

Retrospective Study Of Dental Implants Survival Rate In Postmenopausal Women With Osteoporosis

Research Article

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Abstract

Background: The impact of osteoporosis on implant treatment remains debatable among the science community, with the goal to evaluate long-term implant success rate in patients with osteoporosis.

Methods: Patients who underwent dental implant treatment at least 4 years ago were divided into two groups [Test (osteoporosis/osteopenia) Group and Control Group] according to bone mineral density (BMD) measurements.

Results: A total of 52 patients with a mean age of 59.51 ± 5.66 years (Test Group; 26 patients, mean age: 60.61; Control Group; 26 patients, mean age: 58.42) were included in the study. Implant survival rates were 96.2% and 100% with a mean follow-up 60.84 ± 22.13 and 60.07 ± 20.93 months in Test and Control Groups, respectively ($P > 0.05$). While peri-implant PI (plaque index) and PD (probing depth) were not different between the groups, BoP (bleeding on probing) was significantly higher in Test Group ($P = 0.026$). Although Cristal bone label (CBL) in Test Group was higher than Control Group (0.82 ± 0.63 mm and 0.44 ± 0.33 mm respectively), the difference was not found statistically significant ($P = 0.069$).

Conclusions: The findings recommend that dental implant therapy is a reliable treatment method for those patients to improve the quality of life by increasing function and aesthetics.

Keywords: Osteoporosis; Implants; Postmenopausal Women.

Abbreviations: PI: Plaque Index; PD: Probing Depth; BoP: Bleeding On Probing; BMD: Bone Mineral Density; MBL: Marginal Bone Loss.

Introduction

Osteoporosis is a systemic skeletal disease characterized by reduced bone strength that predisposes to an increased risk of fractures [28]. It is a very common disease which affects an estimated 300 million people worldwide [21, 31]. It is most common in females and its incidence increases with age [17, 37]. It is usually accompanied with the destruction of bone microarchitecture with reduced bone mass and strength and increased fragility [40]. The resistance reflects the amount of bone density and bone quality. Bone density is determined by the maximum value of bone mass (measured in grams per cm^2) and the magnitude of their loss. The diagnosis of osteoporosis was established based on the classical values of bone mineral density (BMD) achieved in the bone den-

sitometry. This method call dual x ray absorptiometry for Lumbar vertebrae (L1, L2, L3, L4) After that, he took the average of the four paragraphs. The osteoporosis was considered when the T-score of less than -2.5 SD (the T number of standard deviations that a subject deviate from the average BMD of a population group of healthy young women [8] Figure(1). This classification followed by the World Health Organization WHO.

Currently the BMD is only considered a risk factor that must be assessed in the context of age, sex, smoking, body weight, family history and / or personal fracture, etc [11, 27].

Management of osteoporosis patient by using medication (bisphosphonates(Alendronate-Risendronate), Glucose calcium 500 -1000 mg and vit D3 600 units) [41].

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Methods

Female Patients, 50 years of age or older, who had been rehabilitated with dental implants placed during 2015. Patients who agreed to sign informed consent and were willing to attend the study were given a control appointment. The study was conducted according to the principles of the Helsinki Declaration of 1975, as revised in 2013. All appropriate patient consent forms. In the form the patient(s) has/have given her/their consent for her/ their images and other clinical information to be reported in the journal. The patients understand that their names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed. The patients were taken from the Al-Assad University Hospital, Damascus University, and the research was conducted at Damascus University as a master's research and Master's decision number 2733.

Initially, 280 women with minimum one dental implant being in function for at least 3 years were called and asked to bring their (DXA) measurements. Information about their age, osteoporotic diagnosis based on T-score, duration of follow-up, smoking habits, systemic conditions, medication, data concerning implant insertion, and prosthetic rehabilitation and any implant failures were provided using their medical and dental records. Subjects unaware of their bone status, because of not having bone mineral density (BMD) assessment, were excluded from the study. Patients who had systemic diseases that may affect implant success such as uncontrolled diabetes, heavy parafunctions (e.g, bruxism), with a history of bone augmentation and/or sinus lift and smoking habit were also excluded. The patients' osteoporotic status was determined according to T-scores based on The World Health Organization (WHO) criteria. Subjects meeting all of the inclusion and neither of the exclusion criteria were divided into two study groups regarding each subject's lowest T-score.

Inclusion Criteria

1. Being postmenopausal woman over 50 years of age with BMD measurements,
2. Having been rehabilitated by dental implants in 2015 or before,
3. Using medication related of osteoporosis (bisphosphonates and calcium) regularly.
4. Having fixed prosthesis over implants only one crown or bridge, exposed to balanced occlusal forces.
5. Not having a history of periodontal\ prei -implant disease.
6. Not having any systemic diseases.
7. Not smoking,
8. Being volunteer to participate in the study.
9. No taking any hormonal drugs
10. Not having sever osteoporosis
11. Not having osteonecrosis of the jaws

Exclusion Criteria

1. Lack of BMD measurements,
2. Having been rehabilitated by dental implants after 2015,
3. Presence of systemic diseases that may affect implant success such as uncontrolled diabetes.
4. Smoking,
5. History of bone grafting and/or sinus lift,
6. Severe parafunctional habits such as bruxism.
7. Unregularly or not medication osteoporosis
8. Having over denture or Exaggerated cantilever prothesis.
9. Lack oral hygiene

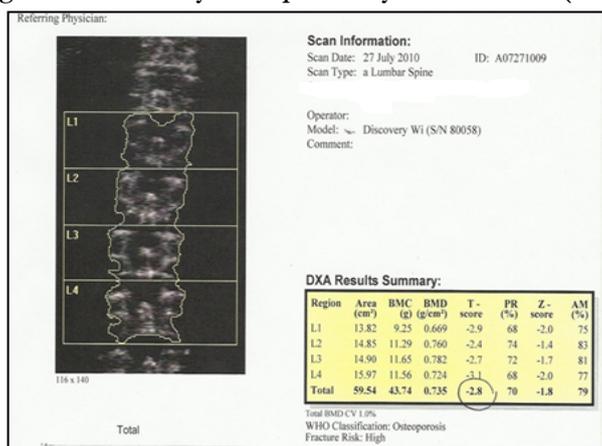
While Control Group included subjects with a T-score ≥ -1 , Test Group (osteoporosis/osteopenia group) included subjects with a T-score < -1 . DXA were adopted for a period of no more than 6 months

During clinical examination, pain , movement, history of swell-

Table 1.

Diagnostic category	Osteoporosis definition
Normal	T-score ≥ -1
Osteopenia	$-2.6 < \text{T-score} < -1$
Osteoporosis	T-score ≤ -2.6
Severe \ established osteoporosis	T-score ≤ -2.6 and the presence of one or more fragility fractures

Figure 1. Dual x Ray Absorptiometry measurement (DXA).



ing, presence of plaque (plaque index [PI]) and the status of the soft tissue around the implant (probing depth [PD] and bleeding on probing [BoP]) were checked by a single calibrated examiner (V.E.T.). Probing of the peri-implant pocket was performed at six sites per implant (mesiobuccal, buccal, distobuccal, mesiolingual/mesio palatal, lingual/palatal and distolingual/distopalatal), and the mean value was used in calculations. The location of the implants, date of insertion and functional loading, and any implant failures were also recorded. If the implants were stable and in function without mobility, they are believed to survive, having no pain or suppuration with the lack of peri-implant radiolucency. However, implant survival just means that it has not been lost but not informs about its situation and the implant success. The amount of CBL gives more information about the long-term outcomes of implants. Health Scale For Dental Implants was taken To determine the survival or failure of implants [42].

Standardized periapical were taken with a digital X-ray machine and marginal bone levels were assessed using image analysis software (Planmeca, Romexis 3.5.1.R). A researcher blinded to the BMD status of the patient (V.E.T.) took the measurements on radiographs and known implant lengths were used for calibration. Marginal bone levels (MBL) were measured as the linear distance between the reference point, implant-abutment junction, and the most coronal point of bone-to-implant contact, both mesially and distally. The average of mesial and distal measurements was calculated to determine a single value for each implant. Parallely technique Digital periapical radiograph taken at the time of implant insertion were regarded as baseline and MBL was calculated as the difference between the Cristal bone level at baseline and the follow-up appointment. For every patient in the study, all of the measurements were averaged into one. Duration of follow-up was calculated from the date of implant insertion to the date of recall visit. Finally, the study was completed with a total of 52 patients with 244 implants.

Statistical Analysis

Sample size was calculated at the beginning of the study ($\alpha = 0.5, 1-\beta$ (power) = 0.8). It was estimated that at least 21 volunteers for each group would be enough to find a difference of 0.34 mm amount of mean MBL between the groups. The data given were analyzed using SPSS. A descriptive analysis was performed using standard deviation (SD) and median with 96% confidence inter-

val (CI). Only ages of the subjects showed normal distribution and were presented as means and SDs of means and compared between the groups by using Independent-samples t test. Analysis of other parameters (T-score, number of implants, follow-up period, PI, PD, BoP and amount of MBL) did not show normal distributions. Therefore, the data for those parameters were presented as means and SDs of means, and median values with minimum/maximum. The differences between the groups were analyzed using Mann-Whitney U test. Fisher's Exact Chi-square Test was used for comparing implant survival rates between the groups on a patient basis. A P value <0.06 was considered statistically significant.

Results

A total of 52 women with 245 dental implants who were approved by the inclusion criteria were included in the study. Patient demographics are listed. While Test Group included 27 subjects with a mean T-score of $-2,54 \pm 0,55$; Control Group included 26 subjects whose mean T-score was $-0,95 \pm 1,70$ being significantly lower than Test Group (P = 0,001). The mean age of the subjects in Test and Control Groups were determined as 60.62 ± 5.70 and 58.40 ± 5.20 , respectively and there was no statistically significant difference between the groups.

One hundred and twenty implants were placed in 27 osteoporosis/osteopenia subjects and 124 were placed in 26 control subjects; with an average of 4.61 ± 3.29 and 4.76 ± 2.14 implants per patient.

The mean follow-up period was 60.80 ± 22.16 and 60.07 ± 20.93 months in Test and Control Groups respectively. All of the implants were followed for at least 36 months. No significant differences were seen between the groups in terms of implant related factors. Figure (2).

Data regarding peri-implant soft tissue status and MBL are summarized in the table stated above.

There were no significant differences for PI, PD values, and the amount of MBL between the groups. Although the mean MBL in Test Group ($0.81 \pm 0,64$ mm) was higher than Control Group ($0.45 \pm 0,35$ mm), the difference was not found statistically significant (P = 0.069). Only BoP percentage of Test Group was sig-

Figure 2.

Implant Quality Scale Group	Clinical Conditions
I. Success (optimum health)	a) No pain or tenderness upon function b) 0 mobility c) <2 mm radiographic bone loss from initial surgery d) No exudates history
II. Satisfactory survival	a) No pain on function b) 0 mobility c) 2-4 mm radiographic bone loss d) No exudates history
III. Compromised survival	a) May have sensitivity on function b) No mobility c) Radiographic bone loss >4 mm (less than 1/2 of implant body) d) Probing depth >7 mm e) May have exudates history
IV. Failure (clinical or absolute failure)	Any of following: a) Pain on function b) Mobility c) Radiographic bone loss >1/2 length of implant d) Uncontrolled exudate e) No longer in mouth

Table 2.

	Total	Test group	Control group	P
Number of individuals (n)	52	27	26	
Age in years (mean ±SD)	59,51	60,61	57,42	0,166
T-score				
Mean ±SD	-0,97	-2,55	0,58	0,001
Median		-2,60	0,90	
Min/Max	-3,40/1,60	-3,40/-1,21	-0,80/1,60	

Table 3.

	Test group	Control group	P (P>0,05)
Number of participants	27	26	
Total number of implants	120	124	
Implant number per patient	4,62	4,75	0,326
Implant number per location			
Anterior mandible	22	8	
Posterior mandible	51	52	
Anterior maxilla	13	14	
Posterior maxilla	36	47	
Observation period (months)	60,80 ± 22,16	60,07 ± 20,93	0,935

Table 4.

Peri-implant soft tissue status and marginal bone level changes			
Peri-implant parameters	Test group	Control group	P
PI			
Mean ±SD	1,70±0,81	1,60± 0,80	0,496
Median (Min-Max)	2,00 (0,00-3,0)	1,63 (0,00-3,00)	
PD (mm)			
Mean ±SD	2,72±0,74	2,68± 0,65	0,906
Median (Min-Max)	2,90(1,00 -4,14)	2,79 (1,25-4,13)	
BOP (%of sites)			
Mean ±SD	70,58 ± 35,05	54,93 ± 30,08	0,025
Median (Min-Max)	78,10 (0-100)	58,33 (0-100)	
MBL (mm)			
Mean ±SD	0,81 ± 0,64	0,45 ± 0,35	0,069
Median (Min-Max)	0,81 (0,00 – 2,08)	0,38 (0,07 -1,32)	

Table 5.

	Total	Test group	Control group	P
Number of implants/ patients	244/52	120/27	124/26	0,326
Number of implants lost	1	1	0	
Survival rate	98,2%	96,3%	100%	0,313

Figure 3. A periapical radiograph showing the resorption around the implant.



nificantly higher than Control Group ($70.58 \pm 35.05\%$ and $54.93 \pm 30.08\%$ respectively).

The only implant failure was detected in a patient in Test Group resulting an overall implant survival rate of 98.1% on subject level at the 5-year follow-up. The implant supported a mandibular overdenture and was inserted in the region of the left mandibular canine. It was lost 2 years after implant placement and a new implant was successfully inserted 3 months after failure and no additional complication was encountered. No statistically significant difference was observed between the groups regarding the implant survival rates (96.3% versus 100% in Test and Control Groups, respectively; $P = 0,313$). Implant Survival Rate

Discussion

Since the average life expectancy is progressively increasing, patients need more dental implants. Long-term success and survival rates of Osseo integrated implants have been reported in a number of studies but it is controversial regarding the patients with Osteoporosis [18]. Many studies have suggested a possible relationship between periodontal disease and Osteoporosis; Figure (3) [38, 4, 29]. Although knowledge about the correlation between skeletal and mandibular/maxillary BMD in osteoporotic patients is scarce and an association between implant failure and osteoporosis has not been proved, osteoporosis has been proposed as a risk factor for implant failure [16, 3]. It has been considered to reduce the rate of bone-to-implant contact and the bone support because of decreased cancellous bone volume [6, 25]. On the other hand, there are studies reporting contrary results [14]. As a better understanding was required, this study was conducted to evaluate the effects of osteoporosis/osteopenia on long-term survival rates of dental implants/MBL in PW. In this retrospective study, after a mean follow-up of 60.50 ± 21.30 months, 2,0 % of all implants placed and 4,2% of implants in Test Group failed. MBL was 0.85 ± 0.69 mm and $0.47 \pm 0,35$ mm for Test and Control Groups respectively with no significant differences between the groups.

Osteoporosis has been defined as a decrease in bone mass and density and an increased risk of fracture [8]. Type 1 osteoporosis generally appears in PW aged over 50 as a result of decrease in estrogen levels and causes women to be susceptible to fracture [9]. WHO has defined diagnostic criteria for osteoporosis based on BMD measurements determined by DXA [15, 8, 34]. It is diagnosed as osteoporosis if the T-score, defined according to the BMD measurements at the hip or lumbar spine, is less than or equal to 2.5 standard deviations (SDs) below the mean of a young-adult reference population ($T\text{-score} \leq 2.5$). When the T-score is between -2.5 and -1 , then a diagnosis of osteopenia is made [Table 1]. Although DXA imaging has been proposed as the "gold standard" for diagnosis of osteoporosis, WHO definition has been criticized since it does not regard male T-scores and the T-scores of the skeletal bones in other parts of the body [7]. So updated guidelines recommend the use of BMD at both proximal femur and lumbar spine and choosing the lower one. While determining the osteoporotic status of patients, we used the lowest T-scores either of femur or lumbar spine in order to increase the susceptibility of WHO definition [20].

According to the American Academy of Periodontology, Osseo

integration is defined as a direct structural and functional contact without having a fibrous tissue between living bone tissue and an implant surface under loading [19]. Given that the amount and quality of bone at the implant recipient site is very important for a successful osseointegration, the effects of osteoporosis on implant success has been investigated in many studies up to now. In many studies osteoporosis was found to be significantly associated with early but not late implant failures [16, 5, 33]. Trullenque-Eriksson et al. assessed long-term outcomes of Osseo integrated dental implants and factors that may have influenced implant survival and MBL. They concluded that patients with osteopenia/osteoporosis presented implant failure more frequently. In this study 105 patients with 342 dental implants were included in the study but how many of them were diagnosed as osteopenia or osteoporosis is unknown so the power of the study is questionable [1]. A recently conducted systematic review with meta-analysis presented that while there was no difference in implant survival rate between patients with and without osteoporosis, MBL around implants revealed a significant difference [16].

On the other hand, there are studies reporting opposite results. In a review on osteoporosis, the evidence for an association between osteoporosis and implant failure was reported to be weak [3]. In another review, it was reported that osteoporosis has been shown to influence osseointegration in preclinical models but not in clinical studies [22, 35]. Holahan et al., demonstrated that osteoporotic status had not affected the survival rate of implants and osteoporosis was not regarded as a contraindication for implant therapy [18]. In another study it was suggested that osteoporotic status and systemic BMD were not associated with local jawbone quality [2]. Dvorak et al. assessed the success rate of dental implants in PW and concluded that PO was not a risk factor for implant loss and periimplantitis [12]. It was also shown that reduced skeletal BMD did not affect survival rate of implants supporting mandibular overdentures [10]. The high survival rate found in this study was attributed to exclusion of patients with risk factors such as smoking, uncontrolled diabetes and alveolar deficiencies as in our study. In the prospective study performed by Temmerman et al., [39] PW with osteoporosis/osteopenia were followed at 6 months and 1 year after functional loading. While the cumulative survival rates were not significantly different between the groups, there was a significant difference in MBL, being higher in osteoporosis/osteopenia group, after 1 year of functional loading. All of these results, except Temmerman's findings, are consistent with the results found in our study. Although amount of MBL in Test Group was higher than control subjects in our study, it was not statistically significant.

The effects of osteoporosis on implant implantation and on the osseointegrated implants should be considered as two separate topics. In this study, we examined the long-term implant success of dental implants inserted at least 3 years ago in PW retrospectively. Therefore, we both evaluated the effects of osteoporosis/osteopenia on implant implantation and on the osseointegrated implants. Besides date of insertion and functional loading, any implant failures were also recorded. When regarding the implant survival rates, the only failed implant was lost 2 years after implant placement so it can be concluded that osteoporotic status did not affect implant implantation or, in other words, osseointegration. On the other hand, although an implant was lost in Test Group resulting an overall implant survival rate of 98.1% on subject level, no statistically significant difference was observed between the

groups. It can also be concluded that osteoporotic status did not affect osseointegrated implants too.

Success of dental implants is generally described by implant survival but progressing MBL could risk the long-term survival. A surviving implant does not absolutely mean the maintenance of well-being, only shows that it has not been lost. Implant success criteria, regarding MBL and other parameters, are considered as the gold standard for implant success [32]. To evaluate the long-term prognosis of an implant, it is mandatory to calculate the amount of MBL for a follow-up period. So, in our study, along with survival rates, we evaluated the amounts of MBL which was less than the amount defined by Albrektsson et al.; figure (4) as implant success criteria [30].

Currently approved medications for the treatment of PO are calcium, vitamin D, bisphosphonates (BPs), hormone replacement therapy, selective estrogen receptor modulators, calcitonin, parathyroid hormone, denosumab, and strontium ranelate. Oral BPs are commonly prescribed pharmacological agents in the treatment of osteoporosis. Osteonecrosis of the jaw (ONJ) has been reported due to oral surgery, including dental implants in patients using BPs in many studies [24]. The likelihood of ONJ may vary depending on the dose, duration, route of administration and the type of BP. Oral BP usage for less than 5 years has been reported to be reliable for dental procedures, particularly for dental implants. It was stated that especially intravenously administered BPs should be considered as a contraindication for dental implant therapy [23]. In the literature, it was reported that more than 90% of the ONJ cases had been seen in patients receiving intravenous BP, while cases in patients using oral BP were scarce. The American Association of Oral and Maxillofacial Surgeons has suggested to stop usage of BPs 3 months before and after oral surgery in patients using BPs for more than 3 years [13]. Only a few of the subjects, six of 26 patients in Test Group (23.07%) in the present study were treated with BPs. Three of them have been rehabilitated with implants after they had given up using the drug. Two of the subjects started BP therapy after implant installation and only one patient was on BP treatment during surgery. All of the subjects using BP were orally administered. Six of the remaining patients were treated with calcium supplementation, one with vitamin D and calcium and one with calcium, vitamin D and denosumab. Since two patients told that they did not receive any treatment and the rest was unknown, pharmacologic agents were not considered and not included in statistics in this study. The only one subject in Test Group who lost one implant was using calcium, vitamin D and denosumab which is a human monoclonal antibody. Although denosumab has been reported to be associated with ONJ, [26] the association of this new therapy is unclear so it is questionable to attribute the only detected failure to the medication used by the patient. Perhaps this failure might be due to the type of prosthetic superstructure since higher implant failure for overdentures, that are generally preferred in complex cases, was reported [36].

One of the limitations of this study was that all subjects were not diagnosed as osteoporosis; a larger number of patients with osteoporosis rather than osteopenia would be beneficial. Seventeen of the subjects were diagnosed as osteoporosis and nine of them were diagnosed as osteopenia according to their T-scores. Since T-scores of the subjects did not show normal distributions, the data for this parameter was presented as means and SDs of

means, and median values with minimum/maximum. While mean value was $-2,55 \pm 0,53$; minimum and maximum values were $-1,20$ and $-3,40$, respectively. Information about the duration of being diagnosed as osteoporosis/osteopenia is unfortunately not enough. We only know the duration of 15 subjects and the rest is unknown. The average duration of being osteoporosis/osteopenia for these patients is 10 years. Another limitation was the lack of knowledge about the medications used by the subjects. Pharmacologic agents, that are often prescribed in osteoporotic patients, may have an effect on the peri-implant bone. Since we could not obtain sufficient information about the medications, pharmacologic agents were not considered.

Conclusion

The main goal of this study was to determine if dental implants were a safely preferable treatment choice for patients with osteoporosis/osteopenia. The present study shows that PO and reduced BMD does not affect long-term success of implants. Based on the results of this study and alongside with recent studies, it can be concluded that dental implant therapy is a preferable option and a diagnosis of osteoporosis/osteopenia is not a contraindication in these patients.

Out the duration of being diagnosed as osteoporosis/osteopenia is unfortunately not enough. We only know the duration of 15 subjects and the rest is unknown. The average duration of being osteoporosis/osteopenia for these patients is 10 years. Another limitation was the lack of knowledge about the medications used by the subjects. Pharmacologic agents, that are often prescribed in osteoporotic patients, may have an effect on the peri-implant bone. Since we could not obtain sufficient information about the medications, pharmacologic agents were not considered.

Declarations

Ethics approval and consent to participate

The authors certify that they have obtained all appropriate patient consent forms. In the form the patient(s) has/have given his/her/their consent for his/her/their images and other clinical information to be reported in the journal. The patients understand that their names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed. Ethical approval was obtained from the ethics committee at the Ministry of Higher Education in Syria. Written informed consent was obtained from each participant in this study.

Competing interests

The authors declare that they have no competing interests

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The study was self-funded.

Authors' contributions

Wasim alsadi conducted the study in damascus, analyzed the results wrote a report on the survey, sent them to Haya al jabban,

who drafted this manuscript and corrected and revised the final version.

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Availability of data and materials

Once published, the data and material in this paper can be obtained from the authors.

Consent for publication

As mentioned above, all the authors have read and approved the final version of this manuscript. No clinical images or details of the participated are included in the manuscript and their anonymity has been preserved.

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