Research Article

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A Comparative Analysis of Resonance Frequency Analysis of Sand Blasted Acid Etched (SAE) & Chemical Modified SAE Dental Implants: A Clinical Study

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ABSTRACT

Background: Chemical modified and sand blasted acid etched (SAE) mechanism leads to wettability of surfaces of dental implants which helps in osseointegration. The present study was conducted in the department of Prosthodontics to determine the ISQ of SAE and SAE chemically modified dental implants.

Materials & Methods: The present study was conducted on 34 patients (males- 16, females- 18) of age ranged 20-50 years. Dental implants (Nobel care) with SAE (Group A) and SAE chemically modified (Group II) were inserted in patients. RFA was done immediately after implant insertion, after 1 week, 4 weeks, 8 weeks and 12 weeks.

Results: Age group 20-30 and 30-40 years had 15 patients each. There was no case of dental implant failure. Maximum mean RFA value in group A was 85.6 and minimum was 43.2. In group B, maximum mean RFA value was 87.4 and minimum 31.8.

Conclusion: There is fastest osseointegration in implants with hydrophilic surfaces than with SAE surfaces. ISQ was higher than 80 in both groups which indicate higher implant stability.

Keywords: Dental implant, Osseointegration, Stability.

INTRODUCTION

Dental implants are being used aggressively in world. Dental implants of numerous companies are available to us.[1] The success of any dental implant is based on its ability to show osseointegration. Various factors are responsible for survival of dental implant. It is divided into host related factors and dental implant related.[2] Host related factors include systemic conditions and local factors.[3]Literature revealed that acid etched or sandblasted implant offer high osseointegration in comparison to machined implants. Dental implant related factors are considered more important before inserting dental implants. Chemical modified and sand blasted acid etched (SAE) mechanism leads to wettability of surfaces of dental implants which helps in osseointegration.[4,5] It has been seen that hydroxylation of oxide layer improves the wettability of titanium oxide surface and absorption of proteins on surface of dental implants by increasing interaction between water and implant surfaces.[6]

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Resonance frequency analysis (RFA) is the method of checking the stability or osseointegration of dental implants. It is represented as implant stability quotient (ISQ). RFA helps in judging the level of osseointegration after insertion of implant or during healing period. This guides dentist to place prosthetic part after obtaining high ISQ value.[7] The method is done by sending magnetic pulses to a small metal rod temporarily attached to the implant. As the rod vibrates, the probe reads its resonance frequency and translates it into an ISQ value. SAE implants have similar microstructure and roughness surface.[8] The present study was conducted in the department of Prosthodontics to determine the ISQ of SAE and SAE chemically modified dental implants.

MATERIALS & METHODS

The present study was conducted in the department of Prosthodontics. It comprised of 34 patients (males- 16, females- 18) of age ranged 20-50 years. The study protocol was approved from institutional ethical committee. All patients were informed regarding the study and written consent was obtained.

Patients without systemic diseases and edentulous area in posterior mandible were included while patients with insufficient bone height, systemic diseases and pregnant women were excluded. In all patients, bone height was, measured with intraoral radiographs and bone height above 8mm was considered. Patients with bone height <8mm were not considered in the study.

In all patients assessment was performed with clinical examination, intraoral radiographic examination and CT scan of the implant site. Dental implants (Nobel care) with SAE and SAE chemically modified were inserted in patients mouth by single surgeon following standardized conditions. SAE implants were marked as group A and SAE chemically modified as group B (Fig- 1). Both types of dental implants were placed adjacent to each other for comparison of results. In all patients, implants with 8mm height and 3.0mm width were inserted. RFA was done immediately after implant insertion, after 1 week, 4 weeks, 8 weeks and 12 weeks. Results thus obtained were subjected to statistical analysis. ANOVA test was performed to compare the groups.

RESULTS

Age group 20-30 years had 8 males and 7 females, 30-40 years had 6 males and 9 females and 40-50 years had 2 males and 2 females (Table I). The difference was non- significant (P> 0.05). The maximum mean RFA value in group A was 85.6 and minimum was 43.2. In group B, maximum mean RFA value was 87.4 and minimum 31.8. RFA in group I in 1st week was 50.4, at 2nd week was 53.7, at 4th week was 46.5, 8th week was 77.1. In group II, it was 48.8, 55.3, 36.2, 75.2 and 81.5 at 2nd week, 4th week, 8th week and 12th week (Table II, Graph I). The difference was significant (P< 0.05). Graph II shows that torque value in group I was 36.4 and in group II was 34.2. The difference was non-significant (P> 0.05).

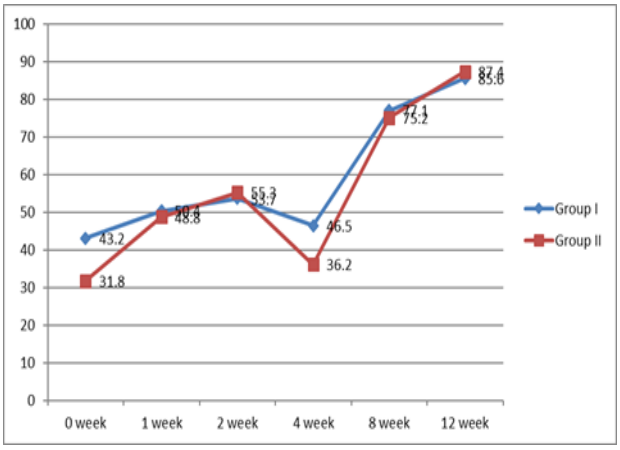
Table 1: Age & gender distribution of patients

Age group (years)	Males	Females	P value
20-30	8	7	0.5
30-40	6	9	
40-50	2	2	

Table II Resonance frequency analysis value for SAE implants (Group A) and SAE chemically modified implants (Group B)

RFA value (Mean± SD)	SAE implants (A)	SAE chemically modified implants (B)	P value
Maximum	85.6	87.4	0.01
Minimum	43.2	31.8	

Graph 1: RFA in both groups.



Graph 2: Torque during implant placement in both groups.

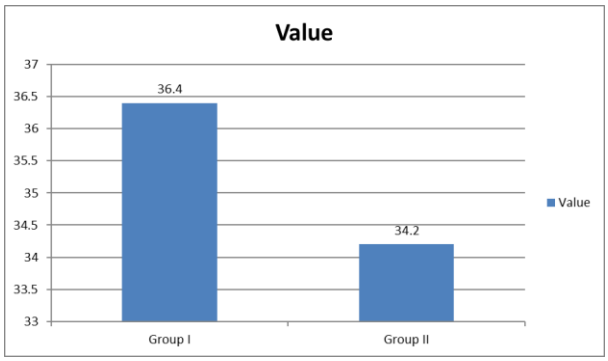
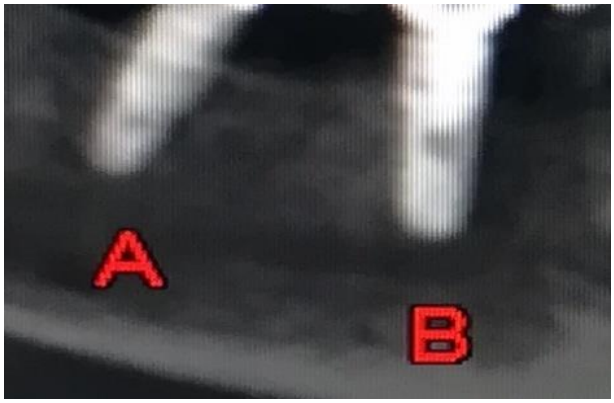


Fig 1: SAE implants (group A) and SAE chemically modified (group B)



DISCUSSION

The success of dental implant is affected by various factors. The general and oral health of the patient, presence of systemic diseases, diabetes mellitus, osteoporosis, bleeding disorders etc. determine the future outcome of dental implant therapy.[9] The diameter, length, site and design of dental implant also affects the stability of dental implant. The quality of bone affects the osseointegration process. Implant placed at D1 and D2 bones are more likely to show better osseointegration as compared to D3 and D4 bone.[10]

In present study we compared ISQ of two similar design implants but treated with sand blasted acid etched (SAE) and hydrophilic SAE. Sim CP et al[11] in their study evaluated the factors such as length of dental implant, quality of bone and instrument positioning on RFA. They suggested that ISQ is affected by bone quality and implant length. Implant placed in D1 and D2 bone is highly stable and shows better osseointegration.

Atieh et al[12] revealed that RFA greatly determines the success and failure rate of dental implants. This technique may be used in healing period to assess the stability of dental implant. Bone deposition at the interface of implant- bone can be evaluated by increasing ISQ. In present study we found that in case of group I, minimum mean ISQ was 43.2 and maximum was 85.6. In case of group II, maximum value was 81.5 and minimum was 31.8. Our results are in agreement with the results of Han et al[13] who found lowest ISQ as 55 and highest as 85. Ersanli et al[14] observed highest ISQ value in type I and II bone than type III and IV bone.

It was observed that ISQ level at all weeks in both groups increased significantly with the progression of time. This may be due to difference in primary and secondary stability between weeks. At initial weeks, low ISQ may indicate loss of primary stability and increase in value indicates secondary stability. Simunek et al[15] in their study concluded that during early healing of immediately loaded implant, the there is minimum stability at 3rd and 4th weeks. Similarly, in our study, it was quite lower at both weeks as compared to subsequent weeks in both groups.

We observed that the ISQ value increased significantly from 4th week to 12th weeks and at the end both the groups. Gahona et al[16] in their study evaluated ISQ of dental implants placed in maxilla and mandible. This comprised of 29 implants in mandibular arch and 31 in maxillary arch. It was seen that in implants with ISQ more than 60, there was successful osseointegration than those less than 60. Similarly, better osseointegration was observed in implants with torque insertion 35 or above.

We observed that torque value in group I was 36.4 and in group II was 34.2. Sarfaraz et al[17] conducted a study on 37 patients. ISQ was measured in 3rd, 7th, 11th and 15th week. Author evaluated RFA, ISQ and insertion torque value. There was positive correlation between ISQ and ITV.

Bornstein et al[18] in their study assessed the ISQ in 3 years prospective study. A comparison was done between acid-etched surface implant and chemically modified sandblasted implant. They suggested that hydrophilic implants have 2 times faster and better osseointegration. SAE implants

had ability to be loaded in 3 weeks than 7-8 weeks. Rocuzzo et al[19] in their study demonstrated that SAE implants can be best placed at 3rd week especially in maxillary posterior teeth region. Maxillary posterior region has type III or IV bone which shows higher implant failure rates. However, surfaced modified dental implants are effectively placed in this bone with higher survival rate. In present study, we used SAE dental implants and SAE chemically modified implants. Active surface treatment of dental implants makes it efficient for osseointegration even in bone with poor density.

Kokovic V et al[20] in their study of immediate vs. early loading of SLA implants in the posterior mandibular region suggested that ISQ >70 is the indicator of higher implant stability. In both groups, we observed ISQ above 80 which is predictor of implant success. Park et al[21] in their study on rabbit tibia found a correlation between ISQ and BIC after 4 weeks of healing. We observed that stability increased with time in both groups. Chambrone et al[22] suggested that surface treated implants may more effectively inserted in poor quality bone and one can expect better results in such cases.

The shortcoming of the study is that small sample was utilized for the study. Long term follow up was not done in present study. Only maxillary posterior region was considered whereas in cases of other parts of jaw bones could have resulted in different findings. Other causes of implant failure such as poor oral hygeine, smoking etc might be the reason for poor osseointegration.

CONCLUSION

There is fastest osseointegration in implants with hydrophilic surfaces than with SAE surfaces. ISQ was higher than 80 in both groups which indicate higher implant stability. However large scale studies are required to substantiate the results obtained in this study.

Clinical Significance

Surface treatment of dental implants offers higher implant bone osseointegration.

CONFLICT OF INTEREST

No potential conflict of interest relevant to this article was reported.

REFERENCES

1. Testori T, Galli F. Immediate non-occlusal versus early loading of dental implants in practically edentulous patients. Int J Oral Maxillofac Implants 2007; 22:815-22.

2. Friberg B, Sennerby L, Meredith N, Lekholm U. A comparison between cutting torque and resonance frequency measurements of maxillary implants. A 20-month clinical study. Int J Oral Maxillofac Surg 1999; 28:297-303.

3. Testori T, Del Fabbro M, Szmukler-Moncler S, Francetti L, Weinstein RL. Immediate occlusal loading of osseotite implants in the completely edentulous mandible. Int J Oral Maxillofac Implants 2003; 18:544-51.

4. Meredith N, Alleyne D, Cawley P. Quantitative determination of the stability of the implant-tissue interface using resonance frequency analysis. Clin Oral Implants Res 1996; 7:261-7.

5. Balleri P, Cozzolino A, Ghelli L, Momicchioli G, Varriale A. Stability measurements of osseointegrated implants using osstell in partially edentulous jaws after 1 year of loading: A pilot study. Clin Implant Dent Relat Res 2002; 4:128-32.

6. Javed F, Ahmed HB, Crespi R, Romanos GE. Role of primary stability for successful osseointegration of dental implants: Factors of influence and evaluation. Interv Med Appl Sci 2013; 5:162-7.

7. Lozano-Carrascal N, Salomó-Coll O, Gilabert-Cerdà M, Farré-Pagés N, Gargallo-Albiol J, Hernández-Alfaro F, et al. Effect of implant macro-design on primary stability: A prospective clinical study. Med Oral Patol Oral Cir Bucal 2016; 21:214-21.

8. Ostman PO, Hellman M, Sennerby L. Direct implant loading in the edentulous maxilla using a bone density-adapted surgical protocol and primary implant stability criteria for inclusion. Clin Implant Dent Relat Res. 2005; 7(suppl 1):60–69.

9. Rodrigo D, Aracil L, Martin C, Sanz M. Diagnosis of implant stability and its impact on implant survival: a prospective case series study. Clin Oral Implants Res. 2010; 21(3):255–261.

10. Sennerby L, Meredith N. Implant stability measurements using resonance frequency analysis: biological and biomechanical aspects and clinical implications. Periodontol 2000 2008; 47:51–66.

11. Sim CP, Lang NP. Factors influencing resonance frequency analysis assessed by Osstell mentor during implant tissue integration: I. Instrument positioning, bone structure, implant length. Clin Oral Implants Res. 2010;21(6):598–604.

12. Atieh MA, Alsabeeha NH, Payne AG. Can resonance frequency analysis predict failure risk of immediately loaded implants? Int J Prosthodont. 2012; 25(4):326–339.

13. Han J, Lulic M, Lang NP. Factors influencing resonance frequency analysis assessed by Osstell mentor during implant tissue integration: II. Implant surface modifications and implant diameter. Clin Oral Implants Res. 2010;21(6):605–611.

14. Ersanli S, Karabuda C, Beck F, Leblebicioglu B. Resonance frequency analysis of one-stage dental implant stability during the osseointegration period. J Periodontol. 2005; 76(7):1066–1071.

15. Simunek A, Kopecka D, Brazda T, Strnad I, Capek L, Slezak R. Development of implant stability during early healing of immediately loaded implants. Int J Oral Maxillofac Implants. 2012; 27(3): 619–627.

16 Gahona O, Granic X, Antunez C, Domancic S, Diaz-Narvaez V, Utsman R. Insertion torque

and resonance frequency analysis (ISQ) as predictor methods of Implant osseointegration. J Osseointegr 2018; 10(3):103-107.

17. Sarfaraz H, Johri S, Sucheta P, Rao S. Study to assess the relationship between insertion torque value and implant stability quotient and its influence on timing of functional implant loading. J Indian Prosthodont Soc 2018; 18:139-46.

18. Bornstein MM, Wittneben JG, Bragger U, Buser D. Early loading at 21 days of non-submerged titanium implants with a chemically modified sandblasted and acid-etched surface: 3-year results of a prospective study in the posterior mandible. J Periodontol. 2010; 81 (6):809–818.

19. Roccuzzo M, Wilson TG Jr. A prospective study of 3 weeks' loading of chemically modified titanium implants in the maxillary molar region: 1-year results. Int J Oral Maxillofac Implants. 2009; 24(1): 65–72.

20. Kokovic V, Jung R, Feloutzis A, Todorovic VS, Jurisic M, Hammerle CH. Immediate vs. early loading of SLA implants in the posterior mandible: 5-year results of randomized controlled clinical trial. Clin Oral Implants Res. 201425(2):114–119.

21. Park KJ, Kwon JY, Kim SK, et al. The relationship between implant stability quotient values and implant insertion variables: a clinical study. J Oral Rehabil 2012; 39(2):151–159.

22. Chambrone L, Shibli JA, Mercurio CE, Cardoso B, Preshaw PM. Efficacy of standard (SLA) and modified sandblasted and acid-etched (SL Active) dental implants in promoting immediate and/or early occlusal loading protocols: a systematic review of prospective studies. Clin Oral Implants Res. 2015; 26:359–370.