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study

Effect of immediate implant placement on alveolar-ridge preservation

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Background

After a tooth is extracted, there are volumetric changes of the alveolar bone, resulting in a reduction in the height and width of the remaining alveolar ridge. These changes can affect the future placement of dental implants in the correct three-dimensional, restoratively driven position. Alveolar-ridge preservation procedures (ARP) have therefore been proposed to reduce these changes.

Immediate implant placement is defined as the placement of a dental implant at the time of tooth extraction, during the same surgical procedure. It provides the advantages of reducing the number of surgical appointments for patients and providing an immediate fixed replacement for the extracted tooth. Unfortunately, evidence suggests that immediate placement does not completely prevent post-extraction changes to the alveolar ridge, and the procedure has been associated with a higher incidence of aesthetic and biological complications, when compared to delayed placement protocols.

Recent evidence supports procedures aiming at combining alveolar-ridge preservation with immediate dental-implant placement. Until now, no study had compared changes in the alveolar ridge following immediate implant placement combined with ARP vs ARP alone.

Aims

The primary aim of this study was to compare radiographically the horizontal changes in millimetres between immediate implant placement and ARP (I-ARP, test) versus ARP alone (ARP, positive control) and spontaneous healing (SH; negative control).

Materials & methods

- A prospective controlled, randomised, clinical investigation.
- Sample-size calculation was based on summary statistics of the mean and standard deviation from a study by Jung et al. in 2013. This resulted in 10 participants per group (three groups in total) to test the null hypothesis (total, 30 patients).
- Participant selection from referrals to the University Vita Salute Raffaele, Milan, Italy between January 2016 and January 2018. Participants consented to the study by signing a written consent form in accordance with the ethical principle of the Declaration of Helsinki.
- Comprehensive inclusion and exclusion criteria.
- A full-thickness flap was raised, with extraction of a single-rooted tooth, preserving the buccal plate. Thereafter, patients were assigned to: 1) I-ARP, receiving an implant, deproteinised bovine bone mineral, and a collagen membrane (DBBM/CM); 2) ARP with DBBM/CM; or 3) SH.
- Post-operatively, patients were instructed to rinse twice daily with 0.2% chlorhexidine. Patients also received Augmentin 1g twice daily for six days and analgesics (Ibuprofen 600mg) if needed.
- Patients followed individual supportive-therapy programmes.
- Four-months post-extraction, patients were recalled for a follow-up.
- Full-mouth plaque scores (FMPS), full-mouth bleeding scores (FMBS), keratinised tissue height (KTH), and gingival thickness (GT) were recorded at baseline and after four months.
- All clinical measurements were made by a single blinded and calibrated examiner.
- Cone-beam computed tomography (CBCT) scans were performed before and after treatment. Exposure parameters, including the length of exposure, were the same in both scans. The two images were superimposed using computer-assisted software at the buccal and lingual aspect and at ridge widths of 1mm, 3mm, and 5mm apical to the bone crest. The Kruskal-Wallis test was applied to compare differences between study groups.

Figure 1

The effect of immediate implant placement on alveolar-ridge preservation compared to spontaneous healing after tooth extraction: radiographic results of a randomised controlled clinical trial
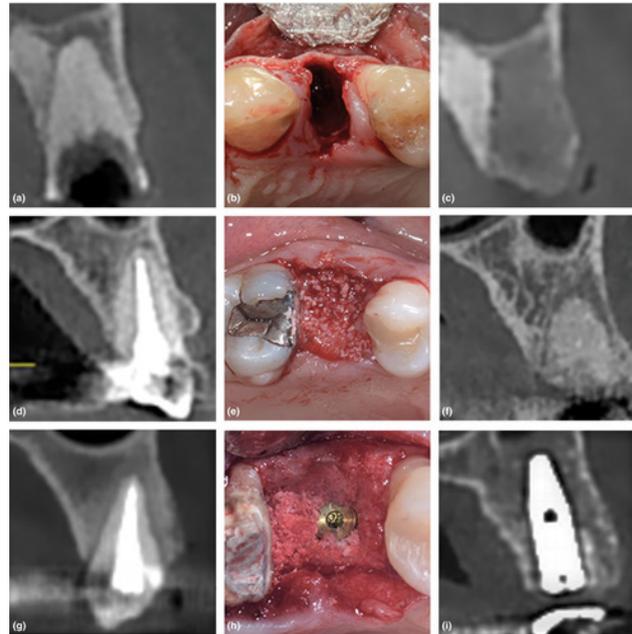
Baseline cone-beam computed tomography (CBCT), intra-operative view, and 4 months postsurgery CBCT, representative of the three treatment modalities.

(1) spontaneous healing:
  (a) baseline,
  (b) intra-operative,
  (c) 4 months.

(2) DBBM-CM site:
  (d) baseline,
  (e) intra-operative,
  (f) 4 months.

(3) IMPL/DBBM-CM site:
  (g) baseline,
  (h) intra-operative,
  (i) 4 months.

Results

- A total of 30 participants were recruited and included in the analysis.
- Clinical outcomes: no statistically significant differences between the three groups were found between baseline and four months for FMPS, FMBS, KTH, and GT.
- Horizontal changes: 1mm apical to the bone crest, the ridge width decreased by 43.2±25% (SH group), 19.2±9.1% (ARP group), and 14.9±4.9% (I-ARP group).
- Mid-buccal ridge width 1mm apical to the bone crest decreased by 54.9±20.9% (SH), 25.9±11% (ARP), and 26±7% (I-ARP).
- Mid-buccal ridge width 3mm apical to the bone crest decreased by 41.5±26.4% (SH), 15.7±13.8% (ARP), and 19.2±9.4% (IARP).
- Mid-lingual ridge width 1mm apical to the bone crest decreased by 24.3±22% (SH), 14.4±9% (ARP), and 5±9% (I-ARP).

- No statistically significant differences were observed between the ARP and I-ARP groups at any assessed time point or measurement.
- Statistically significant differences were found between the SH group and both the ARP and I-ARP groups in the following radiographic parameters: horizontal-dimension change 1mm apical to the bone crest, mid-buccal ridge-width changes 1mm and 3mm apical to the bone crest
- Statistically significant differences were found between the SH and I-ARP groups for the mid-lingual ridge-width changes 1mm apical to the bone crest.
- Vertical changes: no statistically significant differences were found between groups at buccal and lingual bone crests.

Limitations

- Limited sample size, which also prevented carrying out correlations between predictive factors such as tooth position, buccal-bone-plate width at baseline, and radiographic outcomes.
- With CBCT, no analysis of the marginal bone-to-implant contact level is possible in grafted sites.
- Additional follow-up visits to collect data or information on whether dental-implant placement with or without bone grafting was possible in the ARP and SH groups would have been useful, as this is a critical outcome in ARP studies.
- Lack of patient-reported outcome measures to determine any additional adverse effects or benefits of treatments provided.

Conclusions & impact

- **Vertical and horizontal changes of the alveolar ridge occur after a flapped tooth extraction, independently of whether ARP is performed.**
- **ARP techniques (with or without immediate implant placement) reduce morphological changes in the horizontal bone (which occur mostly in the coronal portion of the buccal bone plate) compared to spontaneous healing.**
- **Immediate dental-implant placement in post-extraction sites with ARP may be a viable option to reduce hard-tissue morphological changes and treatment time.**
- **The placement of dental implants combined with ARP procedures resulted in a similar reduction in ridge dimension to ARP alone, which was significantly less than that occurring in spontaneous healing four months after tooth extraction.**
- **Immediate dental-implant placement combined with ARP may therefore be a viable option to reduce overall treatment time.**

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