Comparison between two treatment protocols withor without Guided Bone Regeneration on the treatment of Periimplantitis in a dog model:microbiologic and histomorphometric evaluation

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Abstract

Eight beagle dogs received eight implants each. After 8 weeks, silk ligatures were installed and then removed after 8 weeks, and after the end of 10 weeks the lesions were treated either with antimicrobial photodynamic therapy (aPDT) or topical tetracycline hydrochloride 50mg/ml with and without guided bone regeneration. The animals were euthanized 12 weeks after treatment and submitted to histological processing and microbiological analysis of disinfection by means of DNA-DNA Checkerboard hybridization.

Results: The overall results failed to detect significant differences between the anti-infective treatments and the adjunctive use of guided bone regeneration failed provide better re-osseointegration or bone gain in either of the anti-infective treatments. Buccal sites and implant early exposure negatively affect bone regeneration. The results showed effective bacterial counts reduction for both treatments. aPDT showed better outcomes, with major reductions on the red complex, but no statistical difference between groups when adjusted for multiple comparisons

Conclusion: Both anti-infective therapies stand-alone or combined with guided bone regeneration allowed similar and partial bone gain. Both antiinfective treatments were able to successfully decontaminate implant surfaces. Implant decontamination with aPDT can be used as a substitute to local antibiotics in periimplantitis treatment.

Methods and Materials

Titanium dental implants (BoneLevel TML SLA, ø3.3x10 mm, Straumann, Basel, Switzerland) and healing abutments (ø4.1x3.5 mm, Straumann, Basel, Switzerland) were used.

A bovine bone biomaterial/BBM (Bio-Oss, Geistlich Pharma, Wolhusen, Switzerland) in combination with a resorbable porcine collagen membrane (Bio-Gide, Geistlich Pharma, Wolhusen, Switzerland) were used for GBR.

For the aPDT, a hand-held, battery-operated, diode laser (HELBO mini-laser 2075 F dent, HELBO Photodynamic Systems, Grieskirchen, Austria) was used. The device was set to a wave-length of 660 nm and fluency of 212 mW/cm². The laser was irradiated through an 8.5-cm long flexible fiber optic tip curved at a 60° angle with a ø0.06 cm spot-size. A 10-mg/mL phenothiazine chloride solution (HELBO Blue Photosensitizer, HELBO Photodynamic Systems, Grieskirchen, Austria) was used as photosensitizer.

Surgical procedures (figures a to g)

Food was withheld the night preceding surgeries. For all surgical events, the animals were pre-anesthetized using 10% zolazepam (0.10 mL/kg IM) and acepromazine (0.2-0.3 mg/kg IM). The animals were then maintained on gas anesthesia (isoflurane 1-2% to effect). Depth of anesthesia was monitored by lack of response to toe pinch, lack of corneal reflex, and by monitoring depth of respiration, respiratory rate and heart rate; all anesthesia and related procedures performed and monitored by veterinary staff. Routine dental infiltration anesthesia (mepivacaine 2% norepinephrine 1:100,000) was used at the surgical sites. An opioid (tramadol chlorhydrate 50mg/mL, at a dose of 3mg/kg each 12 hours, for 3 days) and a non-steroidal anti-inflammatory agent (ketoprofen 1 mg/kg IM SID) were used for postoperative pain control.

Peri-implantitis induction

For peri-implantitis induction, silk ligatures (3-0 Silk Ethicon, Johnson & Johnson, São Jose dos Campos, Brazil) were placed around the healing abutments over 8 wks. Ligatures were checked weekly and missing ligatures immediately replaced. Ligatures were then removed and peri-implant lesions were allowed to progress undisturbed for an additional 6 wks (Figure c).

Peri-implantitis defect reconstruction

Treatment Groups:

TTC: Exposed dental implants were conditioned with tetracycline HCL for 3 min using cotton pellets soaked in a 50 mg/mL solution, cotton pellets exchanged every 30 sec. The surgical sites were then thoroughly rinsed with sterile saline.

TTC/GBR: Exposed dental implant were conditioned with tetracycline HCL as described above. The peri-implant defects were then filled to capacity with the particulate BBM, a collagen membrane adapted over the BBM. Fixation devices were not used.

aPDT: Peri-implant defects were filled to capacity with the photosensitizer, the solution left in place for 5 min. The surgical sites were then thoroughly rinsed with sterile saline to remove the photosensitizer solution to minimize optical shielding. The exposed dental implants were divided into six areas and the laser was applied for 30 sec. over each area for a total dose of 44 J/cm².

aPDT/GBR: aPDT and GBR carried out as described above.

The animals were euthanized at 12 wks following reconstructive surgery.

Results

The overall results failed to detect significant differences between the anti-infective treatments and the adjunctive use of guided bone regeneration failed provide better re-osseointegration or bone gain in either of the anti-infective treatments. Buccal sites and implant early exposure negatively affect bone regeneration (table). Following treatment, a major reduction in bacteria counts for all bacteria species was observed. Whereas the aPDT group had, usually, lower red complex bacteria counts than TTC, no significant differences were observed between groups following treatment. The overall counts indicated a numerically better reduction favoring aPDT. The proportions of orange complex showed an increase tendency post-treatment on TTC group whereas aPDT showed lower proportions together with a reduction tendency.

Despite the lack of regeneration, implants with early exposure did not exhibit clinical inflammation.

		Residual defect depth (mm)			Bone gain (mm)			BIC (%)		
		Coef	95%CI	p-value	Coef	95%CI	p-value	Coef	95%CI	p-value
TTC/ aPDT	No	ref	-	-	ref	-	-	ref	-	-
	Yes	0.06	-0.39	0.50	0.06	-0.15	0.27	0.59	-0.06	0.07
GBR	No	ref	-	-	ref	-	-	ref	-	-
	Yes	0.36	-0.18	0.89	0.21	0.00	0.42	0.05	-0.12	0.12
Site	Buccal	ref	-	-	ref	-	-	ref	-	-
	Lingual	-1.39	-2.10	-0.68	0.38	0.15	0.61	0.001	-0.08	0.16
	Medial	-0.91	-1.40	-0.42	>0.001	0.30	0.15	0.46	-0.04	0.15
	Distal	-0.91	-1.39	-0.43	>0.001	0.48	0.26	0.69	-0.02	0.16
Implant location	Anterior	ref	-	-	ref	-	-	ref	-	-
	Posterior	-0.19	-0.46	0.09	0.18	0.24	0.08	0.41	-0.11	0.14
Implant exposure	No	ref	-	-	ref	-	-	ref	-	-
	Yes	1.67	1.12	2.22	>0.001	-0.59	-0.77	-0.42	-0.28	-0.48

Conclusion

Within the limitations of this study, it may be concluded that both anti-infective therapies stand-alone or combined with GBR using BBM and a collagen membrane allowed similar and partial resolution of the peri-implantitis defects without significant differences between protocols. both antiinfective therapies showed to reduce overall bacterial counts, with remarked reductions of the red and orange complex, with a slightly better performance favoring aPDT

References

- Ramos UD, Suaid FA, Wikesjö UME, Susin C, Taba M Jr, Novaes AB Jr. Comparison between two antimicrobial protocols with or without guided bone regeneration in the treatment of peri-implantitis. A histomorphometric study in dogs. Clin Oral Implants Res. 2017 Nov;28(11):1388-1395. doi: 10.1111/clr.12998.
- Ramos UD, Suaid F, Wikesjö UM, Susin C, Vital PC, de Souza SLS, Messoria MR, Palioto DB, Novaes AB Jr. Microbiologic effect of two topical anti- infective treatments on ligature-induced peri-implantitis: A pilot study in dogs. J Periodontol. v. 89, p. 995-1002, 2018.