



## An In-Vivo Evaluation of Radiologic Bone Densities at Different Sites of Implant Placed by Platform Switched and Conventional Philosophies; A CBCT Based Original Research Study

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### KEYWORDS

Dental Implant, CBCT, Bone Density, Platform Switching, Radiology, Surgery

### ABSTRACT:

**Background and Aim:** With the advancements in the field of head and neck radiology, it is comparatively easy now to assess the bony status both qualitatively and quantitatively. Cone beam computed tomography has actually revolutionized all these areas of dental surgery. Dental implant success is mostly dependent on the available healthy bone therefore; this in vivo study was performed to evaluate the radiologic bone densities at different sites of implant placed by platform switched and conventional philosophies. Authors performed this study with the help of three dimensional latest radiologic aid; CBCT.

**Materials and Methods:** Total 20 patients were selected by simple random sampling method and all 20 surgeries were performed by using a single typed implant system. Group 1 patients included 10 patients wherein radiologic bone densities were evaluated at three implant sites and platform switching concept was utilized. Group 2 patients included 10 patients with same evaluation sites and without platform switching concept. All these radiologic assessments were attempted by CBCT. All density related estimations were completed after 2 months of abutment placement by CBCT. The responses were studied as adequate and non-adequate in 2 months post operative timings. P value less than 0.05 was taken as significant.

**Statistical Analysis and Results:** Statistical analysis was completed by SPSS software. Out of 20 studied patients, 13 were males and 7 were females. P-value was highly significant for age group 28-30 years (0.01). In Group 1 (crestal region), 8 patients were found to have adequate radiographic density. Similarly, 2 patients were found to have non-adequate radiographic density. In Group 1 (mid implant region), 9 patients were found to have adequate radiographic density and 1 patient was found to have non-adequate radiographic density. In Group 2 (crestal region), 7 patients were found to have adequate radiographic density and 3 patients were found to have non-adequate radiographic density. The level of significance calculated for between the groups was highly significant (0.001) as per one-way ANOVA analysis.

**Conclusion:** Within the limitations of the study, authors concluded that implants placed with platform switching concept exhibited superior bony densities as compared to the other tested group. In each group, bony densities were superior at apical region and poorer at crestal region and accordingly the results were significant as well.



## Introduction

Radiology is the medical specialty that uses medical imaging to diagnose diseases and guide their treatment. In the recent Radiological development, many non-ionizing radiographic techniques are used like magnetic resonance imaging, ultrasonography, computed tomography, fluoroscopy and positron emission tomography. Cone beam computed tomography (CBCT) is one of the most practiced and advised modality these days for head and neck radiology and implantology. Dental implant success is highly desirable since it involves surgical interventions with high cost and other interrelated factors. The first clinical usage of osseointegrated implants was introduced in the mid 1960s.<sup>1-3</sup> Since then osseointegrated implants has revealed predictable long-term success. However, all implant success related factors are highly subjective and sensitive too. Today, it is a common practice to suggest dental implants to rehabilitate missing teeth in anterior and posterior jaw region.<sup>4-8</sup> Soon after the surgical placement of implants, primary stability is the most important factor. This primary stability solely depends upon the quality and quantity of surrounding alveolar bone. Therefore, primary implant stability is one of the key factors governing the long term implant survival rates.<sup>9-13</sup> With the advent of three dimensional radiographic techniques of head and neck areas, diagnosis and treatment planning is more precise and individualized. CBCT has been considered the most consistent and objective substitute.<sup>14-15</sup> CBCT method offers morphological and qualitative assessment of the underlying bone. CBCT has been used in several clinical studies and research projects. CBCT is one of the most significant ways to examine and evaluate changes in bone density.<sup>16-17</sup> In view of all these noteworthy facts and information, this in vivo study was performed to evaluate the radiologic bone densities (by CBCT) at different sites of implant placed by platform switched and conventional philosophies.

## Materials and Methods

This study was abstracted and conducted to detect the probable solution of the said clinical problems. Authors designed this study on in vivo model wherein the bony densities were tested and evaluated on predetermined implant sites. To maintain the efficacy and data quality throughout the study, authors ensured to perform all implant surgeries by similar operating team with identical approach and armamentarium. Total 20 patients were selected by simple random sampling method. Both male and female subjects were studied in detail in the study. Moreover, all 20 surgeries were performed by using a single typed implant system. Only

implant/surgery was entertained per patient. Inclusion criteria were; patients with missing lower posterior teeth which necessitates artificial replacement (single mandibular molar of either side of jaw), patients who refuse to have removable teeth replacement, patients in the age range of not over 40 years, cooperative patients. Exclusion criteria included patients with all teeth present in lower arch, patients with any type of post operative follow up dilemma, patients receiving severe medication for other diseases which may possibly hamper with data transparency. All density related radiologic assessments were attempted by three dimensional radiologic technique/cone beam computed tomography (CBCT). CBCT completes both arches in rotation with scanning time of 36 seconds without any space between consecutive slides. CBCT also has no magnification distortion, no positioning error with minimal exposure. In this study, the voltage at the time of CBCT exposure was kept at 90 kV with tube current 10 mA at exposure time of 20 seconds. For the relative ease of categorization and result analysis, all 20 patients were grouped under two categories of 10 each. Group 1 patients included 10 patients wherein radiologic bone densities were evaluated at three implant sites; crestal, mid implant and apical. In all 10 patients of Group 1, platform switching concept was utilized/use of smaller diameter abutment on a larger diameter implant platform. Group 2 patients included 10 patients wherein radiologic bone densities were evaluated at three implant sites; crestal, mid implant and apical. In all 10 patients of Group 2, platform switching concept was not utilized/conventional approach. All radiologic evaluations/interpretations was completed by a single radiographic expert to avoid any inter/intra observer bias. All density related estimations were completed after 2 months of abutment placement by CBCT. The responses were studied as adequate and non-adequate in 2 months post operative timings. The study was explained in detail to all participating patients. Signed and informed consents were obtained from all participating patients. Statistical analysis was conducted to draw the inferences and results. P value less than 0.05 was taken as significant.

## Statistical Analysis and Results

All the predictable responses were noted as raw data and it was checked for any potentially incorporated error. Consequently data was subjected to basic statistical analysis with SPSS statistical package for the Social Sciences version 22 for Windows. Nonparametric test, namely, chi-square test, was used for further data analysis; p-value. Out of 20 studied patients, 13 were males and 7 were females [Table 1, Graph 1]. P-value was highly significant for age group



28-30 years. It was 0.01. Maximum 8 patients were found in age group of 31-33 years. Minimum 2 patients were found in age group of 40 years. Table 2 illustrates about the basic statistical description with level of significance evaluation using “Pearson Chi-Square” test (Group 1 wherein platform switching concept was utilized, n=10), CBCT based radiographic densities noted at crestal region as adequate and non-adequate in 2 months post operative timings. Total 8 patients were found to have adequate radiographic density levels as per CBCT at this particular site. Similarly, 2 patients were found to have non-adequate radiographic density levels as per CBCT at this particular site. Table 3 illustrates about the basic statistical description with level of significance evaluation using “Pearson Chi-Square” test (Group 1 wherein platform switching concept was utilized, n=10), CBCT based radiographic densities noted at mid implant region as adequate and non-adequate in 2 months post operative timings. Total 9 patients were found to have adequate radiographic density levels as per CBCT at this particular site. P value was highly significant here (0.02). Similarly, only 1 patient was found to have non-adequate radiographic density levels as per CBCT at this particular site. Table 4 illustrates about the basic statistical description with level of significance evaluation using “Pearson Chi-Square” test (Group 1 wherein platform switching concept was utilized, n=10), CBCT based radiographic densities noted at apical region as adequate and non-adequate in 2 months post operative timings. Total 9 patients were found to have adequate radiographic density levels as per CBCT at this particular site. P value was highly significant here (0.02). Similarly, only 1 patient was found to have non-adequate radiographic density levels as per CBCT at this particular site. Table 5 illustrates about the basic statistical description with

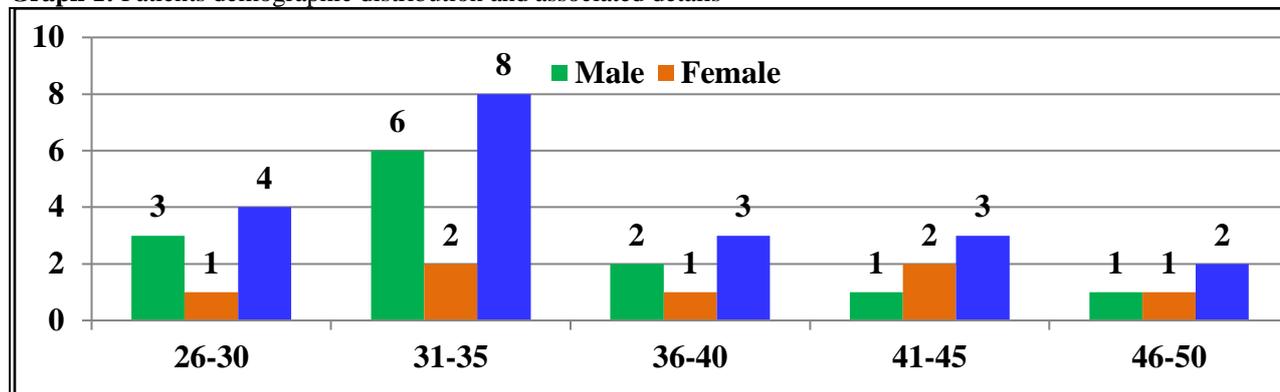
level of significance evaluation using “Pearson Chi-Square” test (Group 2 wherein platform switching concept was not utilized, n=10), CBCT based radiographic densities noted at crestal region as adequate and non-adequate in 2 months post operative timings. Total 7 patients were found to have adequate radiographic density levels as per CBCT at this particular site. P value was highly significant here (0.01). Similarly, only 3 patients were found to have non-adequate radiographic density levels as per CBCT at this particular site. Table 6 illustrates about the basic statistical description with level of significance evaluation using “Pearson Chi-Square” test (Group 2 wherein platform switching concept was not utilized, n=10), CBCT based radiographic densities noted at mid implant region as adequate and non-adequate in 2 months post operative timings. Total 8 patients were found to have adequate radiographic density levels as per CBCT at this particular site. P value was highly significant here (0.01). Similarly, only 2 patients were found to have non-adequate radiographic density levels as per CBCT at this particular site. Table 7 illustrates about the basic statistical description with level of significance evaluation using “Pearson Chi-Square” test (Group 2 wherein platform switching concept was not utilized, n=10), CBCT based radiographic densities noted at apical region as adequate and non-adequate in 2 months post operative timings. Total 8 patients were found to have adequate radiographic density levels as per CBCT at this particular site. P value was highly significant here (0.01). Similarly, only 2 patients were found to have non-adequate radiographic density levels as per CBCT at this particular site. Table 8 illustrates about the assessment amongst all studied groups using one-way ANOVA. The level of significance calculated for between the groups was highly significant (0.001).

**Table 1:** Age & gender based statistical description of contributing patients

Age Group (Yrs)	Male	Female	Total	P value
28-30	3	1	4	0.01*
31-33	6	2	8	0.20
34-36	2	1	3	0.60
37-39	1	2	3	0.90
40	1	1	2	0.50
Total	13	7	20	*Significant
<b>*p&lt;0.05 Significant</b>				



**Graph 1:** Patients demographic distribution and associated details



**Table 2:** Basic statistical description with level of significance evaluation using “Pearson Chi-Square” test (Group 1 wherein platform switching concept was utilized, n=10), CBCT based radiographic densities noted at crestal region as adequate and non-adequate in 2 months post operative timings

Status	n	Stat. Mean	Std. Dev.	Std. Error	95% CI	Pearson Chi-Square Value	df	p value
Adequate	8	1.13	0.019	0.055	1.96	1.281	1.0	0.01*
Non- Adequate	2	1.02	0.541	0.128	1.12	1.942	2.0	0.08

\*p<0.05 significant

**Table 3:** Basic statistical description with level of significance evaluation using “Pearson Chi-Square” test (Group 1 wherein platform switching concept was utilized, n=10), CBCT based radiographic densities noted at mid implant region as adequate and non-adequate in 2 months post operative timings

Status	n	Stat. Mean	Std. Dev.	Std. Error	95% CI	Pearson Chi-Square Value	df	p value
Adequate	9	1.03	0.094	0.055	1.23	1.049	1.0	0.02*
Non-Adequate	1	1.01	0.364	0.128	1.94	1.237	2.0	0.92

\*p<0.05 significant

**Table 4:** Basic statistical description with level of significance evaluation using “Pearson Chi-Square” test (Group 1 wherein platform switching concept was utilized, n=10), CBCT based radiographic densities noted at apical region as adequate and non-adequate in 2 months post operative timings

Status	n	Stat. Mean	Std. Dev.	Std. Error	95% CI	Pearson Chi-Square Value	df	p value
Adequate	9	1.03	0.094	0.055	1.23	1.049	1.0	0.02*
Non-Adequate	1	1.01	0.364	0.128	1.94	1.237	2.0	0.92

\*p<0.05 significant

**Table 5:** Basic statistical description with level of significance evaluation using “Pearson Chi-Square” test (Group 2 wherein platform switching concept was not utilized, n=10), CBCT based radiographic densities noted at crestal region as adequate and non-adequate in 2 months post operative timings

Status	n	Stat. Mean	Std. Dev.	Std. Error	95% CI	Pearson Chi-Square Value	df	p value
Adequate	7	1.23	0.039	0.325	1.26	1.561	1.0	0.01*
Non-Adequate	3	1.04	0.121	0.165	1.22	1.282	3.0	0.07

\*p<0.05 significant



**Table 6:** Basic statistical description with level of significance evaluation using “Pearson Chi-Square” test (Group 2 wherein platform switching concept was not utilized, n=10), CBCT based radiographic densities noted at mid implant region as adequate and non-adequate in 2 months post operative timings

Status	n	Stat. Mean	Std. Dev.	Std. Error	95% CI	Pearson Chi-Square Value	df	p value
Adequate	8	1.13	0.019	0.055	1.96	1.281	1.0	0.01*
Non-Adequate	2	1.02	0.541	0.128	1.12	1.942	2.0	0.08
<b>*p&lt;0.05 significant</b>								

**Table 7:** Basic statistical description with level of significance evaluation using “Pearson Chi-Square” test (Group 2 wherein platform switching concept was not utilized, n=10), CBCT based radiographic densities noted at apical region as adequate and non-adequate in 2 months post operative timings

Status	n	Stat. Mean	Std. Dev.	Std. Error	95% CI	Pearson Chi-Square Value	df	p value
Adequate	8	1.13	0.019	0.055	1.96	1.281	1.0	0.01*
Non-Adequate	2	1.02	0.541	0.128	1.12	1.942	2.0	0.08
<b>*p&lt;0.05 significant</b>								

**Table 8:** Estimation amongst all studied questions using one-way ANOVA

Variables	Degree of Freedom	Sum of Squares $\Sigma$	Mean Sum of Squares $m\Sigma$	F	Level of Sig. (p)
Between Groups	3	1.320	1.437	1.3	0.001*
Within Groups	14	2.204	0.723		-
Cumulative	103.13	07.544			<b>*p&lt;0.05 significant</b>

## Discussion

Several researchers have stated and confirmed that long term implant success and the condition of the surrounding bone necessitate multiple measures, particularly in human bones. Many pioneer studies have been conducted in the recent past to recognize the radiographic changes in bone during the period of osseointegration. Similarly, the changes in bone density that take place 2 months after implant placement is also critical to notice. Several clinicians have been agreed on the fact that implant success rates is solely affected by bone density at the implant site. Hence, comprehensive understanding of the changes in bone density after dental implant placement is crucial. It is highly imperative since it is the key factor in estimating and correlating consequent implant success. Turkyilmaz and associates in the year 2008 studied about the influence of bone density on implant stability parameters and implant success. Their presumptions were highly critical.<sup>18</sup> Issa and colleagues have studied about the radiographic status of bone density changes around titanium implants in the posterior mandible, preoperative, and postoperative. Their inferences were highly comparable with the current concepts and guidelines.<sup>19</sup> Johansson and other workers have studied

in detail about the evaluation of bone quality from placement resistance during implant surgery. They also highlighted about the role of good bone density in implant success.<sup>20</sup> Shapurian and associates have experimented about the quantitative assessment of bone density using the Hounsfield Index. They confirmed that low bony density around the implants have overall poor clinical prognosis in 5 year follow up timings.<sup>21</sup> Olive and other coworkers have studied in detail about the periotest method as a measure of osseointegrated oral implant stability. They clearly demonstrated about the clinical mobility in the implants those illustrated poor radiographic densities on the radiographs.<sup>22</sup> Meredith and other colleagues have studied about the quantitative determination of the stability of the implant-tissue interface using resonance frequency analysis. They also stressed about the importance of acceptable radiographic densities inn long term implant success.<sup>23</sup> Kahraman have also performed somewhat similar studies on bony densities. Their inferences were fairly inn agreement with our results.<sup>24</sup>

## Conclusion

Within the limitations of the study, authors concluded noteworthy presumptions and results. Overall, all



implants placed with platform switching concept exhibited superior bony densities as compared to the other tested group (non-platform switching implants). Among the each group, bony densities were superior at apical region and poorer at crestal region and accordingly the results were significant also. Nevertheless, crestal region of non-platform switched implants have inferior bony densities and apical/mid implant region of platform switched implants has superior bony densities as per CBCT evaluations. Authors also expect some other long term future studies so as to establish other significant guidelines in these prospective.

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