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One-year clinical and radiographic outcome of Titanium-Zirconium implants in partially edentulous ridges

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Introduction

High implant survival rate (>90%) and long term reliability of implant supported prostheses are reported for the rehabilitation of partial edentulous patients using regular/wide implants[1, 2, 3]. It is a general recommendation to use wider implants for the rehabilitation of posterior edentulous jaws. However, in some circumstances it's impossible to place regular/wide implants without additional reconstructive/regenerative procedures. Alternatively, narrow implants may and has been used avoiding the need for reconstructive procedures, but with higher risk of "fatigue" fracture[4, 5, 6].

The most recent titanium alloy, a titanium-zirconium alloy (83-87% Ti, 13-17% Zr, weight) has been introduced by Institut Straumann to produce narrow diameter (3.3 mm) implants, the Roxolid implants. Biomechanical test has shown higher resistance to load when compared to standard 4.1 mm diameter titanium implants[7, 8].

Marginal bone level maintenance is one of the most significant parameters undergoing observation and comparison when evaluating both the survival rate and clinical success of implant therapy. The maintenance of bone levels in radiographs indicates integration of implant with surrounding tissues[2, 9].

The aim of the present study was to assess the clinical and radiographic (change in crestal bone level from implant placement to 12 months) outcome of Straumann 3.3 mm Roxolid® Bone Level implants in the treatment of partially edentulous ridges of adequate bone height but limited bucco-lingual and/or mesio-distal distance.

Materials and Methods

As a part of a non-interventional prospective cohort study, 31 Roxolid® Bone Level implants were inserted into 21 consecutive patients and restored with single crowns or two-unit fixed partial dentures. No specific patient inclusion or exclusion criteria were applied to select patients, other then general indications/ contraindications for implant therapy. All patients gave written informed consent to the study.

Clinical and radiographic examinations were carried out immediately after implant placement (baseline) and 12 months postoperatively (primary endpoint); periapical standardized digital radiographs were taken to evaluate changes in crestal bone level. An independent experienced oral radiologist, outside of the center, performed all digital intraoral radiographs analysis.

Implant success rate (SC), survival rate (SR), peri-implant conditions and prosthetic complications were assessed as secondary variables.

Statistical analysis was performed using SSPS20® (IBM®). Bone loss was regarded as main outcome; non-parametric tests were used due to sample size. Non-parametric MANOVA was used to analyze multiple independent variables on bone loss; Mann-Whitney and Kruskal-Wallis tests were used to compare two or more independent variables on mesial or distal bone loss. The level of significance was $p<0.05$.

Results

All implants were stable and functional at the 1-year visit and presented no prosthetic complications, normal, pink and fixed soft tissues (Figs 5 and 6) (except one patient swollen gingiva) with a survival rate of 100%. The mean change (Figs 1 and 2), after 1 year, in bone loss was 1.3 ± 1.09 mm and 1.11 ± 0.93 mm and in functional bone loss was 0.50 ± 0.81 mm and 0.56 ± 0.82 mm (mesial and distal, respectively). Three patients had perimplantitis and were treated successfully until the control of pathology without affecting implant survival.

There was a statistically significant influence of bone type on bone loss mesial (Mann-Whitney and Kruskal-Wallis p=0.028) (Fig. 3); the presence of another implant in vicinity was statistically significant on overall functional bone loss (MANOVA p=0.030) (Fig. 4) .

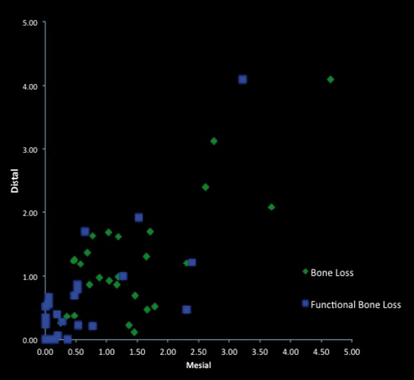


Fig. 1. Scattered mean bone loss and functional bone loss

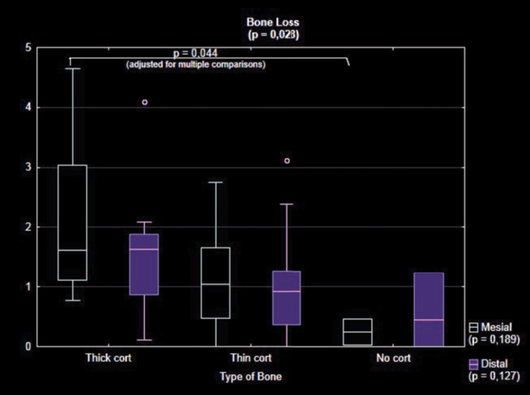


Fig. 3. Influence of bone type on bone loss

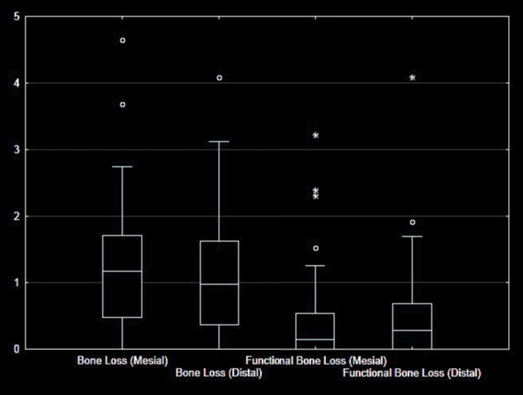


Fig. 2. Boxplot of bone loss and functional bone loss (mesial and distal)

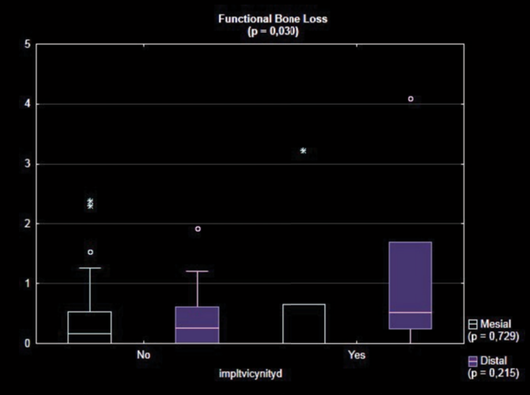
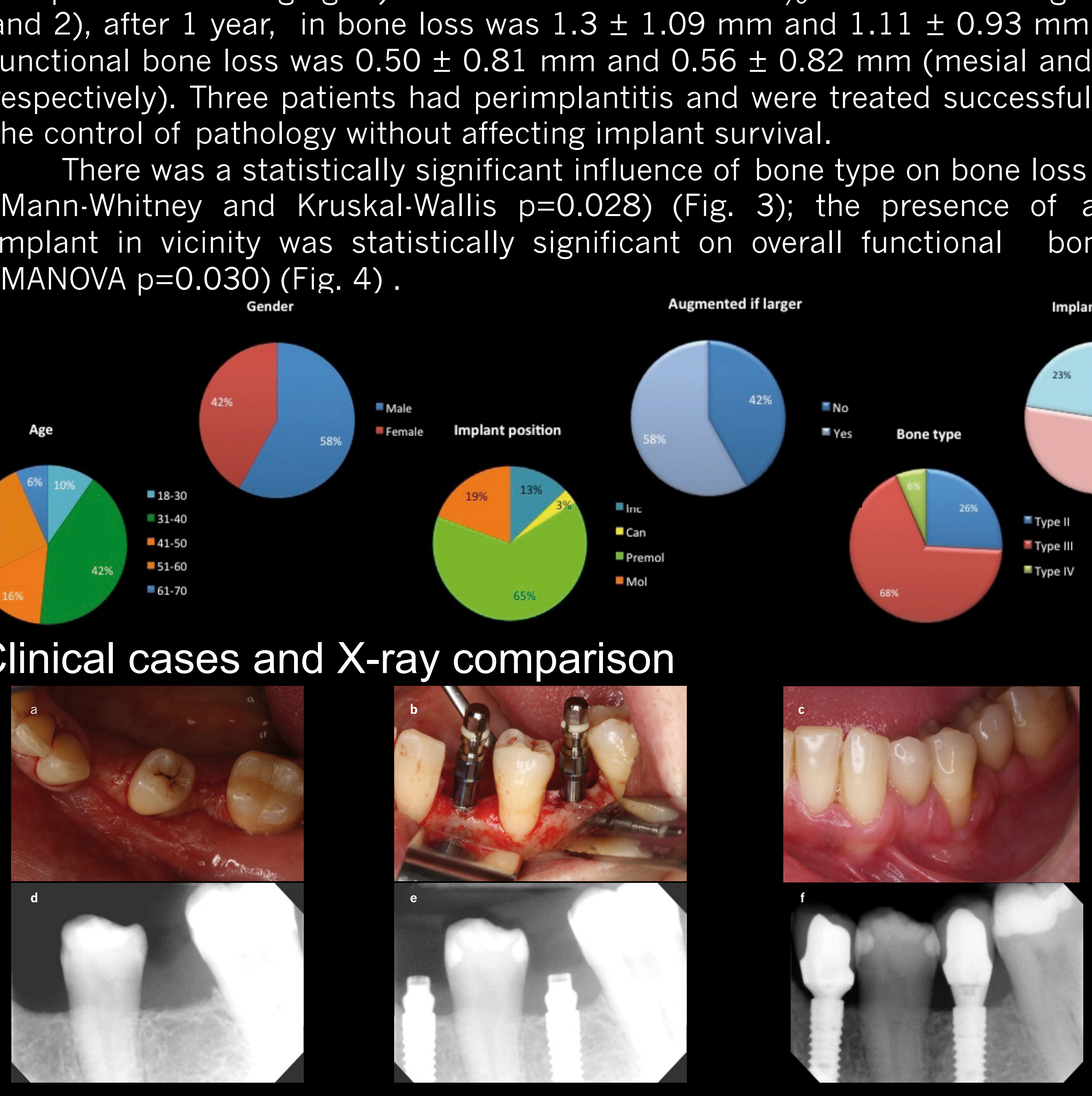


Fig. 4. Influence of implant in vicinity on functional bone loss



Clinical cases and X-ray comparison

Fig. 5. Case 1: placement of two Roxolid® BL implants (length 10 mm) at positions 34 and 36 (FDI); (a) pre-op; (b) implant placement; (c) 1-year follow-up, cemented metal-ceramic crowns; (d-e) radiographic control pre-op, at implant placement and at 1-year follow-up.

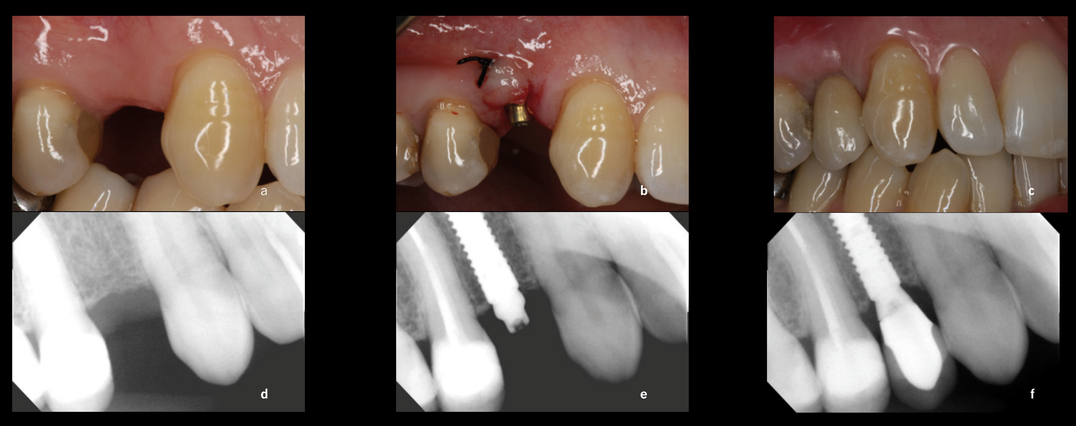


Fig. 6. Case 2: placement of one Roxolid® BL implant (length 12 mm) at position 14 (FDI); (a) pre-op; (b) implant placement; (c) 1-year follow-up, cemented metal-ceramic crown; (d-e) radiographic control pre-op, at implant placement and at 1-year follow-up.

Discussion

Marginal bone level changes are one of the most common outcome criteria used to evaluate implant therapy. Bone remodeling starts with implant placement and continues throughout the lifetime of the implant. It's accept that major bone changes occurs early in time and should be differentiated from the marginal bone loss that may continue during function[1,2,9,10]. Reported values for marginal bone changes from implant placement (baseline) to 1-year follow-up ranged from 1.74 ± 0.36 mm (Astrand[1]) to 1.20 ± 0.78 mm (Ho[11]); lower values were reported for marginal bone changes when abutment connection was set as baseline (0.16 ± 0.42 mm Barter[4]; 0.2 ± 0.4 mm/ 0.25 ± 0.36 mm Liaje[12]). In the present study mean change in marginal bone loss was 1.20 ± 1.01 mm from baseline to 1-year. The reason for this value was that both major early bone change and post-load minor bone loss were included in it, so it actually represent the total bone loss. However, if only bone changes bellow the borderline of SLActive surface was considered and all remodeling above it was subtracted, mean functional bone loss of 0.53 ± 81 mm should be reported. Excluding data related to the perimplantitis cases, revealed as outliers and extremes by statistical analysis, the corrected mean change in functional bone was 0.33 ± 0.51 mm. these results are in accordance with the success criteria proposed by Albrektsson[13].

It seems that bone type may influence bone loss (type 4> Type 3> Type 2; p=0.028); one possible explanation may be that surgical trauma expose weaker bone from narrow ridges with thin cortical to greater stresses. Adjacent implants seem also to be determinant on marginal bone loss (p=0-030); very limited mesio-distal space may result in confluent remodeling that thin ridges can not counteract.

There was no prosthetic problems and perimplant soft tissues were clinically normal. Survival rate was 100% both for implants and prostheses.

Conclusions

Within the limits determined by this case series study and short follow-up period, the performance of Roxolid® Bone Level implants was safe and reliable in daily practice conditions. This implant seems to be useful for the rehabilitation of narrow ridges, frequently avoiding the need for bone regeneration procedures and may bear mechanical stresses from loading conditions in posterior areas of the jaws.

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