Laser-Lok microtextured collar implant in a posterior fresh socket with hydroxyapatite agarose gel

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Abstract

Objectives: This retrospective study evaluated the influence of Laser-Lok microtextured surface (LMS) implants on changes in marginal bone level after immediate implant placement, in maxillary and mandibular posterior fresh sockets with hydroxyapatite agarose gel.

Material and Methods: This study was designed as a retrospective study with a 3-year follow-up.

Forty patients (12 men, 28 women), who underwent immediate implant placement in our department, received 40 implants between 2011 and 2014. The test group ($n = 20$) had LMS implants placed, and the control group ($n = 20$) had machined collared (MC) implants placed. Implants were placed in the maxillary and mandibular posterior region where bony defect height was > 5 mm. After implantation, the gap was filled with synthetic bone substitute hydroxyapatite agarose (HA/agarose) gel and the site was left open. Clinical and radiographic evaluations were performed immediately after implantation and 3 years thereafter.

Results: Mean reductions in proximal bone defect depth were 78.6% in the LMS group and 47.4% in the MC group ($p = 0.02$). The residual marginal bone defect at 3 years was significantly deeper in the MC group ($p = 0.018$), and the mean deepest probing depths (PDs) were 1.17 mm in the LMS group and 4.11 mm in the MC group ($p < 0.01$).

Conclusion: Application of Laser-Lok microtextured grooves to the implant collar resulted in bone healing, and shallower PD than implantation with a MC implant in immediately placed implants in posterior fresh sockets combined with HA/agarose gel.

Background and Aim

Immediate implant placement in the posterior region has several advantages. Some strategies have been developed to improve hard and soft tissue integration and prevent marginal bone loss. One such strategy is the use of Laser-Lok microtextured surfaces (LMSs) (BioHorizons Tapered Internal TLX Laser Lok, BioHorizons, Birmingham, AL., USA). Recently, we have developed a new bone filling material. It is a synthetic hybrid of organic and inorganic materials, and contains hemostatic and off-label-use material.

In cases of > 5 -mm bone height defect and a > 2 -mm gap between the socket wall and an implant in maxillary or mandibular posterior teeth, an LMS implant combined with HA/agarose gel may improve the integration of soft and hard tissue by less invasive surgery, without primary flap closure and barrier membrane. The purpose of the current retrospective study was to compare changes in marginal bone level and the condition of soft tissue in an LMS implant group and a machined collared (XiVE plus, Dentsply Friadent, Mannheim, Germany) (MC) implant group.

Methods and Materials

This study was conducted in compliance with the Declaration of Helsinki, and was approved by the ethical committee of Miyakonojo National Hospital.

This study was registered at the University hospital Medical Information Network center (UMIN.ID 000027172).

Patient selection

Patients enrolled in the present retrospective study were identified through the customized records of Miyakonojo National Hospital. Only patients treated with immediate implant in the posterior (premolar and molar) region in either the maxilla or mandible between January 2011 and December 2014, with successful single-tooth restoration and complete 3-year follow-up were included.

Other inclusion criteria was ; (1) good systemic and oral health, (2) age > 40 , (3) radiographically > 5 -mm bone height defect between a reference point (implant-abutment interface) and the corresponding bone-to-implant contact point, (4) > 2 -mm gap between the implant and socket wall on baseline.

The exclusion criteria were use of potentially interfering medication (e.g., steroid therapy or bisphosphonates), alcohol or drug abuse noted in the patient's records or medical history, heavy smoking (> 10 cigarettes/day), and uncontrolled diabetes.

A total of 40 patients (12 men, 28 women) were included, with a mean age of 63 years (range 49–83 years). Within these patients, 20 patients were treated with a LMS implant (Tapered Internal TLX Laser Lok, BioHorizons, Birmingham, AL., USA) and 20 patients with a MC implant (XiVE plus, Dentsply Friadent, Mannheim, Germany).

Formation of HA/agarose gel

Material

Figure. Experimental procedures of an alternate soaking process.

SEM image of a) the agarose gel b) the HA/agarose gel created by 12 soaking cycles. The diameter of HA particles was about 50–100 nm.

Bone-like apatite could be formed on/in the organic polymer hydrogel matrices with the use of this process. Here an agarose gel is used as an organic polymer hydrogel matrix. HAP/agarose gel is synthetic bone filling material, and hybrid of organic and inorganic material.

Anticoagulant property

Animal study
HA/agarose gel was densely packed into the bone cavity, and the hemorrhage stopped within a few minutes. Packed bone defect particles were washed out by bleeding from the bone cavity.

HA powder   Agarose   HA/agarose gel

HAP/agarose gel adheres vitronectin specially from Western blotting analysis.

Vitronectin plays an important role in bone regeneration and it involved probably also in the interaction of fibroblasts with the vascular cell walls. Vitronectin thus is an important mediator of physiological and pathophysiological processes of hemostasis and thrombosis. (Zach E, Polack F, J Cell Invest. 1990;85:117-23)

Vitronectin (VN) is a multi-functional glycoprotein best known for its effects on cell attachment and spreading, but has more recently been shown to mediate cellular responses to growth factors including EGF, IGF-I, and IGF-II. (Miyazawa T, Yamada K, J Bone Miner Res. 2006;21:1546-1)

Histological findings
3-month postope
Residual Hap/agarose gel was gradually replaced by newly formed lamellar bone.

What is HA/agarose gel?

3 months   1 year

Sinus lift with HA/agarose gel

Marginal bone level measurement

Radiographic measurements of marginal bone loss were conducted via panoramic xray. The vertical distance between a reference point (implant-abutment interface) and the corresponding bone-to-implant contact point was measured (radiographic bone loss). As HA/agarose gel is a radiolucent material, bone-to-implant contact was easily detected. The deepest measurements of each implant at each time-point were calculated and recorded as proximal bone defect. Peri-implant probing depth (PD) was determined at four sides of each implant, buccally, palatally, mesially, and distally.

Surgical procedure

The same surgical protocol was used for all subjects. A failing tooth was gently extracted (Fig. 1a and 1b), and an implant was inserted according to the instructions provided by the manufacture. Using a flapless procedure, the implant was positioned 1 to 2 mm away from the buccal wall, and the implant shoulder was placed 2 to 3 mm apical to the anticipated gingival margin (Fig. 1c).

After implant placement, the gap between the implant and the socket wall was filled with HA/agarose gel.

The socket was covered with HA/agarose gel without primary closure (the site was left open) (Fig. 1d).

Soft tissue healing was excellent at 2 month after implant placement (Fig. 1e). The final restoration was completed between 12 and 20 weeks after implant insertion (Fig. 1f).

Results

Fig2(a) Left mandibular second premolar was extracted due to root fracture.

Fig.2(b) LMS implant placement immediately after tooth extraction. The gap between implant and socket wall was filled up with HA/agarose gel. 10 mm vertical bony defect at medial side was observed. **HA/agarose gel was radiolucent material.**

Fig.2(c) Radiographic finding of LMS implant after 2 years. Bone healing was observed

Fig.3(a) Second premolar was extracted due to root fracture
Fi.3(b) ML implant after filled with HA/agarose gel. **HA/agarose gel was radiolucent material.**

Fig.3(c) Radiographic finding of ML implant after 2 years. Vertical bony defect was observed.

Table 1. Mean Average of Proximal Bone Defect Range (mm) at 3 years
Statistically significant difference was found between two groups using the Student t test.
 $P = 0.018$

	Baseline	3 years
LMS (N=20)	5.30±2.25	0.65±1.12
MC (N=20)	4.10±1.76	1.58±1.29

Table 2. % Reduction of Depth at the Proximal Bone Defect Over Time
Statistically significant difference was found between two groups using the Student t test.
 $P = 0.02$

	LMS (N=20)	MC (N=20)
	78.6%	47.4%

Table 3. Probing Depth Measurement in Both Groups after 3 years.
Statistically significant difference was found using the Student t test. $P < 0.01$

	Probing depth range (mm)	Mean±SD
LMS (N=20)	1.17	0.51
MC (N=20)	4.11	1.19

Conclusions

Within the limitations of this research, the flapless surgery with no primary closure used for immediate implant placement in posterior fresh sockets with missing bony plate and a > 2 -mm gap yielded predictable results using LMS implants combined with HA/agarose gel. Conversely, the procedure is not recommended for MC implants.

References

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