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Original Article

Clinical Outcomes of Dental Implants in Osteoporotic Patients of Indian Ethnicity – A Retrospective Cohort Study

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Abstract

Aim: *To evaluate the survival and clinical outcomes (crestal bone loss, sulcular bleeding index and pocket depth) of dental implants in patients with osteoporosis and their comparison with matched control patients.*

Material and Method: *After ethical approval from institutional ethical board, a retrospective cohort study was performed with the use of records of 50 years or older patients received one or more endosseous dental implants in Department of Prosthodontics between May 2011 and December 2015. Forty patients, diagnosed with osteoporosis at the time of implant placement and their matched controls were selected based on predetermined inclusion and exclusion criteria. Demographic and clinical variables recorded at the time of implant placement and follow-up examination were analyzed and compared using statistical package and social science (SPSS) software (version 17.0).*

Result: *Total 70 implants were placed in the osteoporotic patients, while, the control sample had 68 implants. Thirty six osteoporotic subjects were taking bisphosphonates either from oral or parenteral route. Delayed loading protocol was used to rehabilitate all implants in both the groups. An overall success rate of 95.8% was seen in the osteoporotic samples as compared to 97% within the control samples. .*

The mean crestal bone loss (1.596 ± 0.10 mm vs.1.57 ± 0.088 mm, p=0.74), mean sulcular bleeding index (1.82 ± 0.08 vs. 1.80 ± 0.07, p=0.15) and mean probing depth (1.91 ± 0.12 vs. 1.83 ± 0.07, p=0.36) of osteoporotic and control groups were statistically insignificant from implant placement to the follow-up examination.

Conclusion: *Within limitation of the study, it can be concluded that clinical outcomes of dental implants placed in osteoporotic patients and non- osteoporotic patients are comparable. Osteoporosis is not contraindicated for dental implant therapy if medical control is adequate.*

Keywords: *Bisphosphonate, bone density,crestal bone loss, pocket depth.*

Introduction

Osteoporosis is defined as a common skeletal disorder characterized by low bone mass and microarchitectural deterioration leading to higher fragility and consequently to an increased fracture risk (WHO, 1984).[1] Osteoporosis is a global public health problem currently affecting more than 300 million people worldwide. It is more

prevalent in females and its incidence increases with age.[2]Osteoporosis is in clinical practice diagnosed by the patient's history, physical examination and measurement of bone mineral density (BMD). Dual energy X-Ray absorptiometry (DEXA) has been considered as the gold standard method for determining BMD.[3] One criteria for the diagnosis of osteoporosis established by the World Health Organization (WHO) included having a BMD T-score being more than 2.5 standard deviations below the mean for young healthy adults in the total hip, femoral neck or lumbar spine anatomical regions.[4]

Osseointegration is based on intimate bone-implant contact achieved during the healing. Therefore, any condition affecting bone quality or quantity could theoretically have a negative impact on the survival of a dental implant. Osteoporotic patients exhibited a range of skeletal changes that includes: greater alveolar ridge resorption than average,[5] altered trabecular patterns in the anterior maxilla and posterior mandible[6] and an increased resorption and thinning of the mandibular inferior cortical margin.[7] These changes might affect the survival of dental implants.

Osteoporosis had some controversy about importance and effects on dental therapy outcomes. von Wowern and Gotfredsen[8] concluded that diagnosis of osteoporosis at the time of implant placement may be a risk factor for increased bone loss around dental implants. Some authors suggested that osteoporosis may not be a contraindication for dental implant therapy when the surgical technique was adjusted and longer healing time was provided.[9, 10] From the review of the current literature, it is clear that more clinical studies are required to accurately determine the dental implant outcomes in patient with osteoporosis.

The primary aim of present study was to compare the dental implant outcomes in 50+ years old patients having osteoporosis at the time of implant placement with outcomes in patients without osteoporosis. The null hypothesis was that there would be no difference in dental implant outcomes in 50+ years old patients having osteoporosis compared to those without osteoporosis at the time of implant placement.

Materials and Methods

This was a unicentre, retrospective cohort study. The investigators enrolled a cohort of subjects with 50 years or old in age that underwent one or more endosseous dental implant placement (BioHorizon tapered internal implant system, Riverchase Center Birmingham, USA) between May 2011 and December 2015 in Department of Prosthodontics. Prior to start of the study, an ethical approval was taken from the institutional ethical committee. The study group comprised of patients, rehabilitated with implants supported single crowns and confirmed with diagnosis of osteoporosis by a physician at the time of dental implant placement. Patients with history of severely debilitating disease, radiotherapy, smoking and psychiatric conditions (such as psychosis, alcoholism, drug abuse, neuroses) as recorded in their clinic charts were excluded from the study.

A total of 145 osteoporotic patients (42 Male and 103 Female) were identified from hand search of departmental implant patient records. An invitation letter describing the study and inviting them for a recall intraoral examination was sent to these patients. 92 patients (24Males, 68 Female) were agreed to participate in the study. However, out of 92 patients, 52 potential participants were excluded from study due to various reasons including old age, debilitating disease etc. Finally, 40 patients in the osteoporotic group were recruited.

A control group of 92 patients, rehabilitated with implant supported single crown and without diagnosis of osteoporosis at the time of dental implant placement were identified following same selection criteria as used to assign the subjects in study group. Forty control group patients matched with age, sex, dental implant related characteristics (number, location, bone quality and

extent of surgical procedure and restoration) and ready to visit for follow-up were selected to make two groups comparable (Table 1). Follow-up examination was made at an average of 4 years after implant placement in both the groups.

Both group patients were asked to bring their recent bone density measurements (DEXA: Dual energy x-ray absorptiometry) from their physicians' offices at the time of dental implant placement. After signed informed consent, baseline and clinical data of patients of both groups were recorded. The baseline data recorded, included age, sex, t-score, history of drug therapy for osteoporosis, number and location of implants, time of stage-I surgery and stage II surgery, and implant loading. Measured clinical outcome variables were pocket depth, modified sulcular bleeding index and marginal bone loss. Pocket depth and modified sulcular bleeding index were assessed with the help of plastic periodontal probe on all four surfaces (buccal, lingual, mesial and distal) of each implant in both groups.

Crestal bone loss was determined by periapical radiographs located in the clinic charts taken at the time of implant placement (i.e. baseline radiographs that had been taken when the implants were placed or the date closest to the stage-I surgery) and those taken at the follow-up examination. Bone level measurements were made on the mesial and distal sides of the implants and differences in the bone levels from baseline to follow-up examination were calculated and averaged.

Digital photographs of the intraoral periapical radiographs were analysed with computer imaging software (DBSWIN Version 5.5.0, Durr Dental, Germany). The implant-abutment junction was used as the reference point for all measurements. To adjust the measurements for foreshortening and elongation of radiographs, the length of the implant measured on the radiograph was noted along with the observed crestal bone level. The following equation was used to determine the corrected bone levels:

Corrected crestal bone level = [(measured bone level) x (actual implant length /measured implant length)]

Crestal bone loss= Corrected crestal bone level at baseline - Corrected crestal bone level at follow-up

Descriptive analysis of the demographic data was conducted at both baseline and follow-up examination. Outcome variables recorded in the study group and control group were compared using paired t-tests. All statistical tests were conducted using SPSS software (version 17.0), and p value of <0.05 was considered to be statistically significant.

Results

Total 80 patients (40 in each group) participated in this cohort study with uniform sex distribution. The mean age of both control and study group was statistically similar at the time of surgery (62.28±6.47 years, 58.38±8.490 years, $p>0.05$) and at time of follow-up (66.34±8.54 years. 62.42±4.84years, $p>0.05$) respectively. Age and sex of both groups were matched and comparable. Their mean DEXA T-scores at the femoral neck were -2.2 and -0.52 at the time of surgery and -1.88and -0.76 at the follow- up examination.

Total 70 implants (12 anterior maxilla, 8 posterior maxilla, 22 anterior mandibles and 28 posterior mandibles) were placed in the osteoporotic patients, while, the control group patients had 68 implants (13 anterior maxilla, 9 posterior maxilla, 24 anterior mandibles and 22 posterior mandibles) (Table 1). Thirty six osteoporotic patients were taking bisphosphonates either from oral or parenteral route since 4.32±2.57 years at baseline and 7.82±3.84 years at the time of follow-up. In the control group, there were 6 patients taking bisphosphonates therapy since 0.92± 0.41 years at the follow-up examination.

The bone quality in osteoporotic group at baseline was 20 Type I, 29 Type II, 21 Type III and Type IV in none of the sites. In the control group, the bone quality was 22 Type I, 23 Type II, 19 Type III and Type IV in none of the sites. Therefore, there were no marked differences in the bone

quality types of selected dental implant sites in both groups.

Delayed loading protocol was used to rehabilitate all implants in both the study groups. On an average, the duration of healing period in the osteoporotic patients was 4.84±0.57 months in comparison with 4.54±0.35 months in the controls, although their differences were statistically insignificant (p=0.23). The average duration of implant supported porcelain-fused-to-metal crown in function till follow-up period was 48.26±1.40 months in the osteoporotic patients while in the control patients was 47.96±1.57 months. Their difference was not statistically significant (p=0.724).

The mean crestal bone loss from implant placement to the follow-up examination for both osteoporotic and control groups (Table 2) was 1.596 ± 0.10 mm and 1.57 ± 0.088 mm respectively, and on comparison, their difference was statistically insignificant (t= 0.35, p=0.74).

By intergroup comparison of mean sulcular bleeding index, t- test revealed statistically insignificant difference in sulcular bleeding index from implant placement to follow-up appointment (1.82 ± 0.08 vs. 1.80 ± 0.07, p=0.15) in both the study groups. Similarly, intergroup comparison of mean post pocket depth, t- test revealed similar pocket depth between the two groups from baseline to follow-up appointment (1.91 ± 0.12 mm vs. 1.83 ± 0.07 mm, p=0.3642).

Table 1: Subject and implant characteristics of study and control samples

Characteristics	Osteoporotic Sample	Control Sample	P value
Demographic characteristics			
Male: Female	10:30 (total=40)	8:32 (total=40)	
Age when implants were placed	62.28± 6.47yrs	58.38± 8.490 yrs	0.276
Age at follow-up examination	66.34± 8.54 yrs	62.42± 4.84yrs	0.244
T-score (femoral neck) when implants were placed	-2.2	-0.52	
T-score (femoral neck) at follow-up	-1.88	-0.76	
Use of Bisphosphonate therapy at baseline			
Oral Route	30	0	
Parenteral Route	6	0	
Year of Administration	4.32± 2.57	0	
Use of Bisphosphonate therapy at Follow-up			
Oral Route	28	5	
Parenteral Route	8	1	
Year of medications	7.82±3.84	0.92±0.41	
Dental implant related characteristics			
Total number of implants placed	70	68	
Site of implant placed			
Anterior maxilla	12	13	
Posterior maxilla	8	9	
Anterior mandible	22	24	
Posterior mandible	28	22	
Bone quality recorded at implant placement site	70	68	
Type I	20 (15%)	22 (18.75%)	
Type II	29(45%)	23(50%)	
Type III	21 (40%)	19(31.25%)	
Type IV	0	4	
Healing period (in months) of implant before loading	4.84± 0.57	4.54± 0.35	0.23
Duration (in months) of supra-structure function till follow-up	48.26± 1.40	47.96± 1.57	0.724

Table-2: Clinical outcomes of Patients at Follow-up

Clinical Outcomes	Osteoporotic Sample	Control Sample	t-value	p-value
Crestal Bone loss	1.596 ± 0.10mm	1.57 ± 0.088mm	0.35	0.74
Sulcular bleeding index	1.82 ± 0.08	1.80 ± 0.07	1.76	0.15
Mean Pocket depth	1.91 ± 0.12	1.83 ± 0.07	1.02	0.361

Discussion

Osteoporosis occurs in a large number of ageing women and men. Post-menopausal women are affected most frequently.[11] Therefore, the study consisted of seniors, all above 50 years of age and predominantly women (80%).

Most frequent site to perform DEXA scan is spine, femur neck, total hip and radius. The spine is the site most likely to show the low BMD t- scores for diagnosis of osteopenia or osteoporosis.

Therefore, in both groups, femoral neck region was tested to measure the BMD. This factor improved the sensitivity of the study for detection of patients with osteoporosis.[10] T-score value was high at baseline in almost every subject with osteoporosis. From baseline to follow-up examination, the DEXA values were stable or improved for the osteoporotic sample. This favorable effect might be the result of regular continued treatment with bisphosphonates.

Alveolar bone quality recorded at implant placement site had been classified as type I to type IV (Lekholm and Zarb, 1985).[12] In the present study, at the time of dental implant placement, 71.4% of the osteoporotic sample and 66.15 % of the control sample had type II and type III bone, which are relatively more favorable for dental implant placement and longevity.[13] Early implant failure rate was generally higher with type I and type IV bone.[14] No osteoporotic patient was noted with type IV bone at implant site during placement surgery. In the present study, 3 and 2 implants failure were noticed in osteoporotic patients and control patients respectively. An overall success rate of 95.8% was seen in the osteoporosis sample compared 97% within the control sample. The survival rate noted in the osteoporotic sample was comparable with survival rates reported in previous studies.[15,16,17]

Osteonecrosis was not noted in any patient of both groups following implant placement although 36 of the 40 patients in the osteoporotic sample were taking oral bisphosphonates at the time of implant placement. It can be supported by study by Bao-Thygrant et al.[18] who conducted review of 468 implants placed in 115 patients receiving oral bisphosphonate therapy. There was no evidence of bisphosphonate-associated osteonecrosis of the jaw in any of the patients. They concluded that implant surgery on patients receiving bisphosphonate therapy did not result in bisphosphonate-associated osteonecrosis of the jaw

The mean crestal bone loss reported in both osteoporotic and control groups till follow-up examination was 1.596 ± 0.10 mm and 1.57 ± 0.088 mm respectively. Their difference was not statistically significant. Corcuera- Flores JR et al.[19]performed a 2 year retrospective study to determine relationship between osteoporosis and marginal bone loss in osseointegrated implants and concluded that Osteoporosis does not pose a risk for development of greater marginal bone loss. Parameters adversely affecting the development of increased marginal bone loss are a previous history of periodontitis and especially the placement of implants at sites of bone regeneration.

Periodontal parameters such as sulcus bleeding index, and probing depths were frequently used to assess the health and degree of inflammation in peri-implant soft tissues.[20] Bleeding on probing from the gingival sulcus is one of the earliest symptoms of gingival inflammation.[21] It had been observed in 67% implant locations that had peri implant mucositis and 91% locations that had peri implantitis.[22]

Based on the findings from present investigation, it can be recommended, dental implants can be placed in osteoporotic patients when the medical

control of the disease is adequate, with the expectation that the outcomes are not likely to be different from those who do not have the disease. The present study revealed statistically similar mean sulcular bleeding index and probing depth in both osteoporotic and control samples. These results were similar to study conducted by Ravichandra Julari etal.[11] to determine association of periodontitis to post-menopausal osteoporosis.

Conclusions

The present study showed that there was no statistically significant effect of osteoporosis on clinical outcomes of dental implants. The clinical outcomes of dental implants placed in osteoporotic patients were comparable to non-osteoporotic patients when adequate medical control is possible.

Limitations of the study

This study was limited to one institution, further studies should be planned as multi- institutional longitudinal investigation or similar study designs with a larger number of patients and longer follow-up periods.

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