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study

Soft-tissue volumetric changes after tooth extraction: spontaneous healing or alveolar-ridge preservation?

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Background

After tooth extraction, hard- and soft-tissue structural and morphological alterations can be expected. As described by Schropp et al 2013, dental extraction can lead to a horizontal bone loss of up to 5-7mm. This tissue shrinkage can have consequences on different dental treatment modalities, whether implant supported or conventional (fixed prosthesis).

Recent studies (Tonetti et al, 2019; Ávila-Ortiz et al, 2019) have demonstrated that alveolar-ridge preservation (ARP) is a reliable procedure to counteract post-extraction soft- and hard-tissue alterations. Applying ARP procedures through bone-grafting materials demonstrated a reduction in the usual morphological changes that occur after a tooth extraction.

Despite the growing evidence on the topic, the respective role of the hard and soft tissues in the overall alveolar-ridge changes remains poorly understood. Moreover, in recent years, digitalisation and optical scanning have enabled the assessment of tissue contours and volumes around teeth and implants, allowing a three-dimensional visualisation and an improved understanding of the dynamic changes following different treatment modalities.

Aims

The aim of this randomised controlled clinical trial was to assess the soft-tissue (ST) volumetric changes and the corresponding differences in soft-tissue dimensions, four months after a single-tooth extraction, and three distinct therapeutic approaches: alveolar-ridge preservation, both with and without immediate implant placement, and spontaneous healing.

Materials & methods

Study design:

- This prospective randomised controlled clinical trial included 30 patients.
- The patients were randomly allocated to three different groups of 10 patients: test group 1 (IMPL/DBBM/CM) with immediate implant placement, deproteinized bovine bone mineral, and a collagen matrix; test group 2 (DBBM/CM without implant placement); and spontaneous healing (SH) as the control group.

Procedures and follow-up:

- Full-thickness flap, atraumatic tooth extraction, and granulation-tissue elimination.
- Sutures removed seven days after surgery.
- Maintenance and follow-up according to periodontal and caries risk assessment.
- Recall at four months following the surgical procedure.

Methods and data collection:

- Impressions were performed for each patient with a polyether material at two time points: at the end of the surgery (baseline) and four months later. Casts were manufactured with dental stone and STL files were obtained by scanning these casts.
- Superimposed STL files allowed the evaluation from baseline to four months of linear changes at 1, 3, and 5mm apical to the most coronal soft-tissue margin and volumetric soft-tissue changes at the buccal aspect of the alveolar ridge.
- Buccal soft-tissue thickness was assessed by superimposing the STL files and the DICOM files obtained from CBCTs to assess the soft-tissue dimension (volume and thickness) at baseline and after four months.
- Full-mouth plaque score (FMPS), full-mouth bleeding score (FMBS), keratinised-tissue height (KTH), and tissue thickness (TT) were assessed at baseline and after four months.
- All the measurements were performed by a single calibrated and blinded examiner.

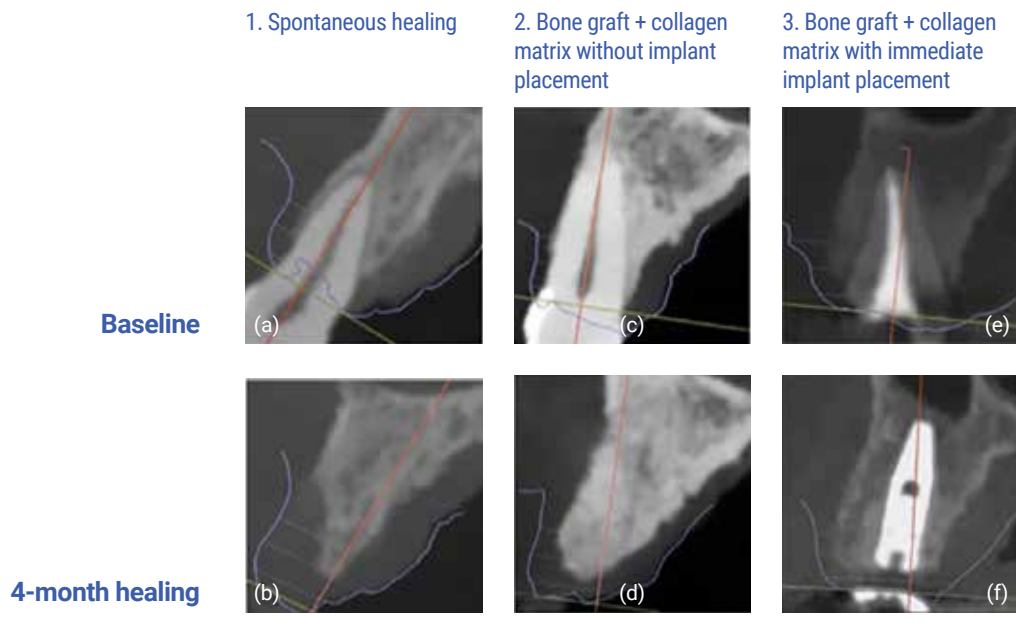
Figure

Superimpositions of hard and soft tissues (purple line) in the three treatment modalities.

1. Spontaneous healing site: (a) baseline and (b) 4-month healing.

2. DBBM-CM site: (c) baseline and (d) 4-month healing.

3. IMPL/DBBM-CM site: (e) baseline and (f) 4-month healing.



Results

At four months:

Soft-tissue linear changes:

- All groups showed a linear horizontal reduction of the bucco-lingual soft-tissue contour.
- The SH group showed a tendency towards greater soft-tissue changes, which were statistically significant only regarding the buccal aspect at 5mm apically to the most coronal ST margin (1.66 ± 0.26 mm in the SH group, 1.02 ± 0.31 mm in the DBBM/CM group, and 0.85 ± 0.26 mm in the IMPL/DBBM/CM group).

Soft-tissue volumetric changes:

- All groups showed ST volumetric reduction at the buccal aspect.
- Despite a tendency to a less pronounced reduction in the two test groups, the differences between the groups were not statistically significant.

Soft-tissue thickness (DICOM/STL image superimposition):

- At 3mm below the most coronal point of soft tissue contour, the soft-tissue thickness demonstrated a significant increase in the SH group when compared to the test groups.
- At 5mm below the most coronal point of soft tissue contour, no differences between the groups were observed.

Limitations

- According to the authors, one of the limitations is the definition of the baseline measurement. Given that dental extraction is usually followed by a slight expansion of the soft and hard tissues, it would be relevant to use the dimensions of the initial socket before tooth extraction as baseline values.
- Moreover, the indirect scanning of cast models leads to additional steps that may increase the risk of imprecision. Conventional impressions with polyether material can induce soft-tissue compression that might undervalue soft-tissue thickness. The use of direct intra-oral scans may have increased the accuracy.
- Surgical procedures involving the combination of connective-tissue grafting (CTG) and ARP was not investigated, while it was suggested that CTG could effectively compensate for a buccal volume loss.

Conclusions & impact

- In the three groups, the buccal soft-tissue profile underwent linear and volumetric changes within the first four months after tooth extraction, and no significant differences were observed between the groups.
- In the SH group, a significant increase in soft-tissue thickness was observed, while in the two test groups, the soft-tissue thickness remained stable.
- When the ARP procedures were not applied, an increase in soft-tissue thickness seems to compensate for the more pronounced horizontal bone loss.

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