, Persson L, Berglundh T, Marinello C, Lindhe J, Klinge B. Different types of inflammatory reactions in peri-implant soft tissues. *Journal of Clinical Periodontology* 1995;22(3):255-61.
- [21]. Binon PP. Evaluation of three slip fit hexagonal implants. *Implant dentistry* 1996;5(4):235-48.
- [22]. Binon PP. Evaluation of machining accuracy and consistency of selected implants, standard abutments, and laboratory analogs. *International Journal of Prosthodontics* 1995;8(2).
- [23]. Sahin S, Çehreli MC. The significance of passive framework fit in implant prosthodontics: current status. *Implant dentistry* 2001;10(2):85-92.
- [24]. Ma T, Nicholls JI, Rubenstein JE. Tolerance measurements of various implant components. *International Journal of Oral & Maxillofacial Implants* 1997;12(3).
- [25]. Faulkner MG, Wolfaardt JF, Chan A. Measuring abutment/implant joint integrity with the Periotest instrument. *International Journal of Oral & Maxillofacial Implants* 1999;14(5).
- [26]. Spazzin AO, Henrique GEP, Nóbilo MAdA, Consani RLX, Correr-Sobrinho L, Mesquita MF. Effect of retorque on loosening torque of prosthetic screws under two levels of fit of implant-supported dentures. *Brazilian dental journal* 2010;21(1):12-17.
- [27]. Oyagüe RC, Sánchez-Turrión A, López-Lozano JF, Suárez-García MJ. Vertical discrepancy and microleakage of laser-sintered and vacuum-cast implant-supported structures luted with different cement types. *Journal of Dentistry* 2012;40(2):123-30.
- [28]. Gomes ÉA, Assunção WG, Barão VAR, Delben JA, Rocha EP, de Sousa EAC. Passivity Versus Unilateral Angular Misfit: Evaluation of Stress Distribution on Implant-Supported Single Crowns: Three-Dimensional Finite Element Analysis. *Journal of Craniofacial Surgery* 2010;21(6):1683-87.
- [29]. Callan DP, Cobb CM, Williams KB. DNA probe identification of bacteria colonizing internal surfaces of the implant-abutment interface: A preliminary study. *Journal of periodontology* 2005;76(1):115-20.