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Original Research Article

Narrow Unitary Implants (3.3 MM) and Reduced Platform (3.0) in Molars for Cases of Reduced Mesiodistal Space

Eduardo Anitua, DDS, MD, PhD[1,2,3*]

[1]Private Practice in Oral Implantology, Eduardo Anitua Institute, Vitoria, Spain
[2]Clinical Researcher, Eduardo Anitua Foundation, Vitoria, Spain
[3]University Institute for Regenerative Medicine and Oral Implantology- UIRMI (UPV/EHU-Fundación Eduardo Anitua), Vitoria, Spain

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***Corresponding author:** Eduardo Anitua
Eduardo Anitua Foundation; C/ Jose Maria Cagigal 19, 01007 Vitoria, Spain

Abstract

Introduction: The rehabilitation of areas with localized horizontal atrophy in the molar region or with reduced interdental spaces using dental implants is challenging. In many cases, horizontal regeneration must be performed prior to implant placement, which increases the morbidity of the procedure, particularly considering it involves a unitary implant. For these situations, narrow-diameter implants with reduced platforms offer a viable solution to address localized atrophies successfully. This case series demonstrates situations resolved with these implants in a safe and predictable manner. ***Materials and Methods:*** Narrow implants with a diameter of 3.3 mm and a narrow platform (3.0 mm) were prospectively analyzed. These implants were placed in molar positions and rehabilitated as single-unit restorations in cases of localized horizontal atrophy with reduced mesiodistal spaces, avoiding the use of regenerative techniques to restore lost width. The primary variable evaluated was implant survival, followed by crestal bone loss and the occurrence of surgical or prosthetic complications during the follow-up period. Qualitative variables were described using frequency analysis, while quantitative variables were summarized using mean and standard deviation. Implant survival was estimated using the Kaplan-Meier method. ***Results:*** Thirteen patients were recruited, receiving a total of 15 implants that met the inclusion criteria. Of these, 73.3% were placed in the mandible, with position 46 being the most frequent location. All the implants studied had a diameter of 3.3 mm with a platform of 3.0 mm and were placed for unitary molar rehabilitation, using screw-retained crowns supported by single abutments. Implant lengths were 5.5 mm in 33.3% of cases and 6.5 mm in the remaining 66.7%. The mean mesial bone loss at the end of the follow-up was 0.49 mm (+/- 0.21), while the mean distal bone loss was 0.43 mm (+/- 0.28). ***Conclusions:*** Narrow-platform (3.0 mm) and reduced-diameter implants can be placed in molar regions and rehabilitated as single-unit restorations in cases of localized horizontal atrophy, reduced interproximal spaces, or both factors combined, with favorable outcomes.

Keywords: Dental Implants, Narrow-Diameter Implants, Molar Rehabilitation, Horizontal Atrophy, Implant Survival.

INTRODUCTION

Narrow-diameter implants with reduced platforms were initially developed for clinical cases with mesiodistal limitations, both surgically and prosthetically, and were predominantly used for teeth with low biomechanical demands, such as maxillary lateral incisors or mandibular incisors [1,2]. Over time, advancements in research and technological development have expanded their applications, making them a predictable option for addressing horizontal bone atrophy [4,5]. These indications now include localized width defects as well as edentulous maxillae and mandibles with moderate to severe atrophy [6,7].

Improvements in implant designs and the scientific evidence generated from biomechanical load studies have enabled their safe use in a broader range of clinical cases without compromising the survival of the rehabilitation [6-9]. However, certain implants with diameters smaller than 2.5 mm and internal connections are indicated exclusively for specific scenarios, avoiding unitary loading [10,11]. Narrow-diameter implants are generally limited to areas with low masticatory demand [12,13]. Nonetheless, in posterior maxillary or mandibular regions, where mesiodistal space is limited or combined with horizontal bone atrophy, narrow implants may be necessary for unitary molar rehabilitation [14-17].

Systematic reviews have reported survival rates exceeding 90% for implants with diameters less than 3 mm in follow-ups of 1 to 3 years, increasing to 93.8% for implants with diameters between 3 and 3.25 mm over follow-up periods of 1 to 5 years [7,8,18]. However, these studies exhibit significant sample heterogeneity, with unitary implants of these dimensions constituting a minority among the rehabilitations analyzed. Despite these limitations, there is consensus on the importance of proper surgical and prosthetic planning, as well as the need to preserve the biology of the recipient bed through careful drilling that minimizes tissue damage and promotes osseointegration [19-21].

The design of narrow platforms has been shown to be a crucial factor in long-term biomechanical performance and the prevention of crestal bone loss. These smaller platforms reduce cortical bone compression during implant insertion and the initial osseointegration phase, a critical region due to its low vascularization and high density [10-11,22]. This area supports the greatest functional load after implant integration, increasing its susceptibility to marginal bone loss [22-25].

Thus, narrow-diameter implants with reduced platforms offer a predictable solution for horizontal bone atrophy rehabilitation, both for unitary and multiple restorations, although more clinical cases have been reported with splinted implants. Furthermore, the long-term success of these implants depends on meticulous planning, appropriate surgical protocols, optimized designs that ensure bone preservation and minimize biomechanical complications, and careful case selection when placed as single units.

In the present case series, we analyze the behavior of 3.3 mm-diameter implants with 3 mm platforms when inserted as single units in molar regions with reduced mesiodistal space and localized horizontal bone atrophy, to assess long-term bone loss, survival rates, and potential surgical or prosthetic complications encountered from insertion to the end of follow-up.

MATERIALS AND METHODS

Narrow implants with a diameter of 3.3 mm and a narrow platform (3.0 mm) placed in molar positions for unitary rehabilitation were prospectively analyzed in cases of localized horizontal atrophy with reduced mesiodistal spaces. The use of regenerative techniques to restore lost width was avoided. These cases were treated between December 2019 and December 2021 at a private clinic in Vitoria, Spain.

Before implant placement, antibiotic premedication consisting of 2 g of oral amoxicillin and 1 g of oral paracetamol (as an analgesic) was administered one hour before the procedure. Afterward, patients continued with amoxicillin 500-750 mg orally every 8 hours (adjusted by weight) for 5 days. All patients were assessed preoperatively using diagnostic models, an intraoral examination, and dental cone-beam computed tomography (CBCT), which was analyzed with specific software (BTI-Scan III).

Implant placement was performed by the same surgeon using the biological drilling technique at low speeds without irrigation (26-28). To estimate marginal bone loss, a known reference length on radiographs (the length of the implant) was used to calibrate the measurements. Once calibrated, the software (Digora for Windows, SOREDEX Digital Imaging systems) calculated actual measurements. Crestal marginal bone loss was determined by measuring from the implant shoulder to the first point of bone-implant contact. Radiographs taken at the time of prosthesis insertion served as the baseline for comparing subsequent records to estimate bone loss for each patient.

Patients attended follow-up appointments every six months, during which new control radiographs were taken. Postoperative follow-up visits and post-prosthesis placement records documented any surgical or prosthetic complications, which were subsequently analyzed.

Statistical Analysis

The Shapiro-Wilk test was used to verify the normal distribution of the data. The primary variable evaluated was implant survival, followed by crestal bone loss and the occurrence of surgical or prosthetic complications during the follow-up period.

Qualitative variables were described using frequency analysis, and quantitative variables were summarized with mean and standard deviation. Implant survival was calculated using the Kaplan-Meier method. Data analysis was conducted using SPSS v15.0 for Windows (SPSS Inc., Chicago, IL, USA).

RESULTS

Thirteen patients were recruited, receiving a total of 15 implants that met the aforementioned inclusion criteria. Two patients were male, and the mean age at the time of implant placement was 71.88 years (+/- 8.10). Of the implants, 73.3% were placed in the mandible, with position 46 being the most common location. The locations of all studied implants are shown in Figure 1.

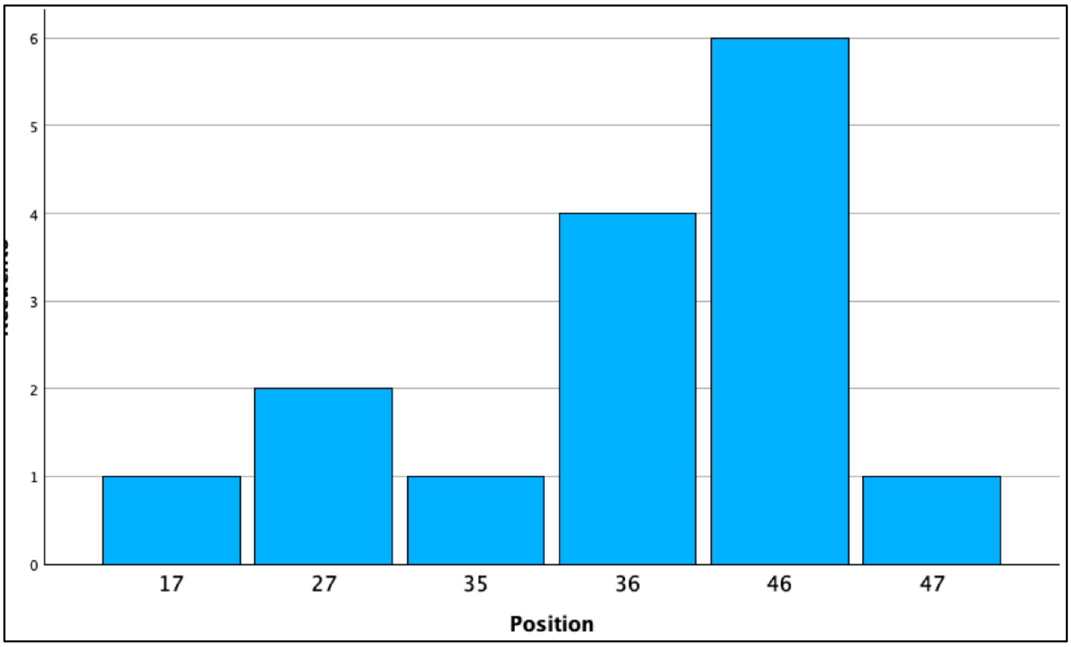

Figure 1: Positions of the implants included in the study

All the implants studied had a diameter of 3.3 mm with a platform of 3.0 mm and were placed for unitary molar rehabilitation using screw-retained crowns with unitary abutments. Implant lengths were 5.5 mm in 33.3% of cases and 6.5 mm in the remaining 66.7%. Both lengths were distributed similarly across the rehabilitated molars, as shown in Figure 2.

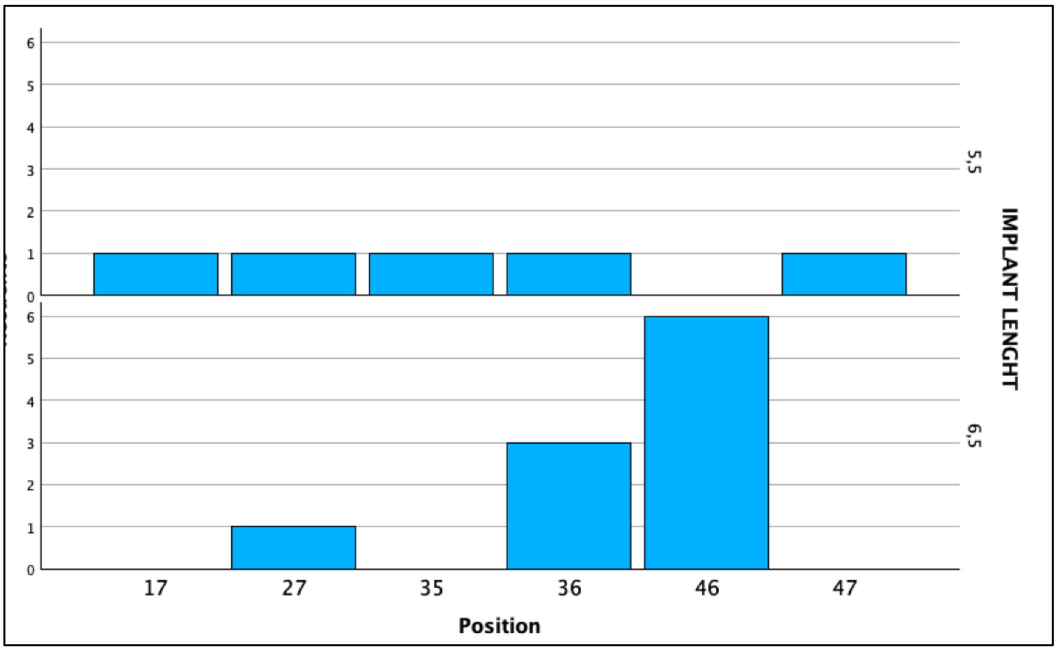

Figure 2: Implant lengths based on the position where they were placed

The mean residual ridge width at the implant insertion site was 4.17 mm (+/- 0.29), and the mean mesiodistal prosthetic distance for implant rehabilitation was 5.81 mm (+/- 0.74).

The bone quality at the implant insertion site varied, with type I and type II bone in 33.3% of cases each, type III in 20%, and type IV in 13.3%. The mean bone density across all cases was 758.56 HU (+/- 347). The mean insertion torque measured with a torque wrench was 40 Ncm (+/- 16.90). Torque values by bone type and implant position for all studied cases are shown in Figure 3.

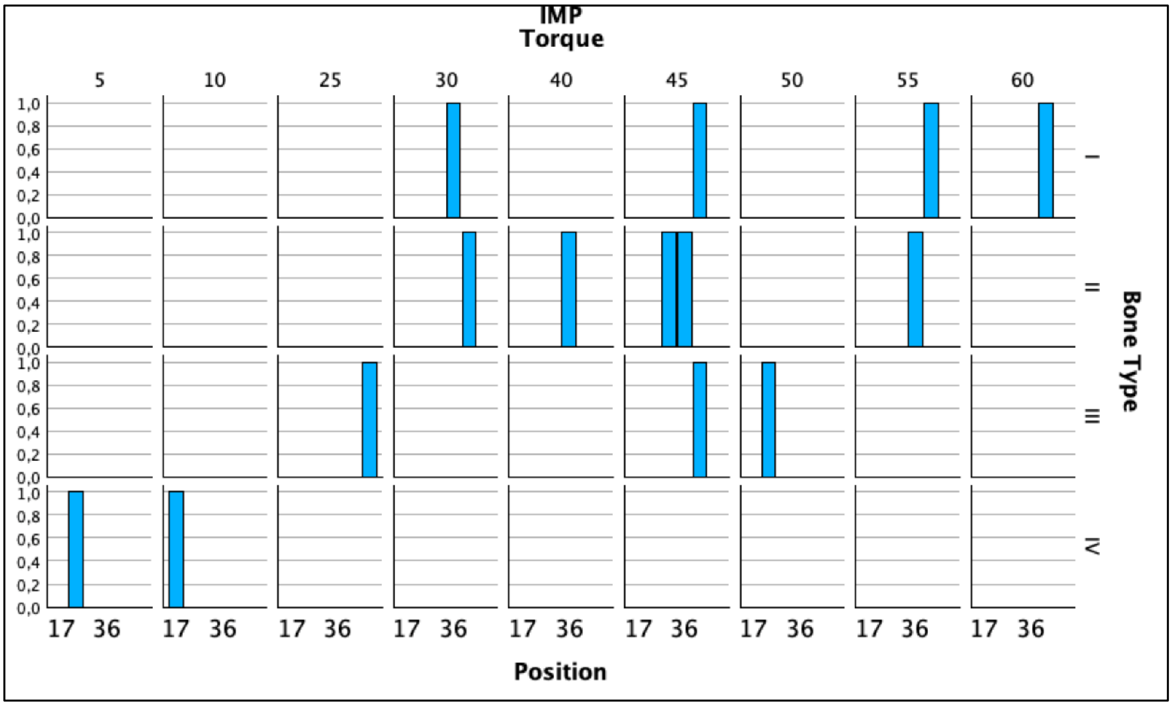

Figure 3: Insertion torque according to bone type and implant position

The mean follow-up period for the implants was 23.78 months (+/- 10.26), ranging from 12 to 45.3 months. During this time, no implant failures or surgical or prosthetic complications were reported in any of the cases. The mean mesial bone loss at the end of follow-up was 0.49 mm (+/- 0.21), and the mean distal bone loss was 0.43 mm (+/- 0.28).

Figures 4–12 illustrate one of the cases included in the study.

Figure 4: Initial radiographic image of the patient showing the loss of a first upper left molar in a prior situation of agenesis of position 35, where the lower third molar has mesialized. Additionally, advanced periodontal disease and a molar in the fourth quadrant in position 48 with a poor prognosis are observed

Figure 5: Intraoral image of the available prosthetic space at position 36, which, as shown, is reduced

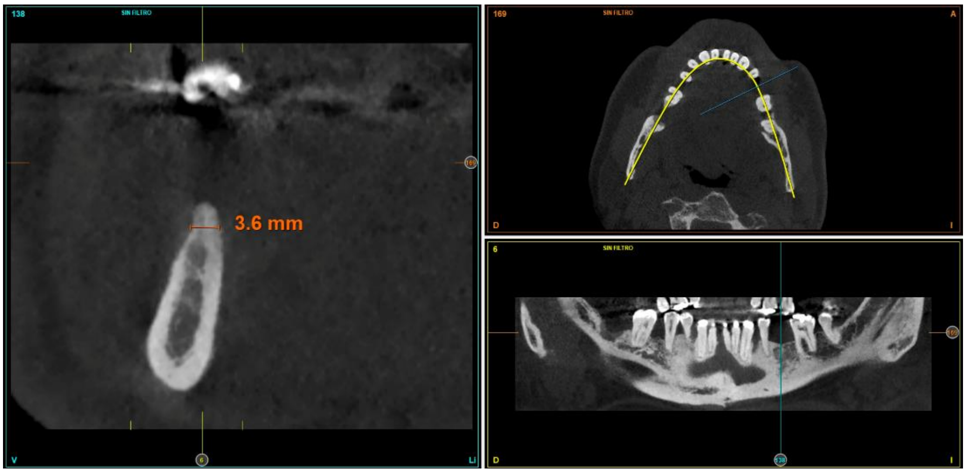

Figure 6: Cone-beam planning scan showing severe horizontal atrophy at this level, with 3.6 mm in the uppermost area of the ridge. A 3 mm platform, like the planned 3.3 mm implant, is highly recommended to avoid excessive bone compression at this level with a wider platform

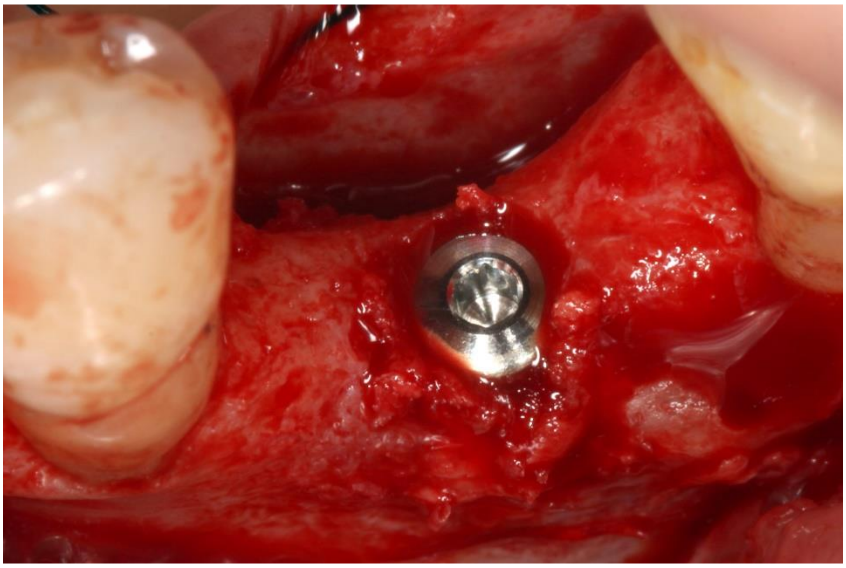

Figure 7: Implant placement with slight expansion mediated by implant insertion and vestibular overcorrection using autologous bone obtained during drilling, combined with PRGF-Endoret

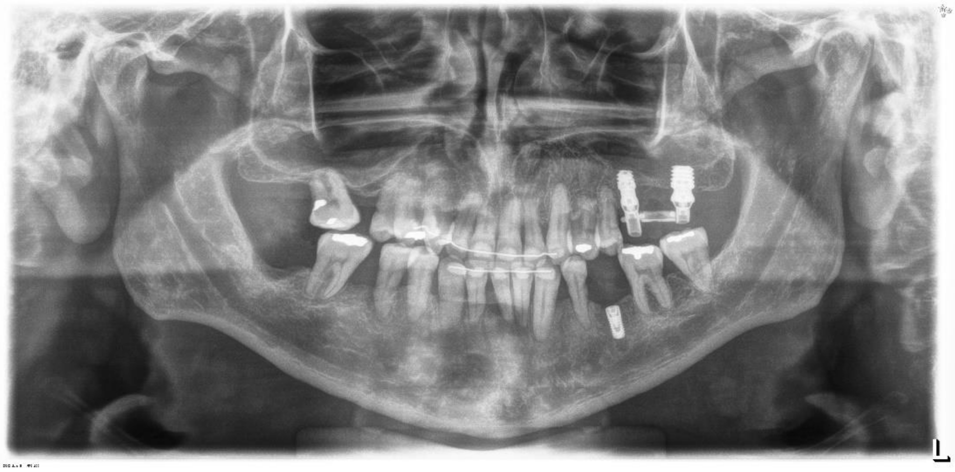

Figure 8: Immediate postoperative condition following implant placement

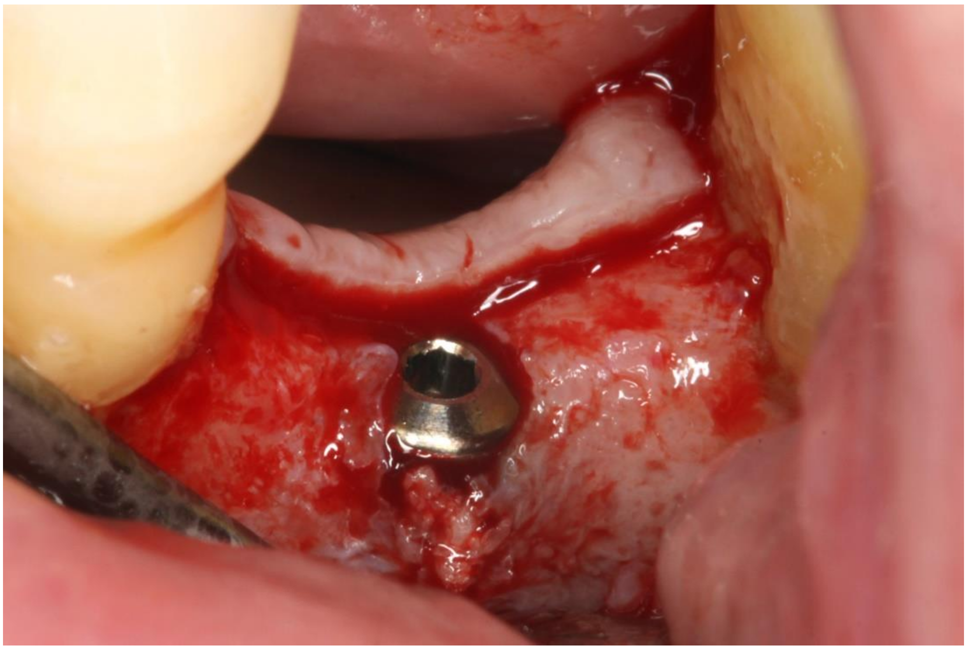

Figure 9: Re-entry at 3 months for the second phase, showing complete integration of the implant and the particulate graft placed in the vestibular region

Figure 10: Crown placement using a single-unit trans-epithelial abutment and interface

Figure 11: Intraoral detail of the crown at the time of placement and occlusal adjustment

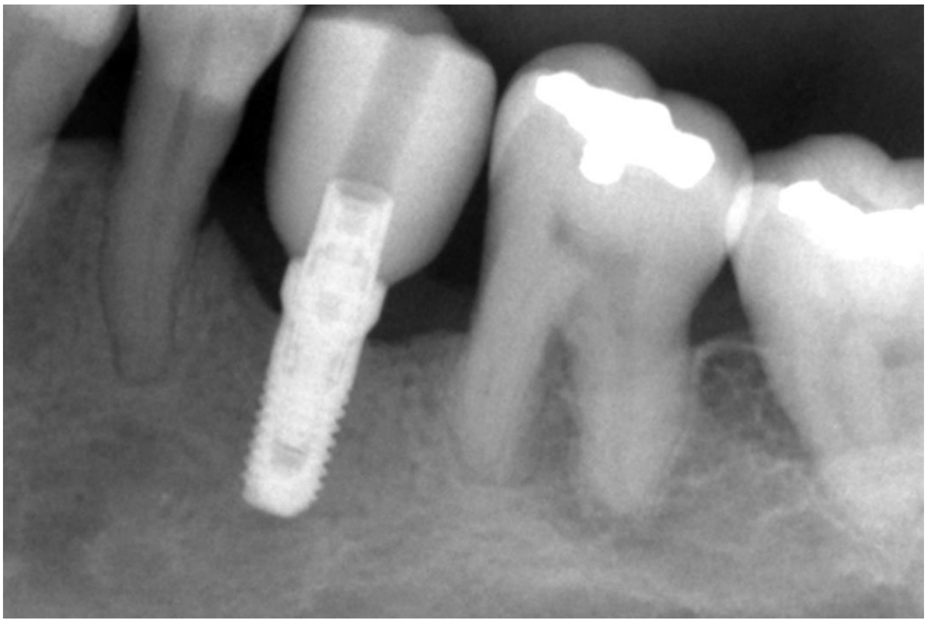

Figure 12: Radiograph after 4 years of case follow-up, demonstrating complete stability of the treatment and control of periodontal disease through regular patient maintenance

DISCUSSION

The use of narrow-platform, reduced-diameter implants, with lengths ranging from 5.5 to 7.5 mm, has become increasingly popular as an effective solution for treating both localized and extensive horizontal atrophies. This approach avoids complex regenerative procedures, which typically require multiple surgical interventions and, consequently, entail greater morbidity for the patient [29,30]. Among implants categorized as narrow or reduced-diameter, those with a diameter of 3.3 mm occupy an intermediate position, with smaller-diameter implants (ranging from 2.5 to 3 mm) and larger diameters (3.5 mm) also included in this group [7]. According to the available literature, implants with a 3.3 mm diameter achieve a survival rate of 97.3% ± 5% over an average follow-up of 29 ± 17 months [18]. These implants are primarily used for single-tooth restorations of lateral incisors with agenesis or mandibular incisors, while their use in other anatomical regions is less common [12-13,32].

It is worth noting that in many studies, implants with a 3.3 mm body diameter feature platforms of the same or larger diameter. The cases presented in this study are notable for using implants with a smaller platform (3 mm). Additionally, the case series examined here includes implants with lengths of 5.5 and 6.5 mm. This choice reflects the frequent coexistence of horizontal and vertical atrophies (combined atrophy) or the deliberate use of the shortest effective implant length, adhering to our philosophy of preserving the recipient bed and using the minimum bone tissue necessary for implant placement. This approach results in a better-vascularized bed, which is critical in cases with severe horizontal atrophy like those shown here, and allows for reversibility in future retreatments if necessary [17,33]. Data on short and ultra-short implants with reduced diameters support this methodology.

In a prospective study by our group (19), the clinical behavior of short (≤8 mm) and reduced-diameter (≤3.5 mm) implants was compared with narrow, longer implants (>8 mm) in fixed prosthetic rehabilitations in atrophic maxillae. The sample included 41 implants placed in 24 patients, with an average follow-up of 26 months. Results demonstrated a 100% survival rate and low, comparable levels of marginal bone loss between the two groups [17].

International literature offers limited data analyzing the behavior of narrow-platform, reduced-diameter implants rehabilitated as single units in molar regions. In the study by Al-Aali *et al.*, published in 2019 (34), the performance of narrow implants rehabilitated as single units and splinted units in various posterior locations was evaluated. The study included 43 single-unit implants and 59 splinted implants, finding no statistically significant differences in bone loss between the two groups. However, greater crestal bone loss was observed in molars rehabilitated as single units compared to premolars. In that study, as in ours, the implant diameter was 3.3 mm, though the lengths used were greater (between 10 and 12 mm).

Similarly, the study by Shi *et al.*, [35] evaluated narrow implants with a 3.3 mm diameter placed in premolar and molar locations, with an extended follow-up of 8 years. However, only 5 single-unit implants out of a total of 98 were analyzed. This study reported high implant survival rates, reaching 96.9% at the implant level and 97% at the patient level, suggesting that narrow implants in molar regions are a viable therapeutic option. Despite these results, further scientific evidence evaluating their use specifically in single-unit rehabilitations is needed.

Comparing reduced-diameter implants with conventional-diameter implants in molar regions with severe horizontal atrophy requires careful consideration of the surgical protocol and implant type, as well as the specific characteristics of the patients. In this context, the study by de Souza *et al.*, (36), using a split-mouth randomized clinical trial, standardized patient-dependent variables. This study compared reduced-diameter (3.3 mm) and conventional-diameter (4.1 mm) implants for single molar rehabilitations. The sample included 22 patients and 44 implants (22 narrow and 22 conventional). No statistically significant differences were found in crestal bone loss, peri-implant probing, or survival rates. However, narrow implants exhibited a slightly lower survival rate (90%) compared to conventional-diameter implants (95%).

In the present study, a 100% survival rate was achieved with a mean follow-up of two years. This outcome is noteworthy given that the implants used were not only narrow but also featured a smaller platform (3 mm) than those in the studies mentioned, where the platform matched the implant diameter. Additionally, the analyzed implants were short. The application of a carefully adapted drilling protocol to the bone bed, along with the use of appropriate prosthetic restorations with single-unit abutments, may explain the high survival rates observed and the minimal crestal bone loss recorded.

In this study, the average crestal bone loss was 0.46 mm, significantly lower than that reported in the study by Shi *et al.*, (1.19 mm) [35], Al-Aali *et al.*, (1.14 mm) [34], and similar to the findings of de Souza *et al.*, (0.58 mm) [36].

CONCLUSIONS

Narrow-platform (3 mm) and reduced-diameter implants can be placed in molar regions and rehabilitated as single units in cases of localized horizontal atrophy, reduced interproximal spaces, or a combination of these factors, with favorable outcomes. However, careful case selection and proper implant placement and rehabilitation protocols are critical factors associated with the success of this type of treatment. Further studies evaluating these restorations over longer follow-up periods are needed to confirm the findings of this study.

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