Original Article

Comparative Evaluation Of Hard And Soft Tissue Changes Around Different Surface Treated Implants In Case Of Immediate Implant Placement: A Clinic-Radiographic Study

Dr. Sajid Husain[1], Dr. Amitabh Srivastava[2], Dr. Vivek Srivastava[3*], Dr. Shivam Yadav[4], Dr. Tanu Sahney,[5]

[1]MDS, Senior Lecturer, Department of Periodontology, Sardar Patel Post Graduate Institute of Dental and Medical Sciences, Lucknow (Corresponding author)E-mail address – shrizvi.rizvi@gmail.comAddress – Sardar Patel Sardar Patel Post Graduate Institute of Dental and Medical Sciences, Chaudhary Vihar, Utrathia, Raebareily Road Lucknow – 226029.
[2]MDS, Professor and Head, Department of Periodontology, Sardar Patel Post Graduate Institute of Dental and Medical Sciences, Lucknowe-mail – docamitabh74@gmail.comAddress – Sardar Patel Sardar Patel Post Graduate Institute of Dental and Medical Sciences, Chaudhary Vihar, Utrathia, Raebareily Road Lucknow – 226029.
[3]*MDS, Professor, Department of Periodontology, Sardar Patel Post Graduate Institute of Dental and Medical Sciences, Lucknowe-mail – drviveksrivastav89@gmail.comAddress – Sardar Patel Sardar Patel Post Graduate Institute of Dental and Medical Sciences, Chaudhary Vihar, Utrathia, Raebareily Road Lucknow – 226029.
[4]Assistant Professor, Department of Dentistry, Autonomous Government State Medical College, Hardoi (U.P)
e-mail – shivam0710@gmail.comAddress – Autonomous Government State Medical College, Hardoi (U.P)
[5]MDS, Senior Lecturer, Department of Periodontology, Sardar Patel Post Graduate Institute of Dental and Medical Sciences, Lucknowe-mail – tanu.sahney910@gmail.comSardar Patel Sardar Patel Post Graduate Institute of Dental and Medical Sciences, Chaudhary Vihar, Utrathia, Raebareily Road Lucknow – 226029.
*Corresponding Author: - Dr Vivek Srivastava
*Professor, Department of Periodontology, Sardar patel post graduate institute of dental and medical sciences
Email: drviveksrivastav89@gmail.com
DOI: 10.47750/pnr.2022.13.S01.302

Abstract

The response of the tissues to the implant is largely controlled by the nature and texture of the surface of the implant. The study compared clinical outcomes and hard and soft tissue changes around resorbable blast media (RBM) surface treated implants & Alumina Oxide Blasted / Acid Etched (AB/AE) surface treated implants in immediate implant cases. 20 immediate implants were placed after extraction of single rooted tooth in maxillary anterior region and randomly divided into 2 groups, group I received AB/AE surface treated and group II received RBM surface treated immediate dental implants. The clinical parameters assessed at baseline, 1 month, 3 month and 6 month after loading were modified plaque index, modified sulcus bleeding index, peri implant probing depth, crestal bone loss evaluated by digital IOPAR at baseline, 3 month and 6 months after loading. Both the groups showed significant increase in modified sulcular bleeding index, modified plaque index. The peri implant probing depth of RBM was higher as compared to AB/AE. RBM surface treated implants exhibits better clinical performance and less peri implant bone loss than AB/AE surface.

Keywords – Surface treatment of implants, immediate implant, Resorbable blast media surface treated implants, acid blasted, acid etched implants, crestal bone loss. ,

INTRODUCTION

In the present dental scenario, various treatment options are available to the edentulous patient including removable partial dentures, complete dentures, overdentures, fixed partial dentures, implant supported prostheses and transplantation. The desire for short treatment time and quick results are growing among the clinician and the patients, thus, immediate implants have become a suitable treatment option to reduce the treatment time. The discovery of osseointegration in 1950s by Dr. Per-Ingvar Branemark was a stepping stone towards the use of dental implants to replace natural teeth. Osseointegration is defined as, " direct structural and functional connection between ordered living bone and the surface of the load carrying implant".[1] The amount of bone-to-implant contact (BIC) is an important determinant in long-term success of dental implants. Increase in surface roughness increases the implant surface area adjacent to the bone. It also increases the cell attachment to bone, bone present at the implant interface. It also provides increased biochemical interaction of implant with bone. The implant surface may be roughened by various processes such aa plasma-spraying, grit blasting, acid etching, anodization of implants, or coating of the surface of the implants with materials such as calcium phosphate.
The alumina blasted / acid etched surface(AB/AE) is prepared by sandblasting the implant surface by either medium-grit or large-grit aluminum oxide (Al_2O_3) particles and then acid-etching it with either a hydrochloric acid/sulfuric acid mixture (HCl/H2SO4) or pickling in 2% hydrofluoric acid/10% nitric acid (HF/HNO3). In addition to increasing surface roughness, surface blasting and acid etching could remove surface contaminants and increase the surface reactivity of the

metal. Resorbable Blast Media (RBM) (Calcium Phosphate, Hydroxyapatite, Beta-Tricalcium Phosphate) is prepared by blasting the implant surface with calcium phosphate particles and is biocompatible, osteoconductive and resorbable which leads to clean, textured, pure titanium surface that demonstrate higher Bone Implant Contact (BIC) as compared to machined surface in animal experimental models.[2]This study was conducted to evaluate and compare clinical outcomes and hard and soft tissue changes around resorbable blast media (RBM) surface treated implants & alumina oxide blasted/ acid etched (AB/AE) surface treated implants in immediate implant cases.

MATERIALS AND METHODS

The study population consisted of 7 patients (four females and three males), in which a total of 20 implants were placed. All the participants were given a detailed verbal and written description of the study, and a signed consent form was obtained before the commencement of the surgery. The study protocol was approved by the Institutional Ethical Committee. Only systemically healthy subjects aged 20-60 years and who were motivated to get dental implant after extraction of single rooted tooth were included in the study. Only the teeth having Grade III mobility with hopeless prognosis were extracted. The subjects were randomly divided into two groups. Subjects in Group I received AB/AE surface treated (ADIN: Touareg - S™) immediate dental implants and subjects in Group II received RBM surface treated (ADIN: Touareg - OS™) immediate dental implant. The subjects were then evaluated for Modified Plaque Index(MPI), Modified Sulcus Bleeding Index (MSBI), Peri-Implant Probing depth (PIPD), Crestal Bone Loss (CBL) at baseline (pre treatment), 3, 6, 9 months post treatment.

Surgical Procedure

Following the process of asepsis and administration of local anaesthesia, the concerned teeth were extracted without fracturing the labial cortical plate and retaining the gingival tissue attachment. The extraction sockets were then thoroughly debrided, following which the sockets were then prepared for implant placement. The osteotomy sites were prepared using subsequent implant drills along with copious irrigation. In Group – I patients ADIN: TouaregTM – S implants were placed using hand ratchet and in Group – II Patients ADIN: TouaregTM – OS implants were placed using hand ratchet. After the cover screw were secured, the surgical site was thoroughly irrigated and the flap approximation is done to achieve complete closure.

2nd stage surgery

At the time of 2nd stage surgery, which was performed 3 – 4 months after implant placement, the soft tissue over the implant was removed to expose the implant. The cover screw was removed and the permucosal attachment was screwed onto the implant. An abutment level impression was taken with elastomeric putty and light body material after ten days, once the gingival cuff had formed and then the metal ceramic, cemented retained prosthesis having no plaque retentive factors was delivered.

RESULTS:

The parameters that were assessed throughout the study were Modified Plaque Index (MPI), Modified Sulcus Bleeding Index (MSBI), Peri-implant Probing Depth (PIPD) and Radiographic evaluation of Crestal Bone Loss (CBL). The MPI was assessed at pre-treatment (baseline) and 3, 6 and 9 month post treatment. The MSBI, PIPD and CBL were assessed at pre-treatment and 6 and 9 month post treatment. The PIPD and CBL were measured in millimetre (mm). The objective of the study was to compare the clinical (hard and soft tissue) outcome measures (MPI, MSBI, PIPD and CBL) between the two groups (RBM and AB/AE).

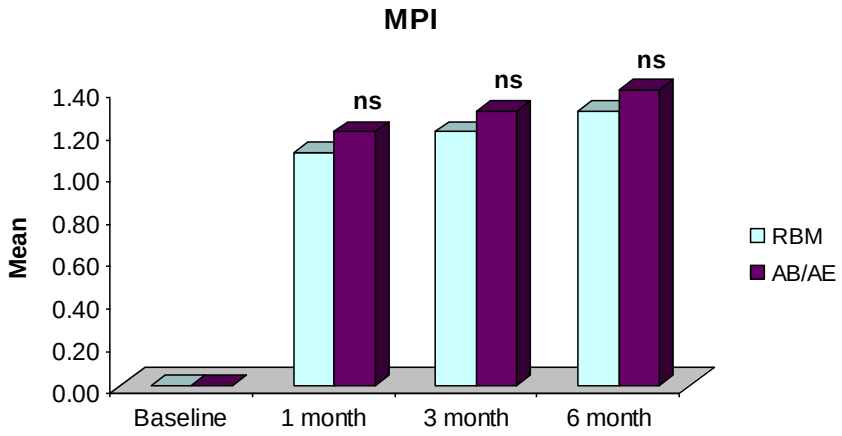
A. Soft Tissue:

i. Modified plaque Index: For each group, comparing the difference in mean MPI between the periods (intra group) and comparing the difference in mean MPI between the groups (inter group), Newman-Keuls test showed insignificant ($p>0.05$) change. However, at final evaluation, both groups showed significant increase (i.e. mean change from baseline to 6 month) in MPI (Table 1, Graph 1)

Table 1: For each group, comparison of difference in mean MPI between the periods by Newman-Keuls test

Comparison	RBM		AB/AE	
	Mean diff.	P value	Mean diff.	P value
Baseline vs. 1 month	1.10	NA	1.20	NA
Baseline vs. 3 month	1.20	NA	1.30	NA
Baseline vs. 6 month	1.30	NA	1.40	NA
1 month vs. 3 month	0.10	0.867	0.10	0.867
1 month vs. 6 month	0.20	0.845	0.20	0.845
3 month vs. 6 month	0.10	0.867	0.10	0.867

diff: difference. **NA:** not applicable (comparison with baseline not evaluable in both groups because of 0 mean and 0 variance/standard error at baseline in both groups).



[ns]p>0.05- as compared to RBM

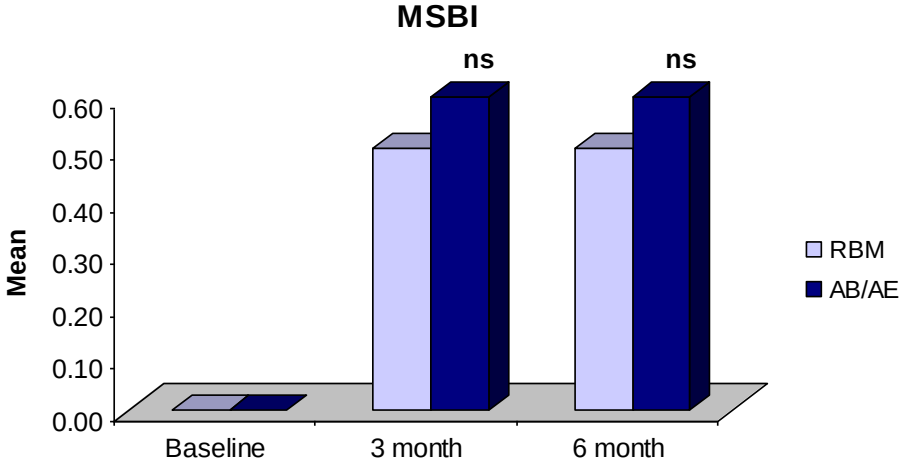
Graph 1. For each period, comparisons of difference in mean MPI between the groups.

ii. Modified Sulcular Bleeding Index: For each group, comparing the difference in mean MSBI between the periods (intra group) and comparing the difference in mean MSBI between the groups (inter group), Newman-Keuls test showed insignificant (p>0.05) change. However, at final evaluation, both groups showed increase significant (i.e. mean change from baseline to 6 month) in MSBI. (Table 2, Graph 2)

Table 2: For intragroup, comparison of difference in mean MSBI between the periods by Newman-Keuls test

Comparison	RBM		AB/AE	
	Mean diff.	p value	Mean diff.	p value
Baseline vs. 3 month	0.50	NA	0.60	NA
Baseline vs. 6 month	0.50	NA	0.60	NA
3 month vs. 6 month	0.00	1.000	0.00	1.000

diff: difference. **NA:** not applicable (comparison with baseline not evaluable in both groups because of 0 mean and 0 variance/standard error at baseline in both groups).



[ns]p>0.05- as compared to RBM

Graph 2 For each period, comparisons of difference in mean MSBI between the groups.

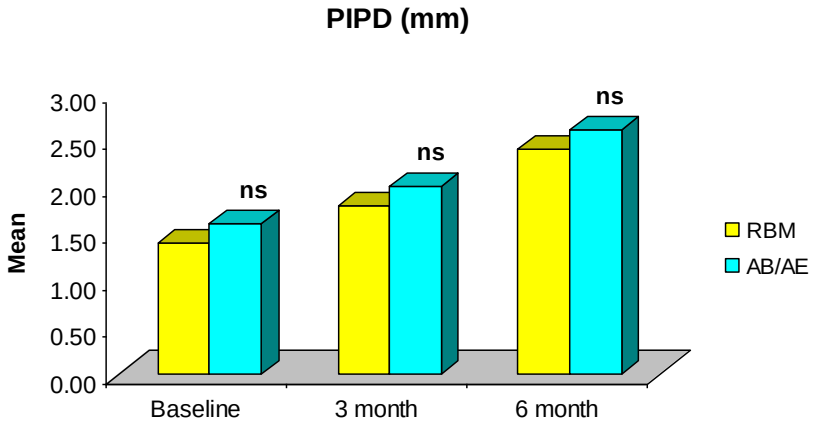
iii. Peri-Implant Probing Depth: For each group, comparing the difference in mean PIPD between the periods (intra group), Newman-Keuls test showed insignificant (p>0.05) change/increase in PIPD in both groups at 3 month as compared to respective baseline i.e. found to be statistically the same.
However, in both groups, it increased significantly (p<0.01) at 6 month as compared to respective baseline. Further, in both groups, it also increased significantly (p<0.05) at 6 month as compared to respective 3 month. (Table 3)

Table 3: For each group, comparison of difference in mean PIPD between the periods by Newman-Keuls test

Comparison	RBM		AB/AE	
	Mean diff.	p value	Mean diff.	p value
Baseline vs. 3 month	0.40	0.172	0.40	0.172
Baseline vs. 6 month	1.00	0.001	1.00	0.001
3 month vs. 6 month	0.60	0.024	0.60	0.024

diff: difference. The p values marked in red are significant.

Similarly, for each period, comparing the difference in mean PIPD between the groups (inter group), Newman-Keuls test showed similar (p>0.05) PIPD between the two groups at all periods (baseline, 3 and 6 month) i.e. did not differed significantly. (Graph 3)



[ns]p>0.05- as compared to RBM

Graph 3. For each period, comparisons of difference in mean PIPD between the groups.

At final evaluation, the net increase (i.e. mean change from baseline to 6 month) in PIPD of RBM (41.7%) was found 3.2% higher as compared to AB/AE (38.5%).

B. Hard tissue:

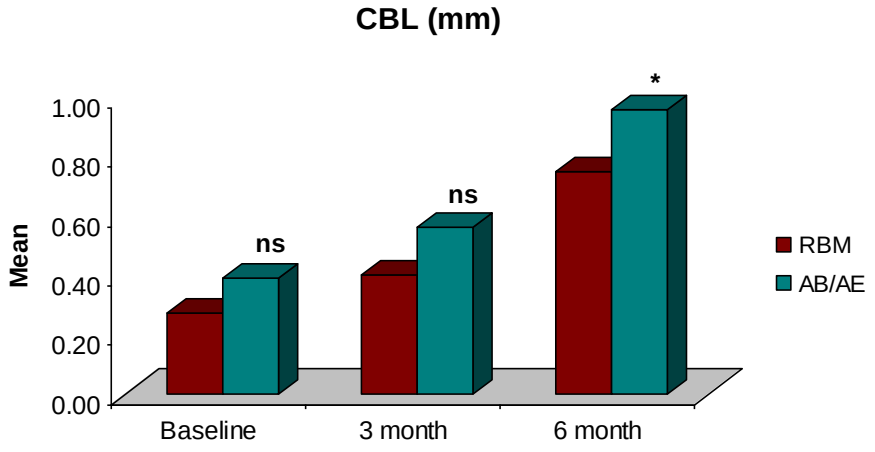
Crestal Bone Loss: For each group, comparing the difference in mean CBL between the periods (intra group), Newman-Keuls test showed insignificant (p>0.05) change/increase in CBL in both groups at 3 months as compared to respective baseline i.e. did not differed significantly. However, in both groups, it increased significantly (p<0.001) at 6 month as compared to respective baseline. Further, in both groups, it also increased significantly (p<0.001) at 6 month as compared to respective 3 month.(Table 5)

Table 5: For each group, comparison of difference in mean CBL between the periods by Newman-Keuls test

Comparison	RBM		AB/AE	
	Mean diff.	p value	Mean diff.	p value
Baseline vs. 3 month	0.13	0.119	0.17	0.030
Baseline vs. 6 month	0.48	<0.001	0.57	<0.001
3 month vs. 6 month	0.35	<0.001	0.40	<0.001

diff: difference. The p values marked in red are significant.

Similarly, for each period, comparing the difference in mean CBL between the groups (inter group), Newman-Keuls test showed similar (p>0.05) CBL between the two groups at baseline and 3 month i.e. did not differed significantly. However, at 6 month, it was found significantly (p<0.05) different and higher in AB/AE group as compared to RBM group.(Graph 5)



[ns]p>0.05 or [*]p<0.05- as compared to RBM

Graph 5. For each period, comparisons of difference in mean CBL between the groups.

At final evaluation, the net increase (i.e. mean change from baseline to 6 month) in CBL of RBM (64.0%) was found 4.6% higher as compared to AB/AE (59.4%).

DISCUSSION

After tooth extraction, the alveolar ridge undergoes bone remodelling, especially within the first year. One study reported that an overall decrease of 4.0 mm in ridge height and 25% loss of total bone volume occurred within 1 year post-extraction. Consequently, the necessity of a 2-stage approach has been questioned. Patient's demand for quicker treatment in the implant field has resulted in immediate implant placement becoming more relevant and popular.[3]The host response after implantation is modified by the presence of the implant and its characteristics. The mechanism by which topography influences osteoblast differentiation appears to be mediated by integrin signaling[4] and mitogen activated protein kinase (MAPK) pathways.[5] Compared to smooth surfaces, textured implants surfaces exhibit more surface area for integrating with bone. AB/AE implants after being blasted with alumina are further subjected to acid etching. Immersion of blasted titanium implants in a mixture of concentrated acids [(HNO_3 & HF in 1-3 volume %) or (HCl & H_2SO_4 in 1-1 volume %)] heated above 100°C is employed to produce a micro rough surface.[6] The degree of etching is dependent on the acid concentration, temperature, and treatment time. Acid-etching produces micro pits on implant surfaces with sizes ranging from 0.5 to 2 μm in diameter.[7] The development of this surface has been associated with good clinical results in comparison to other potential surfaces, which is probably the reason for its most frequent use. The rationale behind using Calcium Phosphate minerals for the surface characterization remains in the fact that these elements are the same basic components of natural bone.[8] The RBM surface treated implant used in this study is not washed after blasting and there is presence of embedded residual blasting media particles on the RBM surfaces.[9] Since these residual materials are resorbable and biocompatible, they do not adversely affect the process of osseointegration. Numerous in-vitro studies have demonstrated the positive response of osteoblasts to RBM surfaces. Numerous studies done by various researchers have compared roughness of AB/AE & RBM and in general AB/AE surface appears to be rougher than RBM surface. However both these surfaces present an average surface roughness in the range of 1-2 μm (Moderately Rough) which is optimal for the bone implant interactions. Witek et al (2013) reported torque to interface fracture was nonsignificant for both the groups until 6lh week where it was reported significantly higher for RBM surface in dog model.[10] Kim et al (2012) reported a survival rate of 97.4 % for RBM treated implants placed in the posterior maxilla where usually Type 3 or 4 bone is encountered.[11] Therefore, the present study was designed to evaluate and compare the hard and soft tissue changes around two similar dental implants with different surface treatments in cases of immediate implant placement. The mean MPI increased from 1st month to sixth month for both the groups, this increase was statistically non-significant ($p>0.05$). Similar increase from baseline to 6 months in mean MPI score was reported in a study conducted by Pellicer-Chover et al (2014).[12] However, opposite trend was noticed in prior studies conducted by Munjal et al (2015) [13] where the mean MPI score decreased from baseline to sixth month. The mean MSBI increased from baseline to 3 month for both the groups, this increase was statistically non-significant ($p>0.05$). The MSBI didn't change for both the groups from 3 months to 6 months and hence the mean difference remained zero. The study conducted by Rajpal et al (2015)[14] reported statistically significant reduction in MSBI scores from 3rd month to 6th month. On the contrary, the study by Munjal et al (2015)[13] reported non-significant reduction in MSBI scores from baseline to sixth month. The probable reason for such variations could possibly be due to difficulty in oral hygiene maintenance after prosthetic loading leading to inflammation and bleeding on probing. The alterations in the mean MPI score between different studies could be attributed to variations in finish of prosthetic components, patient awareness, plaque control measures and compliance to oral hygiene reinforcement instructions. The mean PD increased from baseline to 6 month for both the groups, this increase was also statistically significant ($p<0.01$) yet the periodontal probing depth did not exceed 3mm in both the groups at any of the time interval which is in accordance with study of Salvi & Lang (2004)[15] and Canulo & Rasperini (2007).[16]The differences observed for the same parameter in the above studies can be attributed to subjective variance in probing pressure and probing angulation. Mombelli et al (1997)[17] concluded that peri-implant probing depth measurements are more sensitive to force variation than periodontal pocket probing. Thus, within the limits of this study, RBM surface treated implants exhibited less change in mean PD from baseline to 6 month as compared to AB/AE surface treated implants. Intragroup comparison between the periods in both the groups demonstrated a significantly higher CBL from baseline to 6th month and also from 3rd month to 6th months. Intergroup comparison at all the periods demonstrated statistically lesser CBL for RBM group. Intergroup comparison at baseline and 3 month showed non-significant differences whereas the difference was statistically significant at 6 months. Similar trend was observed in the study by Rajpal et al (2015) where the change in mean CBL was significantly higher ($p<0.001$) at 6th month compared to baseline.[14] Roccuzzo et al. (2001) reported a mean CBL of 0.65 mm after 6 weeks and 0.77 mm after 12 weeks for SLA implants.[18] The possible reasons for variation in CBL amongst different studies can be attributed to surgical trauma, establishment of biological seal, presence of microgap between fixture and abutment, occlusal overload and crest module design.

CONCLUSION

Within the limits of this study, it can be concluded that RBM surface treated implants exhibited better clinical performance than AB/AE surface treated implants for immediate implant placement considering that other variables (Plaque, Bleeding on Probing etc.) were constant. However there is great paucity of comparative clinical human studies evaluating hard and soft tissue changes between AB/AE & RBM surface treated implants. The significant evidence presented by this study paves way for further such long term studies to assess bone loss and other clinical parameters associated with these implant surfaces.

REFERENCES

1. Branemark PI, Zarb G, Albrektsson T. Tissue-integrated prostheses: osseointegration in clinical dentistry. Chicago: Quintessence Publishing Co.; 1985.
2. Piatelli M, Scarano A, Paolantonio M, Iezzi G, Petrone G, Piatelli A. Bone response to machined and resorbable blast material titanium implants: An experimental study in rabbits. J Oral Implantol.2002; 28: 2-8.
3. Richard U Koh, Ivan Rudek, Hom-Lay Wang. Immediate Implant Placement: Positives and Negatives. Implant Dentistry. 2010; 19(2): 98-108.
4. Chappard D, Aguado E, Hure G, Grizon F, Basle MF. The early remodelling phases around titanium implants: A histomorphometric assessment of bone quality in a 3- and 6-month study in sheep. Int J Oral Maxillofac Implants. 1999;14:189-96.
5. Lossdorfer S, Schwartz Z, Wang L, Lohmann CH, Turner JD, Wieland M, et al. Microrough implant surface topographies increase osteogenesis by reducing osteoclast formation and activity. J Biomed Mater Res A. 2004;70(3):361-9.
6. Wennerberg A & Albrektsson T. Suggested guidelines for the topographic evaluation of implant surfaces. Int J Oral Maxillofac Implants. 2000; 15(3):331-44.
7. Goyal N, Priyanka, Kaur R. Effect of Various Implant Surface Treatments on Osseointegration - A Literature Review. Indian J Dent Sciences. 2012; 1(4): 154-57.
8. Coelho PG, Marin C, Granato R, Giro G, Suzuki M, Bonfante EA. Biomechanical and histologic evaluation of non-washed resorbable blasting media and alumina-blasted/acid-etched surfaces. Clin Oral Implants Res. 2012;23(1): 132-5.
9. Coelho PG, Bonfante EA, Pessoa RS, Marin C, Granato R, Giro G, Witek L, Suzuki M. Characterization of five different implantsurfaces and their effect on osseointegration: A study in dogs. J Periodontol 2011;82(5):742-50.
10. Witek L, Marin C, Granato R, Campos FE, Gomes JB, Suzuki M, Coelho PG. Surface characterization, biomechanical, and histologic evaluation of alumina and bioactive resorbable blasting textured surfaces in titanium implant healing chambers: an experimental study in dogs. Int J Oral Maxillofac Implants. 2013;28(3):694-700.
11. Kim YK, Kim SG, Kim JH, Yi YJ, Yun PY. Prospective study of tapered resorbable blasting media surface implant stability in the maxillary posterior area. Oral Surg Oral Med Oral Pathol Oral Radiol. 2012;114(l):el9-24.
12. Pellicer-Chover, H., Peñarrocha-Oltra, D., Bagán, L., Fichy-Fernandez, A. J., Canullo, L., & Peñarrocha-Diago, M. (2014). Single-blind randomized clinical trial to evaluate clinical and radiological outcomes after one year of immediate versus delayed implant placement supporting full-arch prostheses. *Medicina Oral, Patologia Oral y Cirugia Bucal*, *19*(3).
13. Rajpal J, Gupta KK, Tandon P, Srivastava A, Chandra C. Assessment of hard and soft tissue changes around Implants: A Clinico-radiographic in vivo study. J Dent Implant. 2014;4:126-34.
14. Munjal S, Munjal S, Hazari P, Mahajan H, Munjal A, Mehta DS. Evaluation of specifically designed implants placed in the low-density jaw bones: A clinic-radiographical study. Contemp Clin Dent. 2015;6(l):40-43
15. Salvi GE, Lang NP. Diagnostic parameters for monitoring peri-implant conditions. Int J Oral Maxillofac Implants 2004;19 (suppl):116–127.
16. Canullo L, Rasperini G. Preservation of peri-implant soft and hard tissues using platform switching of implants placed in immediate extraction sockets: A proof-of-concept study with 12- to 36-month follow-up. Int J Oral Maxillofac Implants. 2007;22(6):995-1000.
17. Mombelli A, Muhle T, Bragger U, Lang NP, Burgin WB. Comparison of periodontal and peri-implant probing by depth-force pattern analysis. Clin Oral Implants Res. 1997;8(6):448-54.
18. Roccuzzo M, Bunino M, Prioglio F, Bianchi SD. Early loading of sandblasted and acid-etched (SLA) implants: A prospective split-mouth comparative study. Clin Oral Implants Res. 2001; 12(6):572-8Relevant conflicts of interest/financial disclosures: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.