Changes in Ridge Dimension with Pontics Immediately Placed at Extraction Sites: A Pilot Study

Monjir Bakshi, DMD, MS
Dennis Tarnow, DDS
Nurit Bittner, DDS, MS

The aim of this prospective clinical study was to evaluate dimensional changes following immediate placement of a fixed ovate pontic provisional restoration into an intact extraction socket without grafting. The mean buccolingual dimensional change at 1 month was 0.51 ± 0.48 mm and 0.93 ± 0.55 mm at 3 months. The mean incisoapical dimensional change at 1 month was 0.68 mm ± 0.19 mm, and at 3 months, 1.64 ± 1.35 mm. The dental literature reports dimensional change of 3 to 5 mm in width and 1 to 4 mm in height for ridges with no treatment following extraction. This study provides validation for the use of ovate pontics in the preservation of tissue contour. Further research is needed to determine whether placing a graft into the socket with placement of an ovate pontic will decrease dimensional changes after extraction. Int J Periodontics Restorative Dent 2018;38:541–547. doi: 10.11607/prd.3496

Postextraction alveolar ridge remodeling and subsequent tissue loss can pose surgical and restorative challenges, leading to compromised esthetic results. Because the alveolar process is a tooth-dependent structure, removal of multiple teeth or even a single tooth will lead to significant dimensional changes of the alveolar ridge and adjacent soft tissues, with more bone loss in the buccal aspect as opposed to the palatal portion.

Dimensional changes in the alveolar process and overlying mucosa following tooth extraction have been extensively reported in the dental literature. These investigations have evaluated morphometric changes through direct pre- and postextraction measurements via flap elevation, subtraction radiograph, cephalometric analyses, and cast measurements. While measurement techniques vary greatly, a systematic review reported a mean loss of 4.0 mm in ridge width when the socket was allowed to heal without the use of socket preservation techniques. Approximately two-thirds of this reduction occurred within the first 3 months, with maximum change in tissue contour by 1 month. However, the validity of such studies can be questioned due to their design, such as inclusion of flap elevation to perform...
tooth removal and, postoperatively, to measure ridge dimensions.

Proper management of marginal soft tissues begins at the time of extraction by following surgical protocols such as atraumatic extraction to preserve facial bone integrity and a flapless approach to maintain vascular blood supply to the labial bone plate.12

While the immediate insertion of ovate pontics into extraction sockets has been used routinely since the early 1900s as a treatment approach in the esthetic zone, it has not been validated with numerical data to quantify outcomes.

Tinker13 and Brill14 first described implantation of a “porcelain root-tip [to] close the orifice of the root socket.” Tinker advocated the use of short pontics extending one-fourth to one-half the length of the socket, whereas Brill believed in using long pontics extending one-half to three-fourths the length of the socket, with a width of 1 to 2 mm less than the width of the socket.

Reichenbach15 investigated the histologic effect of porcelain root tips inserted in the alveolus immediately after extraction in 25 clinical cases with 2-year follow-up and demonstrated that alveolar resorption occurred. Consequently, apical extension of pontics into the alveolus was not recommended. Dewey and Zugsmith16 reported no bone resorption with the long pontic design, rather illustrating the tendency of the epithelium to cover wound surfaces in which porcelain pontics were inserted. Despite these claims, their results indicated epithelial downgrowth around the root portion of the pontic along with an inflammatory infiltrate of connective tissue with an apical abscess often forming. Irving17 proposed a more conservative approach, recommending the use of short pontics not extending more than one-fourth the length of the original root.

The concept of immediate pontic insertion fell out of use due to indiscriminate application and improper case selection, often resulting in severe inflammatory response and alveolar necrosis.18,19

The root-tipped or ovate pontic re-emerged in 1980 when Abrams20 prescribed its use in conjunction with a de-epithelialized connective tissue pedicle graft as a means to support the augmentation of a facial soft tissue defect of an edentulous site. Abrams suggested that the rounded, convex base of the ovate pontic could be placed 5 mm into the surgically altered recipient site or recent extraction site to accurately conform and maintain the soft tissue–pontic relationship and prevent the collapse of the edentulous ridge. As the socket heals, the attachment apparatus would re-establish itself around the pontic and the immediate pontic could be gradually shortened.

The biologic rationale for using the immediate ovate pontic approach is based on the prosthetic socket-sealing concept, that by stabilizing and protecting the fibrin clot through contact inhibition allows wound healing to initiate via secondary intention.21 The limited histologic evidence supports the notion that, when inserted into a fresh extraction socket, the highly polished ovate pontic stabilizes the fibrin clot, acts as a chamber matrix for formation of the stratified squamous epithelium, and mechanically supports the soft tissue.22 While anecdotal evidence regarding the soft tissue response to the immediately inserted ovate pontic exists, to date no measurements of the soft tissue dimensional changes have been recorded. Therefore, the objective of this prospective clinical cohort study was to measure the vertical and horizontal dimensional change using immediate ovate pontics in postextraction sockets that present an intact buccal plate and adequate soft tissue.

Materials and Methods

This clinical study was approved by the Institutional Review Board of Columbia University. Healthy patients aged 18 years or older were considered for recruitment. Inclusion criteria were no uncontrolled systemic medical conditions, presence of a nonrestorable maxillary anterior tooth (first premolar to first premolar) with intact adjacent teeth, and no recession present. Exclusion criteria included smokers, gingival recession, probing depths of > 3 mm on the facial aspect of the tooth to be extracted, presence of adjacent implants, insufficient interocclusal distance, bruxism or other parafunctional habits, and lack of posterior support.

Of the 10 recruited participants, 9 presented to the Columbia University College of Dental Medicine Triage Department seeking emergency dental treatment due
to a fractured anterior tooth and/or pain on function. The remaining patient had an endodontically failed tooth that was treatment-planned for extraction. The patients were provided alternative treatment options, including immediate implant placement or socket preservation at time of extraction. Study participants refused such therapies due to financial constraints. Enrollment was completed by verbal and written consent of the patient.

After administration of local anesthesia, the nonrestorable tooth was atraumatically extracted using a flapless approach (Fig 1). The extraction socket was thoroughly debrided. The distance from the crest of the facial bone to the free gingival margin was measured using a calibrated periodontal probe to evaluate the buccal plate. Only sites with ≤ 5 mm measurements were included in the study.

In cases where a fixed dental prosthesis was treatment-planned to replace the missing tooth, a traditional three-unit full-coverage provisional restoration was fabricated using autopolymerized polymethyl methacrylate (PMMA) (Super-T, American Consolidated), providing an ovate pontic, and was luted with temporary cement (TempBond NE, Kerr) (Fig 2). However, the majority of cases had natural intact adjacent teeth, and a fixed dental prosthesis was not indicated. In these cases, a provisional resin-bonded prosthesis with an ovate pontic made of autopolymerized PMMA (Super-T, American Consolidated) was adhesively bonded with flowable composite resin (Beautifil Flow Plus,

Fig 1 (a) Frontal view and (b) occlusal view of hopeless maxillary right central incisor scheduled for extraction. (c) Atraumatic flapless extraction. Periodontal probing of the buccal plate measured 3 mm from the free gingival margin. (d) Occlusal view of intact soft tissue and buccal plate.

Fig 2 (a) Occlusal view of maxillary left lateral incisor scheduled for extraction. (b) Atraumatic flapless extraction; periodontal probing of buccal plate measured 3 mm from free gingival margin. (c) Provisional fixed dental prosthesis with ovate pontic. (d) Frontal view and (e) occlusal view of the prosthesis with ovate pontic after extraction of the tooth.
Shofu) following spot-etching of the adjacent teeth with 37% phosphoric acid (Ultradent, Kerr) and application of a light-cured bonding agent (Optibond Solo, Kerr) to the adjacent natural teeth (Fig 3). The ovate pontic surface on all cases was finished to have a smooth, convex subgingival contour extending 3 mm apical to the free gingival margin to properly support the soft tissue profile. The polished surface of the pontic was obtained using a slurry of pumice (coarse/fine grit, Kerr). Occlusion was adjusted to eliminate all centric and excursive contacts.

Irreversible hydrocolloid (Jeltrate Plus-Fast Set, Dentsply) impressions were made at the baseline examination prior to tooth extraction and at the 1- and 3-month follow-up appointments and immediately poured in Type IV dental stone (Fuji-Rock, GC) to fabricate casts for optical analysis. All casts were inspected for the presence of irregularities, undefined gingival margins, and fractured cusps or nodules and were deemed acceptable.

The casts were optically scanned using a digital scanner (E4D PlanScan, Planmeca) to create digital STL files. The STL files were then uploaded into an image analysis software (Romexis Compare). The software automatically superimposed the two STL files (baseline and 1- or 3-month follow-up) according to the unaltered buccal surfaces of the adjacent teeth using a series of best-fit mathematical algorithms. The software was used to measure the dimensional changes in the buccolingual alveolar ridge, comparing the contour before tooth extraction and 1 and 3 months after treatment. The superimposed images were sectioned longitudinally, bisecting the edentulous span into two equal parts mesiodistally. A line coinciding with the axis of the tooth was drawn in the transversal images of the baseline section to serve as a reference point for the follow-up measurements. To evaluate the soft tissue thickness, a line parallel to the axis of the tooth was drawn contacting the most coronal aspect of the gingival margin of the baseline. The distance between this line and the buccal outline was then assessed at 0, 1, 2, 3, 4, and 5 mm below the gingival margin at both time points (Fig 4).

Statistical analysis was performed using a statistical software program (SPSS 20, IBM). The primary
outcome variables were horizontal and vertical soft tissue dimensional change at 1 and 3 months after tooth extraction. Descriptive statistics and paired samples t-test were performed for comparisons ($\alpha = .01$). A two-way analysis of variance ($\alpha = .01$) was performed to compare dimensional changes.

**Results**

A total of 10 patients (6 men and 4 women; aged 21 to 68 years, mean 48 years) were enrolled. Five pontics were placed at a lateral incisor site (50%), four at a central incisor site (40%), and one at a first premolar site (10%). Of the 10 enrolled patients, 2 failed to return for the 1-month follow-up appointment but presented for the 3-month follow-up, and 1 patient only returned for the 1-month follow-up. Healing of all patients was uneventful, without intraoperative or postoperative complications. Clinically, 1 week after insertion of the immediate ovate pontic, all sites on all patients had complete wound closure around the pontic with minimal inflammation or swelling (Fig 5).

A total of 27 casts were fabricated from alginate impressions made at baseline and at 1- and 3-month follow-ups. Digital cast measurements showed a total mean ± SD horizontal (buccolingual) dimensional change at 1 month of 0.51 ± 0.48 mm (range 0.76 to 1.69 mm; standard error [SE] 0.1; $P < .001$), while at 3 months the total mean ± SD horizontal change was 0.93 ± 0.55 mm (range 0.00 to 1.91 mm; SE 0.93; $P < .001$). The total mean ± SD vertical (coronocoronal) dimensional change measured at 1 month was 0.68 ± 0.19 mm (range 0.32 to 0.84 mm; SE 0.06; $P < .001$) and at 3 months was 1.64 ± 1.35 mm (range 0.54 to 4.85 mm; SE 0.48, $P < .001$) (Figs 6 and 7).

**Discussion**

This study demonstrates that placement of a fixed, immobile ovate pontic in an extraction site without the use of socket grafting results in...
less midfacial tissue collapse and recession compared to previous data on nontreated sockets. The average net loss using the fixed ovate pontic technique was about 1 mm horizontally and 1.5 mm vertically at 3 months following extraction, while at sites where no socket augmentation was performed an average loss of 2.6 to 4.5 mm in width and 0.4 to 3.9 mm in height was reported.9

Following extraction, socket preservation is a commonly performed procedure to minimize soft tissue contour change. However, to date, most socket preservation techniques consist only of surgical techniques such as flapless, atraumatic extraction, socket preservation with bone graft and possible connective tissue graft, and/or immediate implant placement. Augmentation of bone volume can be achieved using the guided bone regeneration procedure, which is based on the principle that a barrier membrane is used for space maintenance over a defect to promote the ingrowth of osteogenic cells and prevent migration of undesired cells from the overlying soft tissues into the wound.23 Researchers have been searching for the best containment mechanism for the graft material, using membranes or autogenous gingival graft (socket seal concept)24 at the socket orifice. While these surgical techniques minimize the predicted postextraction tissue loss, they are often technique-sensitive and time consuming, and they involve multiple reentry surgeries.

The use of a provisional alone to maintain tissue architecture has not previously been measured for quantitative outcomes. The diminished collapse and recession observed in this study may be attributed to the immediate fixed ovate pontic functioning as a prosthetic socket-sealing device. The treatment concept applies the principles of guided tissue regeneration: clot stabilization, wound protection, and space creation.23 Inserting the ovate pontic immediately into the extraction socket stabilizes and protects the blood clot and maintains the space for bone remodeling.25 Since the epithelium does not contain blood vessels, the fibrin clot provides a vascular bed across which epithelial cells can migrate and initiate wound healing via secondary intention. The free edge of the injured epithelium of the socket will proliferate and migrate until it meets another free edge of epithelium, where it is signaled to stop growing laterally through contact inhibition.26 Just as the pontic serves as a containment vehicle for the fibrin clot, it can serve to contain graft material. Further research is needed to determine whether the fixed ovate pontic could provide better graft containment, papilla height, maintenance of soft tissue dimensions, and patient-related outcomes, such as comfort and shorter treatment time.

Other important factors affecting postextraction tissue healing, such as buccal plate thickness, interproximal bone levels, thick or thin periodontal biotypes, and preoperative soft tissue inflammation, were not considered in the present study. An additional limitation is the relatively small sample size and the limited follow-up time of 3 months. Further research is also required to assess the long-term stability of this technique in compromised sockets without a buccal plate with and without socket grafting.

Conclusions

This is the first study to evaluate dimensional changes using an ovate pontic without graft material in a fresh extraction socket. Within the limitations of this cohort study, the results suggest that an ovate pontic placed immediately into a fresh extraction socket may minimize the loss of soft tissue in horizontal and vertical dimensions. Compared to previously reported values of 3 to 5 mm loss in width and 1 to 4 mm in height where no measures were taken to preserve the soft tissue, results using the ovate pontic suggest minimal change, with an average 0.93 mm loss in width and 1.64 mm loss in height. These findings validate the use of the ovate pontic, which could provide a nonsurgical approach to gaining optimal esthetic results in the anterior maxilla without the use of bone grafting. Larger sample size is necessary to corroborate these preliminary findings with and without bone grafting of the socket. Future studies to evaluate the use of ovate pontics in sockets with buccal bone plate defects are also indicated.

Acknowledgments

The authors thank J. Doung of the Department of Biostatistics at Columbia University, as well as the Irving Institute for Clinical and
Translational Research for the help with the statistical analysis. The authors reported no conflicts of interest related to this study.

References