Evaluation of labial bone thickness of implants placed with or without simultaneous guided bone regeneration using CBCT scanning after at least one year in function

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Introduction

Simultaneous guided bone regeneration (sGBR) at the time of implant placement has been advocated in the aesthetic zone to achieve optimal aesthetic outcome[1]. The grafted material is expected to regenerate missing bone, prevent excessive resorption around the implant and maintain the alveolar contour. This procedure is costly, carries associated morbidity and it's aim to regenerate bone volume quantitatively has no evidence linking it to aesthetic outcome[2].

Immediate implant placement (Type 1) has often been associated with sub-optimal aesthetic outcome with increased mucosal recession which has been attributed to insufficient thickness of the labial bone wall. Around 50% reduction in the width of buccal ridge dimension has been reported in Type 1 implants[3]. Resorption of the bundle bone after tooth extraction has a significant role to play in this remodelling process which immediate implants have failed to prevent[4,5].

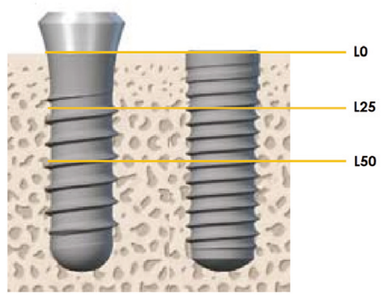
Aims

To evaluate the labial bone thickness with or without simultaneous guided bone regeneration around single tooth implants after at least one year in function using cone beam CBCT imaging. Furthermore, the influence of timing of implant placement on the labial bone thickness was evaluated.

Materials & Methods

46 single tooth implant restorations in the maxillary aesthetic zone (inter-canine) with at least 12 months post-loading follow-up period were evaluated using CBCT scans. Rough hydrophilic (Straumann SLActive) implants placed without guided bone regeneration (non-GBR) were compared to the ones placed with sGBR using deprotinized bovine bone and porcine collagen membrane.

Two experienced radiologists measured the labial bone thickness (LBT) on CBCT scans at three different points along the implant length (i) L0 – identified as the shoulder in a bone level (BL) and the SLA junction in a tissue level (TL) implant; (ii) L25 - 25% and; (iii) L50 - 50% of the implant length. The groups were further subdivided based on Type 1, Type 2 and Type 4 placement protocols for comparison of LBT.



Results

Mean age of patients was 33y. Mean time from surgery to CBCT was 3.7y (max. 5.6y). The inter-examiner reliability was confirmed (r>0.8).

Mean LBT (SD) in Type 1 placement protocol at L0, L25 and L50 for nonGBR were 0, 0.8(0.4), and 1.3(0.8)mm respectively in comparison to 1.1(0.8), 1.8(1), and 2.1(0.9)mm for the sGBR group. The differences for L0 and L25 were statistically significant ($p<0.05$).

In Type 2 placement the mean LBT at L0, L25 and L50 were 1.2(0.7), 0.9(0.5), and 0.5(0.4)mm respectively in the non-GBR group and 1.6(1.3), 2.5(0.9), and 2.1(1.3)mm for the sGBR group. The differences for L25 and L50 were statistically significant.

In Type 4 placement the mean LBT at L0, L25 and L50 were 0.6(0.7), 1.3(0.5) and 1.2(0.7)mm respectively in the non-GBR group and 1.1(1), 2(1.1) and 2.2(0.8) mm for the sGBR group. The differences at L0 and L50 were statistically significant.

Type 2 had greater LBT than Type 1 particularly in cases with dehiscence or fenestrations.

	No GBR			sGBR		
	L0	L25	L50	L0	L25	L50
Type 1	0	0.8 (0.4)	1.3 (0.8)	1.1 (0.8)	1.8 (1.0)	2.1 (0.9)
Type 2	1.2 (0.7)	0.9 (0.5)	0.5 (0.4)	1.6 (1.3)	2.5 (0.9)	2.1 (1.3)
Type 4	0.6 (0.7)	1.3 (0.5)	1.2 (0.7)	1.1 (1.0)	2.0 (1.1)	2.2 (0.8)

All measurements in mm (SD)

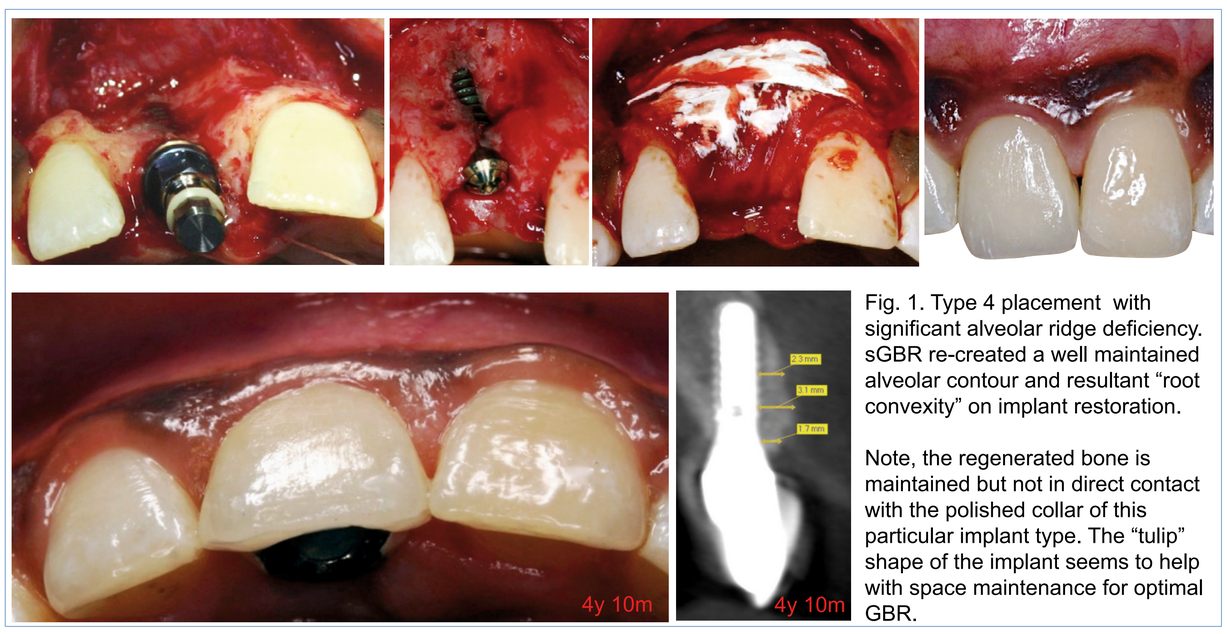


Fig. 1. Type 4 placement with significant alveolar ridge deficiency. sGBR re-created a well maintained alveolar contour and resultant "root convexity" on implant restoration.

Note, the regenerated bone is maintained but not in direct contact with the polished collar of this particular implant type. The "tulip" shape of the implant seems to help with space maintenance for optimal GBR.

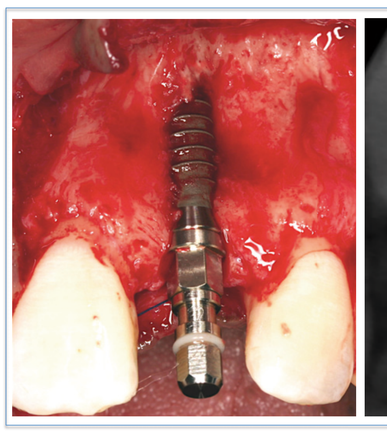


Fig. 2. A "tissue-level" implant with dehiscence. Labial bone thickness of >3mm recreated with sGBR and maintained at 5 years.
Again, the bone is coronal to the SLA-polished collar junction.

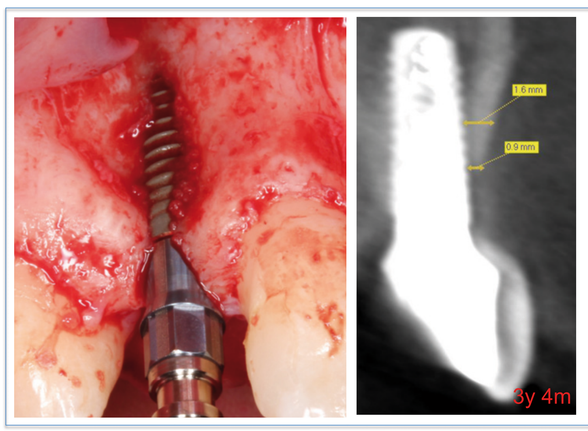


Fig. 3. A "bone-level" implant with dehiscence. Labial bone thickness recreated with sGBR and maintained at 3 years.

The regenerated bone at the implant shoulder is missing. Majority of bone level implants with dehiscence showed similar results on the CBCT scans

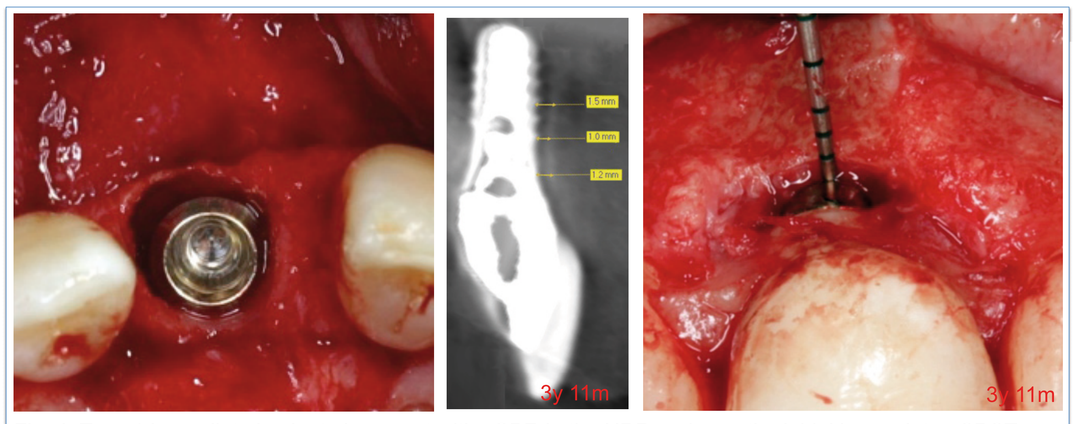


Fig. 4. Type 1 immediate implant placement with sGBR in the HDD and over the labial bone plate. CBCT scan and surgical re-entry demonstrate only 1mm labial bone was maintained, precisely at the SLA junction.

Conclusions

Within the limitations of this study, sGBR with deprotinized bovine bone and porcine collagen membrane on rough hydrophilic implants seem to be predictable in maintaining LBT up to a mean follow up of 3.7y.

In Type 1 implants sGBR appears to preserve some but not increase the LBT.

On the contrary, sGBR in Type 2 placement (even with dehiscence or fenestrations) significantly increases the amount of labial peri-implant bone thickness in implants that have been in function for at least one year.

Discussion

The results indicate that the use of sGBR at the time of implant placement is not the sole determinant in regenerating or preserving labial bone thickness.

The timing of implant placement seems to play a significant role in the long-term outcome, which will consequently influence the aesthetic outcome.

It is plausible that the osteoclastic activity during resorption of the bundle bone in early stages after tooth extraction interferes with sGBR if Type 1 implant placement is attempted.

Currently, soft tissue healing over the extraction socket is suggested as the rationale for Type 2 placement protocol. As a result of our findings, we propose a rethink, and this will involve a move away from soft tissue coverage to be replaced by resorption of bundle bone as the main rationale behind 4-8 week post extraction implant placement.

References

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