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study

Healing of compromised alveoli over six months: is ridge preservation worth it?

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Background

Following tooth extraction, the residual alveolar bone undergoes marked qualitative and quantitative changes: the amount of ridge resorption that occurs during the healing process appears to be inversely proportional to the baseline level of alveolar bone loss. After the extraction of periodontitis-diseased teeth, each phase of wound healing takes longer (Kim et al, 2017), and cortication of the socket entrance and bone deposition are particularly delayed compared to intact sites (Ahn & Shin, 2008).

Ridge preservation is a safe technique indicated to minimise the loss of ridge volume that typically follows tooth extraction. Regarding severely absorbed extraction, the literature remains controversial: some authors reported that the grafting of compromised alveoli reduced ridge resorption compared to spontaneous healing (Aimed, 2018), while others reported that this postoperative resorption reduction was less evident and mainly concerned the cervical width of the ridge (Zhao et al, 2018) or the socket height (Rasperini et al, 2010).

Plausible reasons that may explain the discrepancies in the reports include heterogeneity in the biomaterials and surgical techniques used and the morphology of the sockets at baseline.

Aims

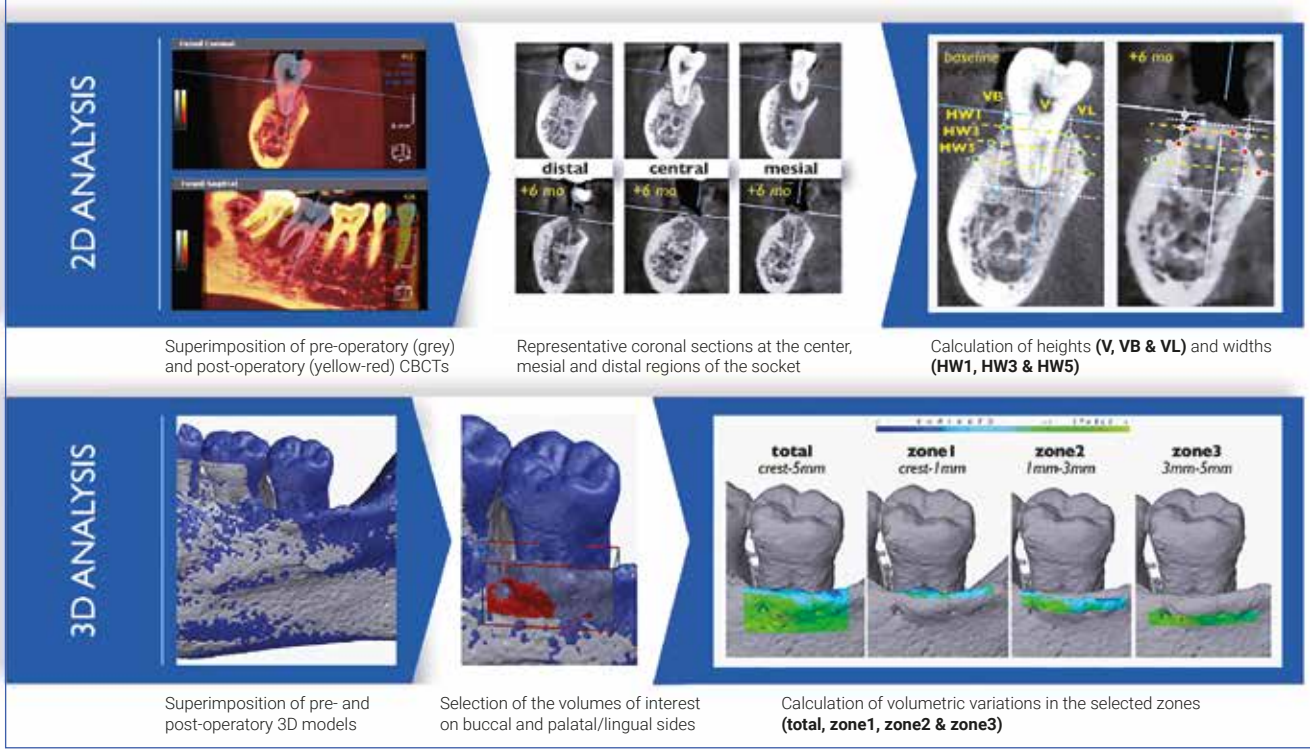
The aim of this randomised controlled trial was to analyse modifications of extraction sockets of periodontally compromised teeth treated with ridge-preservation techniques, compared with spontaneous healing, using volumetric analysis of standardised CBCT images and histomorphometric data.

Materials & methods

This randomised clinical trial enrolled 26 subjects, diagnosed with stage III/IV periodontitis, requiring single or multiple extractions of periodontally compromised teeth with subsequent implant-supported restoration.

- All subjects received a periodontal evaluation, using probing and periapical radiographs complemented by cone-beam computed tomography (CBCT) scans. Included participants underwent supportive periodontal therapy at least one week before treatment (full-mouth plaque and bleeding scores ≤25%).
- The patients were randomly assigned to one of two groups:
  - Test group – ridge preservation (RP): alveoli were filled with deproteinised bovine bone mineral with 10% collagen (DBBM-C; Geistlich Bio-Oss Collagen, Geistlich Pharma AG) and covered with a double layer of a native collagen membrane (NBCM; Geistlich Bio-Gide, Geistlich Pharma AG).
  - Control group – spontaneous healing (SH): no grafts or sutures were placed.
- Week 23: postoperative CBCT was performed.
- Week 24: all sites were re-entered for implant placement. The central portion of the alveolar crest was excised and processed for histomorphometric analysis.
- The efficacy of RP was determined by confronting baseline and postoperative linear and volumetric modifications on CBCT.
- The histomorphometric assessment of the samples was performed using a digital software program (Photoshop, Adobe, USA) that measures the percentage of bone, residual graft, and connective tissue in each specimen.
- The primary outcome measurement of the study was horizontal width. Secondary outcomes were height measurements, volumetric measurements, and histomorphometric outcomes. For statistical analysis, nonparametric tests were used.

Figure: Calculation of socket dimensional alterations



Superimposition of pre-operatory (grey) and post-operatory (yellow-red) CBCTs

Representative coronal sections at the center, mesial and distal regions of the socket

Calculation of heights **(V, VB & VL)** and widths **(HW1, HW3 & HW5)**

Superimposition of pre- and post-operatory 3D models

Selection of the volumes of interest on buccal and palatal/lingual sides

Calculation of volumetric variations in the selected zones **(total, zone1, zone2 & zone3)**

Results

- A total of 26 subjects scheduled for extraction and subsequent implant-supported restoration in the maxilla or mandible were included in this study: 13 individuals (18 sockets) in the RP group and 13 individuals (16 sockets) in the SH group. There were three smokers per group.
- Preoperative socket width was not significantly different between groups.
- Width changes: at week 23, both treatments resulted in a significant reduction in socket width: RP resulted in a reduced bone attenuation compared with SH and the resorption was mainly at cervical level.
- Height changes: buccal and lingual bone walls presented a significant resorption from baseline to week 23, which was more severe in SH compared with RP. In both groups, the reduction in buccal bone height was more severe compared to the palatal/lingual aspect of the socket; at the palatal/lingual bone plates, socket grafting significantly preserved bone.
- Volume changes: the mean volume difference from baseline to week 23 was −26.88% in RP pockets and −50.34% in SH sites, and it was most pronounced in the coronal zones.
- In SH sockets, baseline bone damage was associated with greater subsequent ridge resorption.
- Histological data: reduced bone quantities were found in biopsies: 30.1% in RP, 53.9% in SH. In RP specimens, newly formed bone surrounding the residual bone-substitute particles, free of inflammation was found. In SH specimens, living bone was found, consisting mainly of woven bone organised in trabeculae.

Limitations

- The timing of the baseline CBCT: the first CBCT scan was made before extraction, even though the surgical procedure itself alters the immediate postoperative ridge dimensions.
- No reference was made to the need for additional augmentation techniques for subsequent implant placement.
- There is no reference to the image-acquisition protocol, whose setting may have had an impact on the quality of the images and subsequently on the superimposition of the CBCT images.

Conclusions & impact

- The placement of Bio-Oss collagen secured with a collagen membrane in fresh extraction sockets seemed to minimise the bone-remodelling process, resulting in a less pronounced change in the buccal profile of the alveolar crest and a better maintenance of the volume when compared to unassisted socket control.
- Baseline bone resorption seemed to influence the dimensional shrinkage of the ridge.
- Volumetric dimensional alterations of the hard tissues in severely resorbed alveolar sockets can be quite extensive. The application of a slow-resorbing xenograft with a secured covering collagen membrane may limit post-extraction bone loss and plausibly simplify later implant insertion.

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