

Photodynamic therapy and socket shield technique in infected sockets: a randomized controlled trial

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Abstract

Socket shield technique (SST), which has evolved into a predictable technique for preserving buccal bone and oral soft tissue volume and contours, involves leaving behind a sliver of root on the facial aspect of the socket. When performed on an endodontically infected tooth, this may serve as a potential source of pathogens that increases the risk of failure and implies a pivotal importance of socket disinfection prior to implant placement in SST.

In this study we explored antimicrobial photodynamic therapy (aPDT) as an adjunct socket disinfection strategy in 21 out of 42 consecutive implants placed with SST for the restoration teeth with endodontic infections, for possible improvements in implant healing and stability.

Resonance frequency analysis revealed that, whereas all the implants had comparable initial Implant Torque and Implant Stability Quotients (ITQ, ISQ) and were all sufficiently well integrated at the twelve-weeks time-point to receive final restorations, implants placed in aPDT-treated sockets had a significantly higher ISQ-value at six- and twelve-weeks post-SST, implying accelerated osseointegration.

Background and Aim

Immediate implantation using SST results in highly aesthetic and functional outcomes for patients. However, this approach remains controversial when performed in infected sockets with residual pathogens¹.

HELBO® aPDT is a well-studied disinfection method that involves the use of a photosensitizer dye, methylene blue, in conjunction with a 660nm low-level laser. While there is considerable scientific evidence in the literature on the efficiency and safety of aPDT for socket disinfection², preventing painful dry sockets³ and complications with immediate implant placement⁴, some animal studies also point out a potential positive effect on the actual healing of immediate implants⁵⁻⁶. As of now, there are however no clinical studies that demonstrate the impact of adjunct aPDT for extraction socket disinfection on the stability of immediately placed implants, which is indicative of successful osseointegration, particularly with the SST.

Therefore, the aim of this study was to evaluate the survival and stability of implants placed in fresh extraction sockets of teeth with infections of endodontic origin, utilizing SST with and without aPDT, the null hypothesis being that there is no difference.

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Methods and Materials

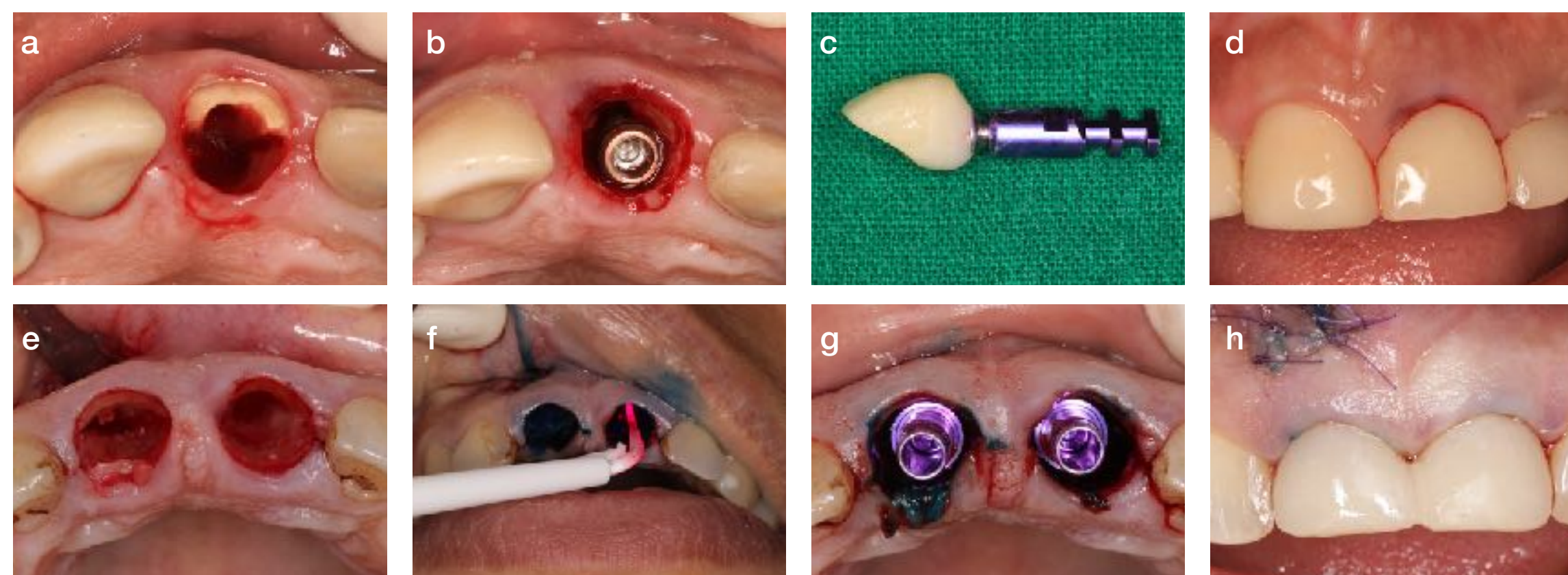


Figure 1 - Procedure of SST for immediate implant placement in control-group (a-d) and test-group (e-f) cases.

From 27 patients recruited to the study between July 2021 and March 2023, 42 apically infected teeth in were sectioned for SST immediate implantation using PET kit (Komet, Germany). All patients were given a single loading dose of 2gm Amoxicillin 1 hour prior, and all sockets were curetted along with copious saline irrigation. Then, shielded extraction sockets (Fig.1 a, e) were allocated by randomization to either the *control group* (n = 21) that did not receive local disinfection, or to the *test group* (n=21) that were disinfected with aPDT as per manufacturer's instructions (HELBO®, bredent medical) (Fig.1 f). Subsequently, implants (copaSKY®, bredent medical) were placed in the appropriate position, without the use of bone grafts (Fig.1 b, g). Provisional restorations or custom healing abutments were placed to seal the sockets. (Fig.1 c-d, h). Baseline radiovisography (RVG) and ITQ were recorded. ISQ was measured (Penguin™) at baseline, six and twelve weeks after implant placement and statistically evaluated using Student's t-test and repeated measures ANOVA. Additionally, correlation between implant dimensions (diameter and length) as additional independent variables of the study, with ITQ- with and ISQ-values over time was studied using Pearson correlation coefficient test.

Results

Fig.2 shows baseline RVG of control (a) and aPDT test (b) cases depicted above. There were no significant differences in ITQ values (Fig.2c) or ISQ values (Fig.2d)

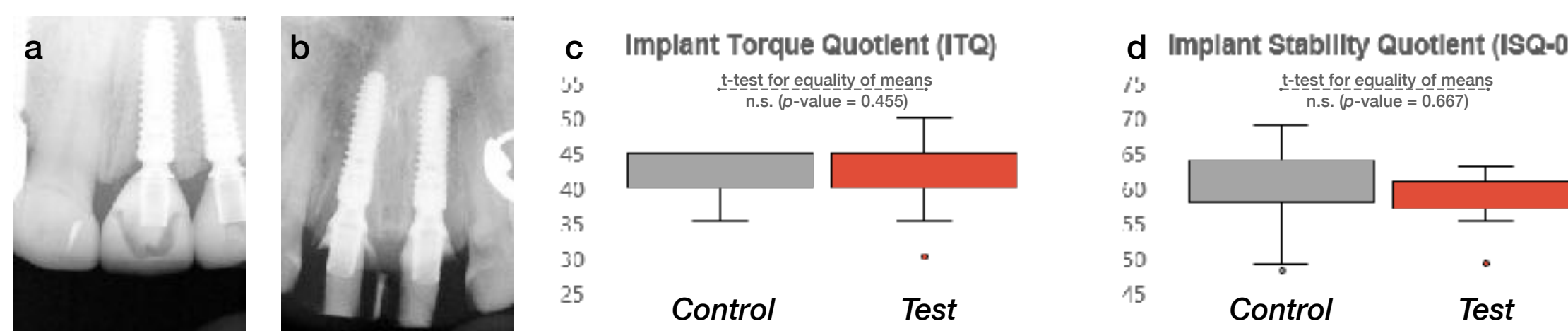


Figure 2 - Baseline RVS of the above control-group (a) and test-group (b) cases, ITQ (c) and ISQ (d) box-plots.

Results (continued)

At the twelve-week endpoint, all implants from both experimental groups had survived, with no signs of pathology in soft (Fig. 3 a, d) or hard tissue (Fig. 3 c, f) and had been well enough integrated, to allow for final restorations (Fig. 3 b, e). The ISQ-measures however show a small but statistically significant increase of 1.62 ± 0.79 in group mean for aPDT-treated sites (p -value = 0.047).

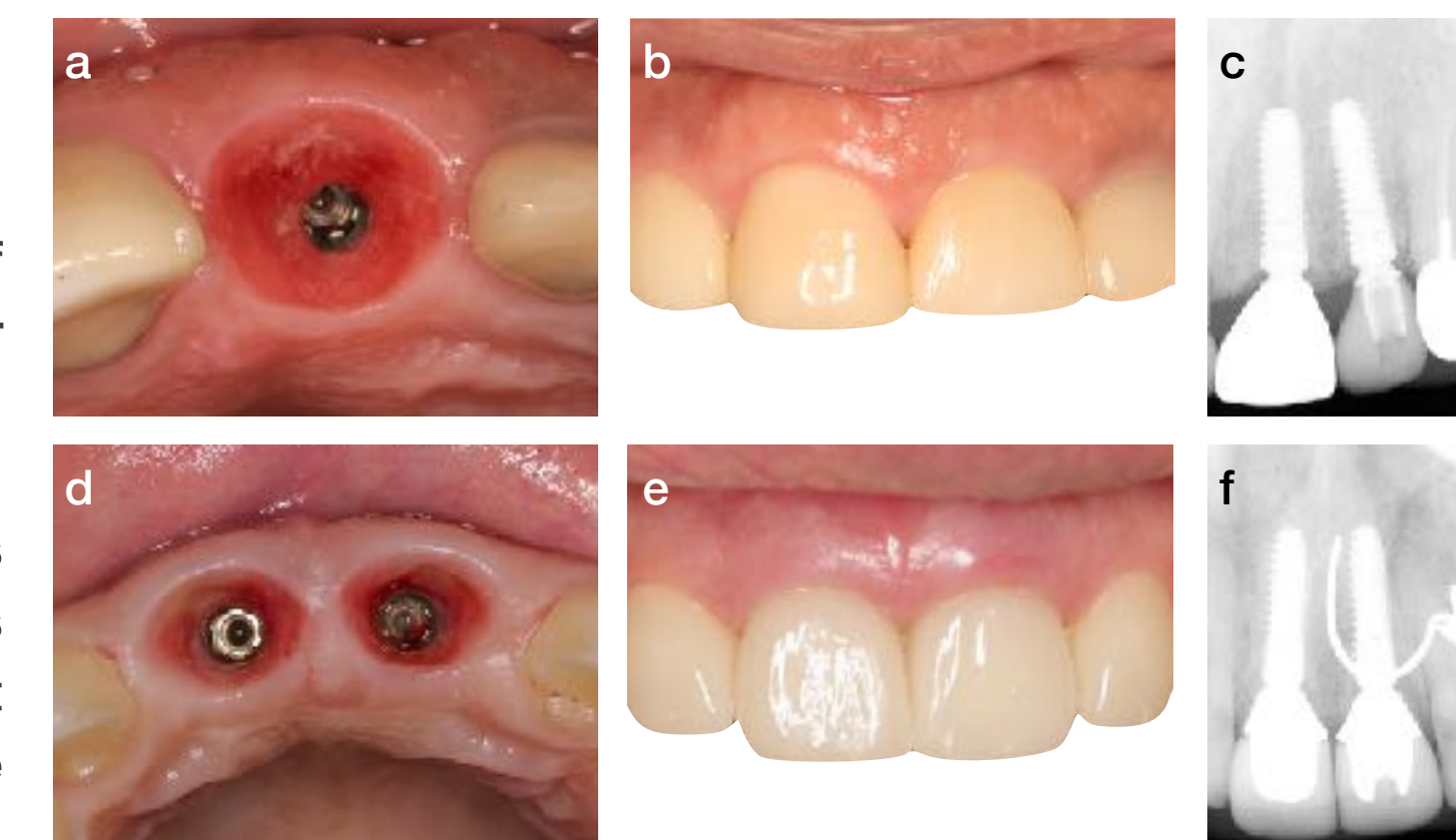


Figure 3 - Clinical result with final restorations at twelve weeks for the above control-group (a-c) and aPDT-group (d-f) cases.

Multivariate analysis of ISQ further demonstrated a positive dependency with both healing time alone and in combination with intervention, in favour of adjuvant aPDT (p -value < 0.001) (Fig. 4). Indeed, implants placed in the aPDT-treated sockets already reached a mean ISQ = 68.19 ± 2.54 at 6-weeks, which was a strong significant difference as compared to the less stable implants in the control group with ISQ = 64.48 ± 4.27 at the middle time-point (p -value = 0.002).



Figure 4 - ISQ-improvement during implant healing. Difference in means: n.s. = not significant, *,** = significance level.

Moreover, baseline ISQ showed a moderate correlation the ITQ, whereas both baseline and endpoint ISQ strongly correlated with the midpoint ISQ measured after six weeks. Other independent variables, such as implant length or diameter did not significantly correlate with the rising ISQ-values over time.

Conclusion

SST can be successfully applied to failed root canal-treated and apically infected teeth. Although survival was independent of local socket disinfection, the herein placed implants benefited from adjuvant aPDT with significantly accelerated osseointegration. The results of this randomized controlled study substantiates the positive effect of aPDT on immediate implant healing, additionally to its infection control functionality, thereby possibly enabling earlier final restoration for such implants.