Implant Success Rate and Marginal Bone Loss Following Vertical and Horizontal Guided Bone Regeneration: A Retrospective Analysis

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BACKGROUND

Therapy for partially dentate and edentulous patients are routinely resolved with endosseous implants. The general guidelines and requirements for implant placement are commonly limited to the availability of bone. The increased use of implants resulted in the increase of bone augmentation procedures for hard tissue defects. Guided bone regeneration (GBR) utilizes barriers for adequate revascularization, space maintenance, and stability for graft materials. Although GBR may provide satisfactory volumetric bone regeneration for implant placement, the long-term success of implants in grafted sites remain unclear.

PURPOSE

Question: *Do implants placed in horizontally or vertically guided bone regenerative sites maintain marginal bone level from the time of implant placement?*

The aim of this study is to assess the marginal bone stability, success rate, and survival rate of implants in GBR sites.

MATERIALS & METHODS

A chart review of all patients who received GBR and then implant placement in both at Loma Linda School of Dentistry Center for Implant Dentistry (LLUSD) between 2000 to 2020 was conducted.

INCLUSION CRITERIA

- Age 18 years or older
- Available pre-/post-operative radiographic images
- Radiograph image following implant placement
- Radiograph image following restorative insertion
- Radiograph after at least 6 months of functional loading
- Implants removed at the time of 2nd stage procedure due to failure

DATA COLLECTION VARIABLES

- Demographics
- Date of GBR procedure
- Type of bone graft
- Type of membrane
- Date and radiograph of implant placement
- Date and radiograph of prosthesis loading
- Date of latest radiograph

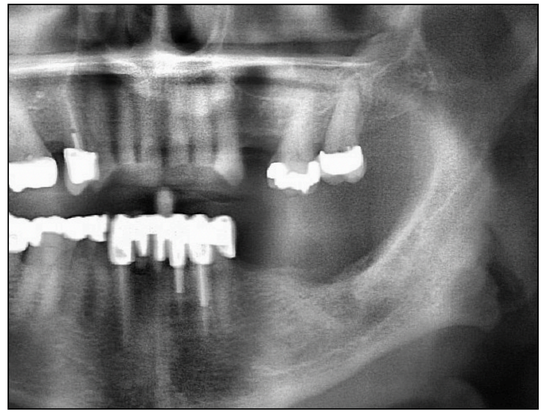

Fig 1. Pre-op Radiograph

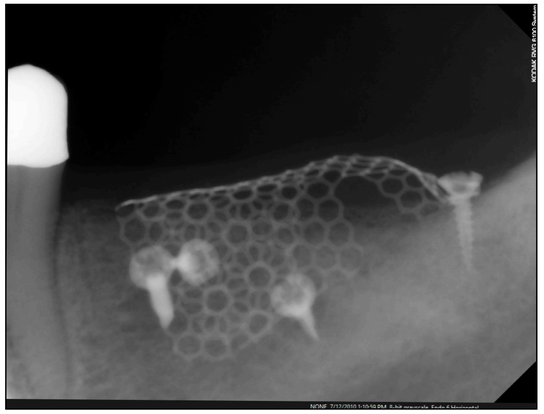

Fig 2. Post-op Radiograph

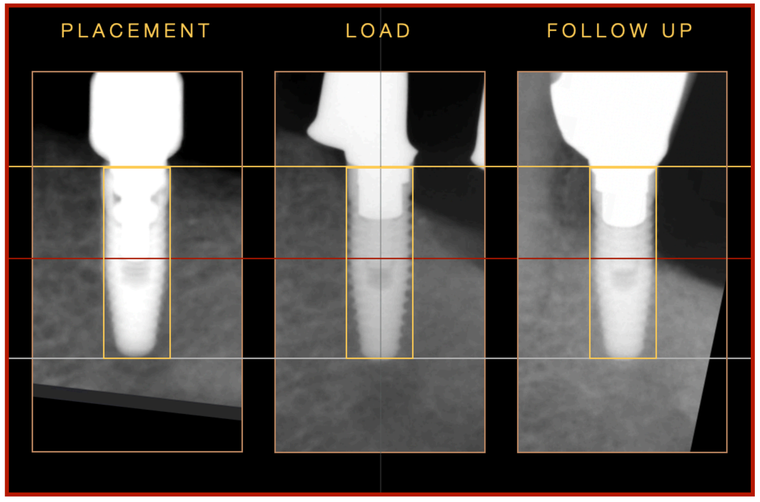

Fig 3. Sequence of radiographs, calibrated for measurement

MATERIALS & METHODS

Test Group 1 - Vertical GBR

Radiograph pre-/post-op ≥ 3mm gain in vertical direction

Test Group 2 - Horizontal GBR

Radiograph pre-/post-op ≥ 3mm gain in horizontal direction

DATA ANALYSIS

- Radiographic measurements by periodical radiographs :
  - Time of bone graft (T_0)
  - Time of implant placement (T_1)
  - Time of prosthetic load (T_2)
  - Time of latest follow-up (T_3)
- Measurements made on Apple Keynote (Cupertino, CA)

Criteria for implant failure:

- ≥30% bone loss at the time of follow-up with/without implant removal
- Implants removal at the time of 2nd stage uncovery

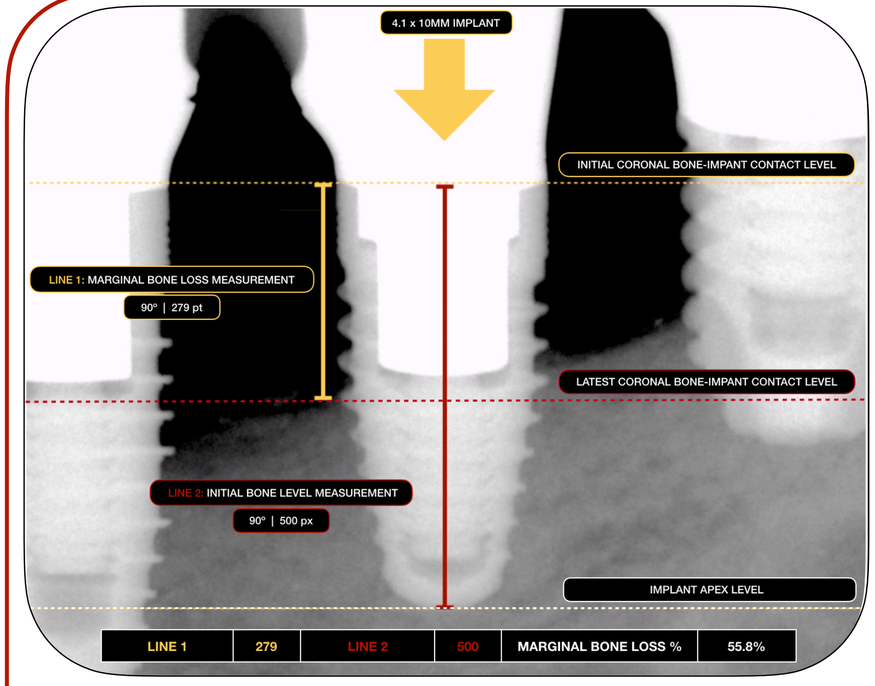

Fig 4. Keynote Measurement Diagram

Measurement (units in points)

X-axis horizontal lines drawn at the level of implant platform and apex = Total length of implant (***z***)

X-axis horizontal lines drawn at level of bone at T_1 = (***x***)

X-axis horizontal lines drawn at level of bone at T_3 = (***y***)

Equation for bone level change in percentage:

$$(x-y)/z*100\% = q$$

MATERIALS & METHODS

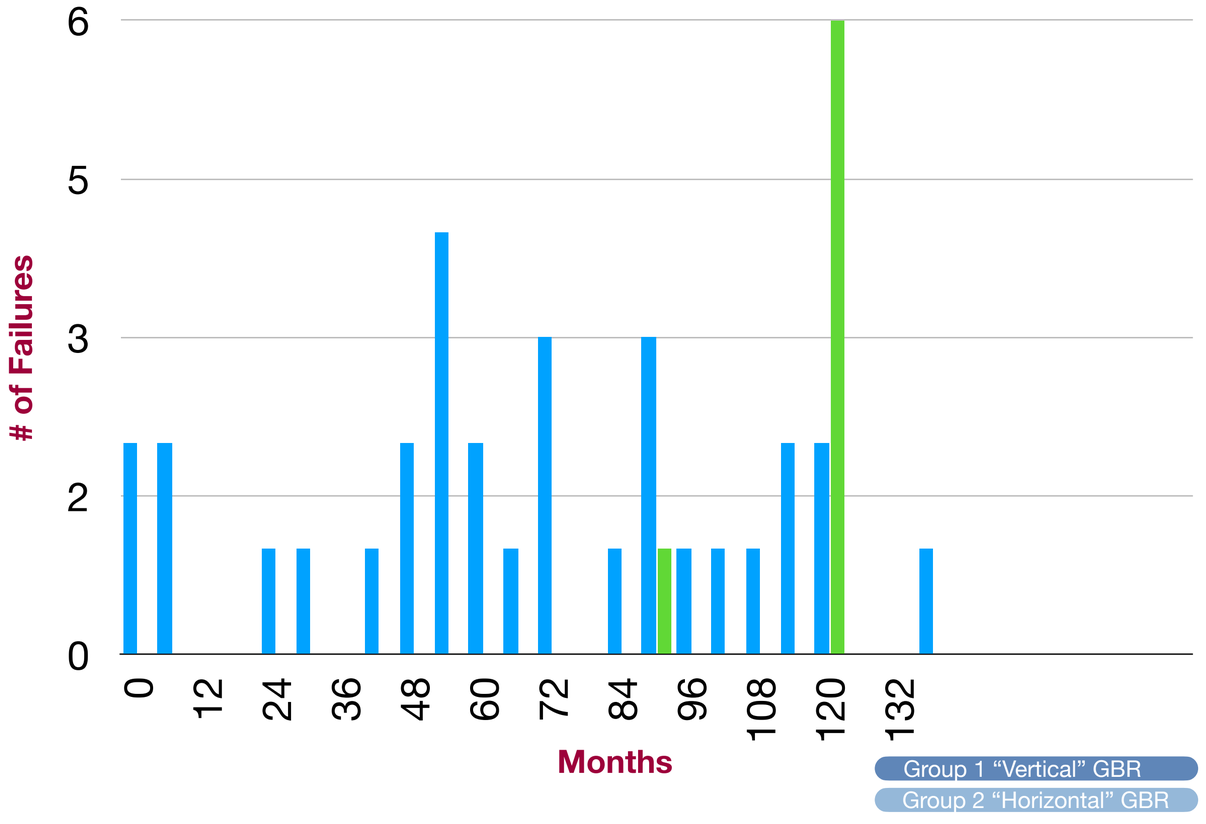

Fig 5. Cluster bar chart of implant failures over time

	Group 1 (*Vertical*)	Group 2 (*Horizontal*)
Number of patients	37	51
Total implants (*n = 201*)	79	122
Mean Follow-up Time	75.6 mos	67 mos
Mean bone loss (%)	29.4%	9.8%
Implant Removal	12	2
Marginal Bone Loss ≥ 30%	30	7
Overall Failure Rate	37.97%	5.74%

Table 1. Results of implant included in study

	Group 1	Group 2
Ti-Mesh	25	4
Collagen Membrane	20	112
PTFE Membrane	23	5

Table 2. Overall Implants Barrier Types

	Group 1	Group 2
Allograft	29	34
Xenograft	2	14
Autograft + Allograft	14	16
Autograft + Xenograft	7	0
Allograft + Xenograft	11	32
Autograft + Allograft + Xenograft	12	24

Table 3. Overall Implants Bone Graft Types

RESULTS & CONCLUSION

	Group 1 (*Vertical*)	Group 2 (*Horizontal*)
Total Failures	30	7
Ti-Mesh	10	—
Collagen Membrane	13	5
PTFE Membrane	7	2

Table 4. Implant Failure based on Barrier Type

	Group 1 (*Vertical*)	Group 2 (*Horizontal*)
Allograft	16	—
Xenograft	—	—
Autograft + Allograft	4	2
Autograft + Xenograft	2	—
Allograft + Xenograft	5	1
Autograft + Allograft + Xenograft	3	4

Table 5. Implant Failure based on Bone Graft Type

RESULTS

- 57 Females, 29 Males
- Mean age 60, range age 20-81
- Group 1 Mean follow-up 75.6mos (0-145)
- Group 2 Mean follow-up 67mos (12-168)

CONCLUSIONS

- ***Within the confines of this study, about 1/3 of vertical GBR cases experienced significant bone loss around implants over the course of 6 years***
- ***Horizontal GBR, on the contrary, remains relatively successful over 5 years***

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