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Clinical evaluation of submerged and non-submerged implants for posterior single-tooth replacements: a randomized split-mouth clinical trial

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Abstract. The aim of this study was to evaluate clinical and radiographic results of submerged and non-submerged implants for posterior single-tooth replacements and to assess patient-based outcomes. Twenty patients were included in the study. A split-mouth design was used; implants inserted using a submerged technique were compared to those inserted with a non-submerged technique. Implants were restored with metal–ceramic crowns after 3 months. Reconstructions were examined at baseline, 6, 12, and 24 months. Standardized radiographs were made. Radiographic crestal bone level changes were calculated, as well as soft tissue parameters, including pocket probing depth, bleeding on probing, plaque index, and gingival index. Results were analyzed by two-way repeated measures of variance (ANOVA). To evaluate patient-based outcomes, patients were asked to complete a questionnaire at the 6-month follow-up; the Wilcoxon paired signed rank test was used to compare scores. The data of 18 patients were reviewed. During 24 months, non-submerged implants (0.57 ± 0.21 mm) showed significantly lower bone loss than submerged implants (0.68 ± 0.22 mm) ($P < 0.01$). Patient satisfaction with non-submerged implants (median 87.5) was significantly higher than with submerged implants (median 81.5) ($P < 0.01$). Non-submerged implants showed comparable clinical results to submerged implants and resulted in higher patient satisfaction due to decreased surgical intervention.

Key words: dental implant; single tooth replacement; submerged implant; non-submerged implant; clinical evaluation..

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Over the past 35 years, endosseous dental implants have demonstrated predictable results when used to support restorations that replace missing teeth.[1–6] Currently, probably the most common indication for implant placement is restoration of a missing or failing single tooth.[7,8] Success rates for single-tooth replacements supported by implants have been very promising in terms of both implant survival and prosthetic outcomes.[9–11] The results of implant-supported single-tooth replacements are commonly evaluated independently, because there are differences between edentulous and partially edentulous patients that may have an impact on the final result.[12] Single implant restorations are more prone to biomechanical complications because they are subjected to greater functional forces than splinted implants.[13,14] Furthermore the replacement of one tooth may be a great aesthetic challenge, particularly in the anterior region. In contrast to the majority of patients with edentulous jaws, single-tooth replacements are frequently performed in young patients.

The original Brånemark concept prescribed two-stage surgery with a submerged healing period of 3 months in the mandible and 6 months in the maxilla in order to optimize the process of new bone formation and remodelling following implant installation.[1] The outcome of the submerged technique was verified in several clinical studies, which reported high success rates.[1–5] However, recent studies have shown that osseointegration can be achieved using single-stage surgery where the implants are left to heal non-submerged.[15,16] Non-submerged implant placement has gained interest since it reduces the number of surgical interventions, thus reducing the surgical time and patient discomfort; it also results in a healed and healthy peri-implant mucosa at the time of prosthetic rehabilitation.[17,18] However, the submerged technique is preferable in combination with bone augmentation, because it prevents overloading of the implants and secures an infection-free environment during the healing period.[18] Some studies on the non-submerged technique have implemented exclusion criteria such as bruxism and heavy smoking.[15,19,20] Although promising results have been reported for non-submerged implant installation,[16,17,19–24] divergent results have also been presented.[18,25]

Clinical studies comparing submerged and non-submerged techniques have generally been performed in edentulous and partially edentulous patients.[16–25] The present study was designed to evaluate clinical and radiographic results of submerged and non-submerged implants for single-tooth replacements in the same patient using a split-mouth technique and to assess patient-based outcomes with the two treatment protocols. The hypothesis was that there would be no difference in results between the two surgical methods concerning implant survival, clinical parameters, and patient satisfaction.

Materials and methods

A split-mouth study was designed to determine any differences in outcome between implants installed using the submerged surgical technique and those installed using the non-submerged technique. The study protocol was reviewed and approved by the clinical research ethics board of the faculty. The CONSORT statement (http://www.consort-statement.org) was used as a guide for reporting the present clinical study.

Twenty patients (nine men and 11 women) ranging in age from 23 to 51 years (mean age 38.4 years) were included in the study. The surgical and prosthetic treatments and follow-up visits were performed between September 2009 and October 2012. All patients received oral and written information about the study and those who agreed to participate gave their written consent.

Inclusion criteria were the following: good general health for implant surgery; no untreated periodontal disease or other mucosal or bone lesions; not being a heavy bruxer or clencher; single-tooth bilateral edentulous sites in the canine, premolar, or molar region with adequate bone width and similar bone height at the implant sites; at least 2 months since tooth extraction; good arch stability (or an occlusal scheme that allowed the establishment of identical occlusal cusp/fossa contacts).

A total of 20 patients were treated according to the study protocol. The surgical procedure was performed under local anaesthesia. Each patient received two implants (IDcam implants; IDI, Paris, France). The main features of the implant include a threaded, tapered shape, with a Morse taper implant–abutment connection, and a concave-shaped apex design (CSO; concave securit osseo-wedging) (Fig. 1). The CSO apex has been designed to act as a bone reservoir for bone grafting (with its concave shape), to limit the risks of damaging the sinus membrane and nerve (with its 'securit' round-shaped end), and to increase the apical bone retention surface (with its peripheral and wedging groove). For implant placement, it was considered to provide a minimal 0.5 mm bone thickness around the inserted implants.

Midcrestal incisions and vertical releasing incisions were used and full thickness flaps were reflected. One side was selected at random to be restored with the submerged technique and the other with the non-submerged technique. To perform within-subject comparisons, left–right randomization was done directly after implant

Fig. 1. IDcam implants used in this study.