

## A Clinical and Radiographic Evaluation of Resonance Frequency Analysis of Sand Blasted Acid Etched (SAE) and Chemical Modified Sae Dental Implants

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### INTRODUCTION

Dental implants are being used aggressively in the world. Dental implants of numerous companies are available. The success of any dental implant is based on its ability to show osseointegration. Various factors are responsible for the survival of dental implants. It is divided into host-related and dental implant-related factors. Host-related factors include systemic conditions and local factors.<sup>[1]</sup> 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. Chemically modified and sandblasted acid-etched (SAE) mechanism leads to the wettability

### ABSTRACT

**Aims and Objective:** Chemically modified and sandblasted acid-etched (SAE) mechanism leads to wettability of surfaces of dental implants which helps in osseointegration. The present study was conducted to determine the implant stability quotient (ISQ) of SAE and SAE chemically modified dental implants.

**Materials and Methods:** The present study was conducted on 210 patients with 120 males and 90 females. Dental implants (Adin) with SAE (Group A) and SAE chemically modified (Group B) were inserted in patients. RFA was done immediately after implant insertion and after 1 week, 2 weeks, 6 weeks, 10 weeks, and 14 weeks. Results were statistically evaluated using SPSS Statistics for Windows, Version 21.0, IBM Corp., Armonk, NY, USA.

**Results:** Maximum patients were in the age group of 25–35 years (males – 65, females – 48), followed by 35–45 years (males – 40, females – 32) and 45–55 years (males – 15, females – 10). Maximum dental implants were given in the right side (88) in males than females (56). On the left side, maximum implants were given in females (62) than males (56). Maximum RFA value of 86.2 and minimum value of 44.6 were observed in SAE dental implants (A). The maximum mean RFA value in chemically modified implants SAE (B) was 89.4 and minimum was 32.5.

**Conclusion:** It was observed that surface treatment of dental implants shows higher implant–bone osseointegration. There is fastest osseointegration in implants with hydrophilic surfaces than those with SAE surfaces. ISQ was higher than 75 in both groups, which indicate higher implant stability.

**KEYWORDS:** Dental implant, osseointegration, stability

of surfaces of dental implants, which helps in osseointegration.<sup>[2]</sup> It has been seen that hydroxylation of oxide layer improves the wettability of titanium oxide surface and absorption of proteins on the surface of dental implants by increasing interaction between water and implant surfaces.<sup>[3]</sup>

Resonance frequency analysis (RFA) is the method of checking the stability or osseointegration of

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dental implants. It is represented as implant stability quotient (ISQ). RFA helps in judging the level of osseointegration after the insertion of implant or during healing period. This guides dentists to place prosthetic part after obtaining high ISQ value.<sup>[4]</sup> 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.<sup>[5]</sup> The present study was conducted to assess the ISQ of SAE and chemically modified SAE dental implants.

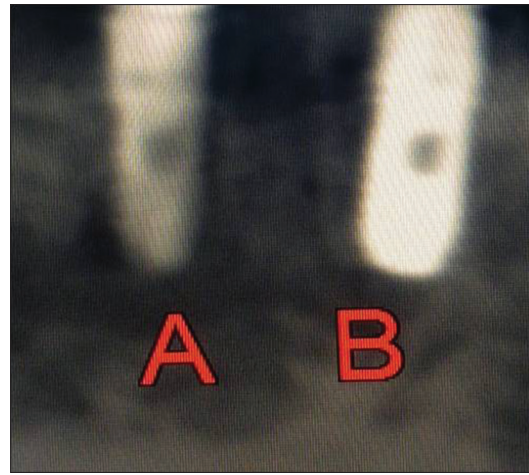
## MATERIALS AND METHODS

The present study was conducted at the department of prosthodontics as Bridge and Crown work from June 2011 to May 2016. This prospective study comprised of 210 patients of age ranged 25–55 years. Sample size was calculated using Cochran's statistical formula at

95% confidence interval  $n = \frac{n_0}{1 + \frac{(n_0 - 1)}{N}}$  where  $n = 210$

and  $N = 786$ , hence the sample was worked out to 210 which was sufficient for the present study. Inclusion criteria were patients without systemic diseases (such as diabetes and chronic illness), and edentulous area in posterior mandible. Exclusion criteria were patients with insufficient bone height (<8.5 mm), systemic diseases, history of periodontitis, and pregnant women. In all patients, bone height was measured with intraoral radiographs and bone height above 8 mm was considered. The study protocol was approved by the institutional Ethical Committee (Ref no. PSM-204/Pub/2011). All patients were informed regarding the study, and written consent was obtained.

Patients were subjected to clinical examination. In all patients, intraoral radiographs such as periapical radiographs and computed tomography scan of the implant site were done. After careful evaluation of the site, dental implants (Adin) with SAE and SAE chemically modified were placed in mandibular posterior region. All the procedures were performed by single trained prosthodontist following standardized conditions. Selected patients were randomly divided into Group A and Group B by second investigator to avoid bias in selection. SAE implants were marked as Group A and SAE chemically modified as Group B [Figure 1]. Dental implants with 9 mm height and 3.3 mm width were inserted. Radiofrequency analysis (RFA) was performed immediately after implant insertion and after 1 week, 2 week, 6 weeks, 10 weeks, and 14 weeks.



**Figure 1:** Sandblasted acid-etched implants (Group A) and sandblasted acid-etched chemically modified implants (Group B)

**Table 1: Resonance frequency analysis in two implant systems**

RFA	SAE implants (A)	Chemically modified implants SAE (B)	P
Maximum	86.2	89.4	0.05
Minimum	44.6	32.5	

$P < 0.05$ . RFA=Resonance frequency analysis, SAE=Sandblasted acid etched

## STATISTICAL ANALYSIS

Results thus obtained were statistically evaluated using SPSS Statistics for Windows, Version 21.0 (IBM Corp., Armonk, NY, USA). Student's *t*-test was used for mean  $\pm$  standard deviation determination. ANOVA test was performed to compare the groups at statistical significance of 0.05.

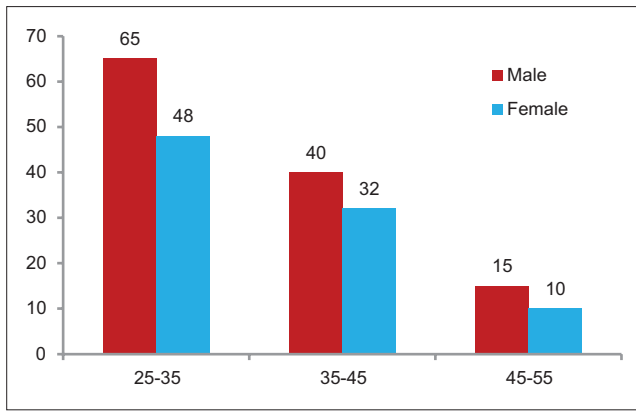
## RESULTS

Graph 1 shows that a majority of patients were in the age group of 25–35 years (males – 65, females – 48), followed by 35–45 years (males – 40, females – 32) and 45–55 years (males – 15, females – 10). The difference was statistically significant ( $P < 0.05$ ).

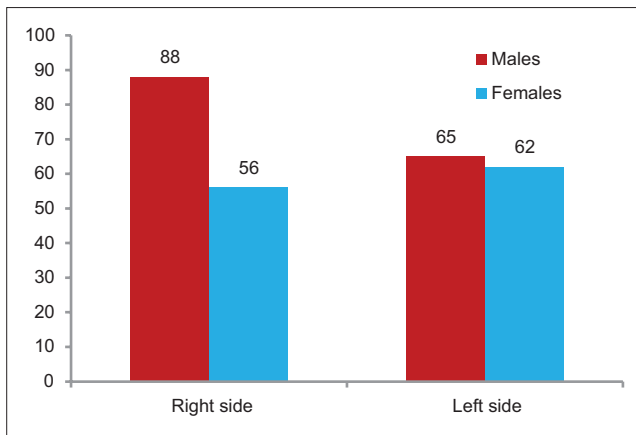
Graph 2 shows that maximum dental implants were given in the right side (88) in males than females (56). On the left side, maximum implants were given in females (62) than males (56). The difference was statistically significant ( $P < 0.05$ ).

Table 1 shows maximum RFA value of 86.2 and minimum of 44.6 in SAE dental implants (A). The maximum mean RFA value in chemically modified implants SAE (B) was 89.4 and minimum was 32.5. The difference was statistically significant ( $P < 0.05$ ).

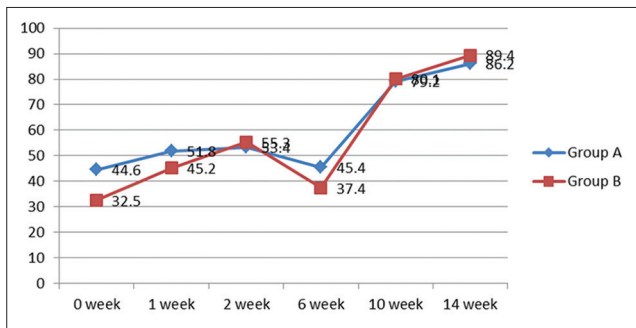
Graph 3 shows that maximum mean RFA value in Group A was 86.2 and minimum was 44.6. In Group



**Graph 1:** Distribution of patients according to age group



**Graph 2:** Number of dental implants and side;  $P < 0.05$ , test used-ANOVA test



**Graph 3:** RFA value in both groups;  $P < 0.05$

B, maximum mean RFA value was 89.4 and minimum was 32.5. RFA in Group I in the 1<sup>st</sup> week was 51.8, at the 2<sup>nd</sup> week was 53.4, at the 6<sup>th</sup> week was 46.4, and at the 10<sup>th</sup> week was 79.2. In Group B, it was 45.2, 55.3, 37.4, and 80.1 at the 1<sup>st</sup> week, 2<sup>nd</sup> week, 6<sup>th</sup> week, and 10<sup>th</sup> week, respectively. The difference was statistically significant ( $P < 0.05$ ).

Table 2 shows that torque value in Group A was 35.2 and in Group B was 33.7. The difference was statistically nonsignificant ( $P > 0.05$ ).

**Table 2: Torque during implant placement in two implant systems**

Group A	Group B	P
35.2	33.7	0.1

$P > 0.05$

## 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.<sup>[6]</sup> The diameter, length, site, and design of dental implant also affect the stability of dental implant. The quality of bone affects the osseointegration process. Implants placed at D1 and D2 bones are more likely to show better osseointegration as compared to D3 and D4 bone.<sup>[7]</sup>

In the present study, we compared ISQ of two similar design implants but treated with SAE and hydrophilic SAE. Sim and Lang<sup>[8]</sup> in their study evaluated factors such as length of dental implant, quality of bone, and instrument positioning on RFA. Implant placed in D1 and D2 bones is highly stable and shows better osseointegration. The authors suggested that ISQ is affected by bone quality and implant length.

Atieh *et al.*<sup>[9]</sup> 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 implants. Bone deposition at the interface of implant and bone can be evaluated by increasing ISQ. In the present study, we found that in case of Group A, minimum mean ISQ was 44.6 and maximum was 86.2. In case of Group B, maximum value was 89.4 and minimum was 32.5. Our results are in agreement with the results of Sennerby and Meredith<sup>[10]</sup> who found lowest ISQ as 55 and highest as 85.

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.*<sup>[11]</sup> in their study concluded that during early healing of immediately loaded implant, there is minimum stability at the 3<sup>rd</sup> and 4<sup>th</sup> 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 the 4<sup>th</sup> week to 12<sup>th</sup> week and at the end both the groups. Gahona *et al.*<sup>[12]</sup> in their study evaluated ISQ of dental implants placed in maxilla and mandible.



This comprised 30 implants in mandibular arch and 32 in maxillary arch. It was seen that in implants with ISQ >60, there was successful osseointegration than those <60. Similarly, better osseointegration was observed in implants with torque insertion 35 or above.

We observed that torque value in Group I was 35.2 and in Group II was 33.7. Sarfaraz *et al.*<sup>[13]</sup> conducted a study on 37 patients. ISQ was measured in the 3<sup>rd</sup>, 7<sup>th</sup>, 11<sup>th</sup>, and 15<sup>th</sup> weeks. The authors evaluated RFA, ISQ, and insertion torque value (ITV). There was a positive correlation between ISQ and ITV.

Novellino *et al.*<sup>[14]</sup> in their study demonstrated that SAE implants can be best placed at the 3<sup>rd</sup> week, especially in the 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. van Eekeren *et al.*<sup>[15]</sup> in their study assessed the ISQ in a 3-year prospective study. A comparison was done between acid-etched surface implant and chemically modified sandblasted implant. They suggested that hydrophilic implants have two times faster and better osseointegration. SAE implants had ability to be loaded in 3 weeks than 7–8 weeks.

Chambrone *et al.* in a systemic review found from previous studies that there are no significant differences in relation to implant loss or clinical parameters between the immediate/early loading and delayed loading protocols and concluded an overall survival of 95% for standard sandblasted and acid-etched (SLA) and 97% for modified SLA (SLActive) implants at the end of follow-up.<sup>[16]</sup> Meng *et al.* in their review stated that beneficial effect on osseointegration cannot be obtained from bioactive surface modifications on implant surface always. However, surface modifications of titanium dental implants with biomolecular coatings seem to promote peri-implant bone formation, resulting in enhanced osseointegration during the early stages of healing.<sup>[17]</sup>

From our study, we found that surface treatment of implant could help in improving the osseointegration, which helps in the success of dental implants. In the 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 *et al.*<sup>[18]</sup> in their study of immediate versus 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 a predictor of implant success. Park *et al.*<sup>[19]</sup> in their study on rabbit

tibia found a correlation between ISQ and bone-implant contact after 4 weeks of healing. We observed that stability increased with time in both groups. Chambrone *et al.*<sup>[16]</sup> 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 the present study. Only maxillary posterior region was considered. Further long-term study is required to evaluate on larger sample size on different geographic areas.

## CONCLUSION

There is fastest osseointegration in implants with hydrophilic surfaces than with SAE surfaces. ISQ was higher than 75 in both groups, which indicate higher implant stability.

## FINANCIAL SUPPORT AND SPONSORSHIP

Nil.

## CONFLICTS OF INTEREST

There are no conflicts of interest.

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