



## Immediate Implants in Extraction Sockets with Peri-apical Lesions: A Prospective controlled Study

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### OPENACCESS

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### ABS TRACT

**Context:** Immediate placement of dental implants into fresh extraction sockets is indicated to be a predictable and successful procedure when proper protocols were followed but results from published studies are inconclusive and unclear

**Aims:** To evaluate the efficacy of immediate implants placement in fresh extracted sockets with peri-apical lesions as compared to without peri-apical lesions

**Settings and Design:** This Prospective controlled trial was conducted in the Department of Oral and Maxillofacial Surgery of a Dental College and Research Institute in North-India

**Methods and Material:** The study consists of Control-Group with 12 extraction socket without peri-apical infection and study-Group with 12 extraction sockets with peri-apical infection for immediate implant placement. Implant Stability Quotient (ISQ) and Labial bone thickness at baseline and at 4 months were assessed.

**Statistical analysis:** Independent sample t-test and paired t-test were used to test for association taking a p-value <0.05 as level of significance.

**Results:** The two groups were comparable by gender and age. The Implant survival rate at 4 months of follow-up was found to be 100% in both groups. The mean(SD) ISQ at the baseline increased significantly at 4 months in both groups and was found to be statistically significant(p<0.001).A statistically significant gain in Labial bone thickness from the baseline was detected in the control group (0.958±0.320mm) and study group (1.025±0.133mm)(p<0.001) but no significant difference was detected between the two groups (p=0.688).

**Conclusions:** Implant bone stability and Gain in Labial bone thickness at 4months was comparable and implant survival was 100% in both groups.

**Keywords:** Immediate implants, Implant survival, Peri-apical lesions.

### INTRODUCTION

Teeth play a significant part in the maintenance of a healthy personality and an affirmative self-image.<sup>1</sup> Branemark's innovative discovery in 1952 led to the development of osseointegration and the use of dental implants to support and retain dental prostheses.<sup>2</sup> The introduction of immediate placement of implants into fresh extraction sockets, first described in 1976 has been proven to be a viable and safe treatment option.<sup>3</sup>

The first report of success on immediate implantation in sockets with periapical lesions was described by Novaes Jr and Novaes in 1995. The protocol suggested by the authors included careful extraction and debridement of the socket followed by copious irrigation with saline solution, by guided bone regeneration, primary closure and a systemic antibiotic regimen, starting 24 hours before implantation.<sup>4,5</sup>

Immediate implant placement of dental implants into fresh extraction sockets has been shown to be a predictable and successful procedure when proper protocols were followed but placement into infected sites is contentious and the risks of the application still continue to be a matter of debate in clinical practice.<sup>6,7</sup> This study aims to investigate the treatment outcome of dental implants immediately placed in extraction sockets with or without periapical pathology relating to

implant survival rate, implant bone stability and gain in labial bone thickness with 4 months of follow-up.

## **SUBJECTS AND METHODS:**

This Prospective controlled trial was conducted in the Department of Oral and Maxillofacial Surgery of a Dental College and Research Institute in North India during 2021 to 2023. The study population consisted of patients 18-65 years of age of both gender attending the out-patient department with or without peri-apical lesions who wanted immediate implant after extraction. Only patients with ASA 1 and 2, having buccal bone height upto or greater than midroot level of the tooth with adequate bone at least 2-3 mm beyond the apex of the tooth or beyond the peri-apical lesion and presence of four bony walls of the socket were included in the study. Patients who were medically compromised, having acute peri-apical pathology, smokers and tobacco users, undergoing chemotherapy and radio therapy, pregnant and lactating, ASA 3 and 4 and Bone less than 2 mm beyond the apex of the tooth or beyond the peri-apical area were excluded from the study.

All patients reporting to the Out-patient department were evaluated for immediate implant placement. A total of 24 patients were selected following predetermined inclusion & exclusion criteria based on number of past daily Out-patient attendance and feasibility of the study. Patients fulfilling inclusion criteria were consecutively recruited for the study and were assigned to a Control group of 12 patients with 12 extraction sockets without peri-apical infection and a Study group of 12 patients with 12 extraction sockets with peri-apical infection.

Thorough past and current medical, dental, personal and pharmacological history was taken. Fitness of the patients were checked and recruited patients were subjected to routine blood investigations and Cone Beam Computerized Tomography (CBCT).

Pre-operative regimen of 0.12% chlorhexidine mouthwashes (three times a day for 4 days before) and 625 mg amoxicillin/clavulanic acid (three times a day for 4 days before; in case of penicillin allergy, 300 mg clindamycin were prescribed every 8 hours) was carried out for all patients. All surgeries were performed by the same clinician.

A crevicular incision was given on the tooth to be removed extending till papilla of the opposite tooth. The tooth were mobilised with the help of luxators. Tooth which required surgical treatment was split into 2 halves horizontally with a 701 carbide burr into a buccal half and a palatal half without any bone removal and the tooth was extracted in two parts. After traumatically extracting the tooth with or without peri-apical pathology, the alveolae underwent meticulous curettage in all socket walls to remove all the granulation tissue. Alveolae was disinfected with 0.12% chlorhexidine-soaked gauzes (applied for one minute) and abundantly irrigated with physiological serum and 0.12% chlorhexidine to eliminate any remaining debris from the alveolus. Osteotomy was prepared on the palatal side by sequential drilling protocol according to the implant size indicated by the implant manufacturer, by Adin. After sequential drilling, the implant placement as done achieving insertion torque  $>35$  N/cm in all cases and cover screw was placed. After implant placement autologous PRF (Platelet Rich Fibrin) was prepared by withdrawing 10 ml of venous blood at 2700 RPM for 12 mins. If the jumping distance was  $> 2$ mm Biphasic calcium phosphate graft (DM bone) was placed to fill the gap between the socket wall and implant and Autologous PRF was placed to cover the graft and implant. If the jumping distance was  $< 2$ mm only an Autologous PRF was placed to cover the implant and no graft was placed. Suturing was done in a vertical mattress fashion approximating the labial and palatal flap to achieve primary closure. An immediate post-operative Resonance Frequency Analysis (RFA) was done to check for Implant bone stability. [Fig 1]

All patients had the same post-operative regime, continuing with the prescribed pre-operative antibiotics for further 7 days after surgery with addition of 600 mg Ibuprofen (three times a day for 4 days) and applications of 1.2% chlorhexidine gel in the surgical area (three times a day for 10 days). The periapical specimen obtained was subjected for histopathological analysis.

All patients were followed up at 1 week and 4 months. At 1 week of follow up pain was assessed using a Visual Analogue scale (VAS). At 4<sup>th</sup> month of follow up RFA was done to check the stability and CBCT was done to evaluate the gain in thickness of the labial bone.

The RFA measurements was carried out at baseline during surgery and at 4 months before crown cementation with the Penguin RFA device. Two consecutive measurements, one from the frontal and one from the palatal direction were recorded. The mean ISQ values was considered the final ISQ of each implant. Once the implant was nearly placed, a manual calibrated torque gauge ratchet was used to place the implant in its final position and at that instance, the maximum final torque applied was noted on the torque gauge scale.

VAS score: Patients were asked to represent their pain on Visual Analogue Score on the 7<sup>th</sup> post-operative day of surgery. Patients were instructed that 0 represent no pain, 1-3 represent mild pain, 4-6 represent moderate pain, 7-10 represent severe pain and 10 represent worst pain.<sup>18</sup>

**CBCT standardization:** All pre-operative and post-operative scans were acquired using NNT CBCT interactive software version 9.0 (Newton Italy) at 10 mA, tube voltage of 90 kV, FOV of 5x5 and voxel of 150 microns. Cross sections were created 1mm thick with a slice interval of 1mm to reproduce and standardize the procedure.<sup>8</sup>

Ethical clearance of the study was obtained from the Institutional Ethics committee (ECR/697/Inst/UP/2014/RR-21) vide Ref No. ITSCDSR/Director-Principal/2024/L/158. Ethical principles of the Declaration of Helsinki was followed. Written Informed consent was obtained and strict privacy and confidentiality was maintained for all collected information.

Statistical analysis was done using IBM SPSS software version 22. Descriptive statistics like frequency, percentages, mean & Standard deviation were performed. Analytical statistics like Chi-square test, Independent sample t-test for intergroup comparison and Paired t-test for intragroup comparison of baseline values and at 4 months of follow up. A p-value of <0.05 was taken as the level of significance.

## RESULTS

A total of 24 patients were recruited in the study comprising of 12 (control group) participants without peri-apical lesions and 12 (study group) participants with peri-apical lesions. The age ranges from 20 to 53 years with a mean (SD) age of 32.79± 10.2 years and median age of 32 year. There were equal number of males (12) and females (12) participants. The study and control groups are comparable by age and gender as there is no statistically significant difference.

The mean (SD) VAS pain score in the control group was 2.83± 1.94 and in the study group was 3.17± 1.74 but the difference was found to be not statistically significant (p=0.633). The mean (SD) ISQ in the control group at the baseline was 60.17±4.67 which increased to 78.53±1.97 at 4 months of follow up and it was found to be statistically significant (p<0.001). The mean (SD) ISQ improved significantly from the baseline by 4 months of follow up in the study group and it was statistically significant (p<0.001) [Table 1] There is no statistically significant difference between the mean (SD) ISQ at month 4 of follow up and the two groups are comparable (p=0.421) [Table 2]

The Implant survival rate at 4 months of follow up in the control group was found to be 100% similarly in the study group at 4 months of follow all 12(100%) implants survived and there were no implant failures. The mean (SD) Labial Bone Thickness of the pre-operative measurement (1.06±0.260mm) improved significantly by month 4 of follow up to 2.05±0.40 mm in the control group and it was statistically significant (p<0.001). The Labial Bone Thickness of the pre-operative measurement improved significantly by month 4 of follow up in the study group by 1.025 mm and it was statistically significant (p<0.001) [Table 3]

There is no statistically significant difference between the mean (SD) Gain in Labial Bone Thickness at month 4 of follow up between the control and study groups (p=0.688) [Table 4]. The histopathology report of the study group showed 11 patients confirmative of peri-apical granuloma and only 1 case was confirmative of radicular cyst.

**Table 1. Paired t-test showing comparison of Implant bone stability Quotient (ISQ) by RFA at the baseline and at 4 months of follow up for the study and control group. (N=12)**

| Implant Bone stability (ISQ) by RFA | ISQ Mean (SD)        | Mean Difference with 95% CI | t-value                  | p-value |       |
|-------------------------------------|----------------------|-----------------------------|--------------------------|---------|-------|
| Control group                       | Baseline             | 60.17±4.67                  | -18.36(-21.32 to -15.41) | -13.65  | 0.001 |
|                                     | 4 month of follow up | 78.53±1.97                  |                          |         |       |
| Study group                         | Baseline             | 58.91±5.47                  | -18.35(-21.09 to -15.62) | -14.79  | 0.001 |
|                                     | 4 month of follow up | 77.27±4.96                  |                          |         |       |

**Table 2. Comparison of Implant bone stability by RFA at month 4 of follow up between the two groups using t-test. (N=24)**

| Group         | Implant Bone stability at 4 month follow up (ISQ) Mean (SD) | Mean Difference with 95% CI | t-value | p-value |
|---------------|---|-----------------------------|---------|---------|
| Control Group | 78.53±1.973   | 1.54 (-1.934 to 4.467)      | 0.821   | 0.421   |
| Study group   | 77.27±4.968   |                             |         |         |

**Table 3. Paired t-test showing comparison of Labial Bone Thickness pre-operative and at month 4 of follow up for the study and Control group. (N=12)**

| Group         | characteristics                               | Labial Bone Thickness (mm) Mean (SD) | Mean Difference with 95% CI | t-value | p-value      |
|---------------|---|--------------------------------------|-----------------------------|---------|--------------|
| Control group | Pre-op Labial Bone Thickness                  | 1.06±0.260                           | -0.958(-1.161 to -0.754)    | -10.36  | <b>0.001</b> |
|               | Labial Bone Thickness at month 4 of follow up | 2.05±0.40                            |                             |         |              |
| Study group   | Pre-op Labial Bone Thickness                  | 0.90±0.293                           | -1.025(-1.323 to -0.726)    | -7.566  | <b>0.001</b> |
|               | Labial Bone Thickness month 4 of follow up    | 1.93±0.512                           |                             |         |              |

**Table 4. Comparison of Gain in Labial Bone Thickness at 4 months of follow between the two groups using t-test. (N=24)**

| Group         | Gain in Labial Bone Thickness at week 4 of follow up (mm) Mean (SD) | Mean Difference with 95% CI | t-value | p-value |
|---------------|---|-----------------------------|---------|---------|
| Control Group | 0.958±0.320   | -0.066 (-0.406 to 0.273)    | -0.406  | 0.688   |
| Study group   | 1.025±0.469   |                             |         |         |



**Figure 1 Showing Implant Placement and after 4 months follow up**

**List of Abbreviations:**

| Abbreviation | Definition                              |
|--------------|---|
| ASA          | American society for Anaesthesiologists |
| CBCT         | Cone Beam Computerized Tomography       |
| ISQ          | Implant Stability Quotient              |
| PRF          | Platelet Rich Fibrin                    |
| RFA          | Resonance Frequency Assessment          |
| VAS          | Visual Analogue Score                   |

**DISCUSSION**

Preventing tooth loss and maintaining a healthy dentition with ideal functional efficiency, structural balance, and aesthetic harmony are the main objectives of modern dentistry.<sup>2,7</sup>This prospective controlled trial was designed to compare the prognosis of immediate implantation in extraction sockets with or without peri-apical infection in the maxillary esthetic zone. Results showed that, compared with the healthy controls, immediate implant placement into infected sites demonstrating peri-apical pathology had an equally favorable survival rate, as long as the surgical

procedures and treatment plans were carefully considered.

Most of the reasons for tooth extraction include infected areas caused by tooth fracture, periodontitis or endodontic infection. Some clinical reports have suggested that history of endodontic or periodontal infections is a predictive risk marker for future implant infection and failure.<sup>6</sup> On the contrary this study has 100 percent success rate of implants placed in peri-apical infection. A prospective study by **Crespi R et al**<sup>9</sup> on 30 patients with and without periapical infection also showed 100 percent success in both groups. Many studies have supported the hypothesis that Immediate Implant at an infected site with endodontic or periodontal lesion show a high survival rate.<sup>6-9</sup>

For infection control in this study antibiotics were prescribed before the surgical procedures were carried out and Implants were immediately placed into infected extraction sites after socket degranulation in the study group. Similar procedure were followed in previous studies undertaking immediate implantation into extraction sockets with peri-apical lesions.<sup>10</sup>

In our study bone grafting with Biphasic Calcium phosphate and covered with a PRF membrane was done in cases where the jumping distance was greater than 2mm. Three cases out of 12 in the study group and 1 case out of 12 in the control group received bone grafts as their jumping distance was greater than 2mm. As a general rule, the buccal gap between the socket walls and the implant surface should be filled with a slowly resorbing bone graft. In gaps >2mm use of a bone graft and membrane is recommended by **Wilson TG Jr et al**<sup>11</sup> and **Paolantonio M et al**.<sup>12</sup>

In our study our primary assessment was labial bone thickness through CBCT and secondary assessment was primary insertion torque, resonance frequency analysis, histopathology of the lesion and vas score for pain. Our study showed good gain in labial bone thickness at 4 months of follow up in the control group ( $0.958 \pm 0.320$  mm) and  $1.025 \pm 0.133$  mm in the study group. Similar findings were reported in a study conducted by **Arora D et al**<sup>13</sup>. **Farronato D et al**<sup>14</sup> highlighted the importance of the buccal bone thickness at implant placement as a key influence on the stability of the facial gingival margin. In our study there was significant gain in labial bone thickness at 4 months of follow up from the baseline in both the groups.

The primary insertion torque was favourable in both groups and there no statistical difference between the two groups. **Douglas de Oliveira DW et al**<sup>15</sup> in a systematic review on 589 studies concluded that insertion torque of 30 Ncm is enough for implant survival in cases of immediate loading, while the results demonstrated a high survival rate. All cases in the present study exhibited a primary insertion torque greater than 35Ncm and showed 100 percent survival.

A study done by **Bafijari D et al**<sup>16</sup> detected significant differences between the primary and secondary dental implant stability by RFA values. In our study the mean(SD) Implant bone stability (ISQ) improved significantly from the baseline by 4 months of follow up in both the groups. Both groups has good increase of ISQ from primary stability period to secondary stability period. Authors have highlighted the significance of Implant stability quotient measurements using RFA.<sup>17</sup>

**Schulz M et al**<sup>18</sup> studied the histology of periapical lesions and reported 70% granulomas, 23% cysts and 5% abscesses, 1% scar tissues, and 1% keratocysts. Another study by **Love RM et al**<sup>19</sup> stated that periapical granulomas and cysts were the most common periapical lesions of endodontic origin associated with persistent periapical pathosis. The histopathology report of our study showed 11 patients confirmative of peri-apical granuloma and only 1 case was confirmative of radicular cyst. In our study the pain on 7<sup>th</sup> day was assessed using a visual analogue scale. Although there was no significant difference between the groups for both parameters and there was no pain or mild pain on the 7<sup>th</sup> post-operative day. **Santhanakrishnan M et al**<sup>20</sup> also reported no difference in VAS for pain between immediate and delayed implant placement.

The limitations of our study may be the small sample size may but the results of our study conform with the findings of other studies<sup>9-13</sup> that the immediate placement of implants in chronically infected sites may be an expedient technique if appropriate clinical procedures like antibiotic administration, meticulous cleaning, and alveolar debridement are performed before the implant surgical procedure.

## CONCLUSION

For those implants where primary stability was achieved, the data of the present study shows that immediate implant placement in extraction sockets of teeth that exhibited chronic peri-apical pathology did not induce an increased rate of complications and rendered an equally favorable osseointegration compared to implants placed in extracted sockets which did not have any peri-apical pathology.

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