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Standardization of vertical root resection during socket shield technique in immediate implant placement

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ABSTRACT

Objectives. The aim of the present study was to standardize an accurate and significant technique of root separation during socket shield technique.

Patients and methods. Two phases of the study were conducted. In vitro study was performed on 20 extracted single-rooted anterior teeth. The second phase was clinical application of the new technique on 10 patients seeking to restore their badly decayed anterior teeth in the esthetic area with immediate implant placement utilizing the socket shield technique. Decoronation was done. The root canal was mechanically enlarged by means of manual assorted files. Canals were further enlarged with Gates Glidden drills. Peeso Reamer drills were used till the root was entirely separated into two parts (buccal & palatal). The palatal root was cautiously removed when the labial and palatal root halves were sufficiently separated. In case the root to be removed was endodontically treated, Gutta-percha was mechanically removed using Gates Glidden, & Gutta-percha solvent to remove the coronal and apical parts.

Outcomes. Using manual endodontic K-files, Gates Glidden burs, and Peeso Reamer's drills in separating the single-rooted teeth into two halves is a reproducible, and reliable procedure during socket shield technique.

Conclusions. This technique prevents possible complications of root sectioning during socket shield technique with immediate implant placement. It preserves surrounding soft tissue structures, and labial shield during shield preparations, maintains the integrity of the labial plate of bone during extraction. Additionally, it offers total root apex removal by entirely separating the palatal portion from the labial shield.

Keywords: socket shield technique, single-rooted anterior teeth, vertical root resection, tooth preservation, labial bone plate preservation

INTRODUCTION

One of the greatest treatment choices for restoring function at the aesthetic zone is the extraction of unrestorable teeth followed by immediate implant insertion. The alveolar ridge proportions changed as a result of socket repair after tooth removal since the greatest loss happens on the buccal side [1]. The majority of the vascular supply for the delicate, thin buccal bone comes from the periodontal ligaments of the anterior teeth. Because the periodontal ligament's blood supply at the buccal region is cut off after extraction, alveolar resorption is a multifactorial physiological process that cannot be completely avoided [2]. The socket shield technique is a promising approach that helps to maintain function and aesthetics since it completely preserves the attachment apparatus for the alveolar ridge. In order to prevent tissue changes after tooth extraction, a partial root fragment was preserved surrounding an immediate implant using the socket shield approach.

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Therefore, the objective of the present study was to standardize technique of root division [3].

MATERIAL AND METHODS

In vitro study to standardize the technique

This was performed on 20 extracted single-rooted anterior teeth; to standardize an accurate and significant technique of root separation, whether the root was endodontically treated or not.

Teeth were inserted in an acrylic block prior to sectioning (Figure 1A). Pre-operative periapical radiograph was taken on all surfaces of the tooth at different angles (Figure 1B). The tooth was decoronated and working length was determined radiographically (Figure 1C). The root canal was mechanically enlarged by means of manual assorted files (Mani endodontic K-files, manufactured by MANI, INC) starting from #15 reaching the whole working length till size #50 using K files. Canals were further enlarged with gates glidden drills (Mani gates glidden drills manufactured by MANI, INC) to size #6 sequentially.

Splitting the root using peeso reamer drills (Mani peeso reamer drills, manufactured by MANI, INC), with the canal as a reference point was done in mesiodistal direction to the full working length till the root was entirely separated into two parts (buccal & palatal). Periapical radiograph was taken with a resection bur in the prepared site.

After the labial and palatal root halves were sufficiently separated, the palatal root segment was carefully displaced labially using a microperiotome instrument and retrieved with a curved hemostat (Figure 1D).

In case of the root to be removed was endodontically treated, Gutta-percha was mechanically removed using gates glidden drills #2, 3 & gutta-percha solvent (Carvene, manufactured by Prevest Denpro) to remove the coronal and apical parts using H-files #35 & 40. Confirmatory periapical x-ray was taken to ensure complete gutta-percha removal and working length was determined. Irrigation using NaOCL (sodium hypochlorite) concentration 2.5%, 5 cm plastic syringe, and sterile needle (25 gauge). Sequential steps mentioned above were done.

In Vivo application of the standardization technique

The procedure was achieved under local anaesthesia at the chair side via labial and palatal infiltration technique to anesthetize the anterior superior alveolar nerve labially, and nasopalatine nerve palatally.

A bite block was inserted to provide the comfort of the TMJ, and avoid over-tension on the joint. Minnesota retractor was used to retract the upper lip, then exposure of the field of surgery was performed by designing & reflecting a full-thickness pyra-

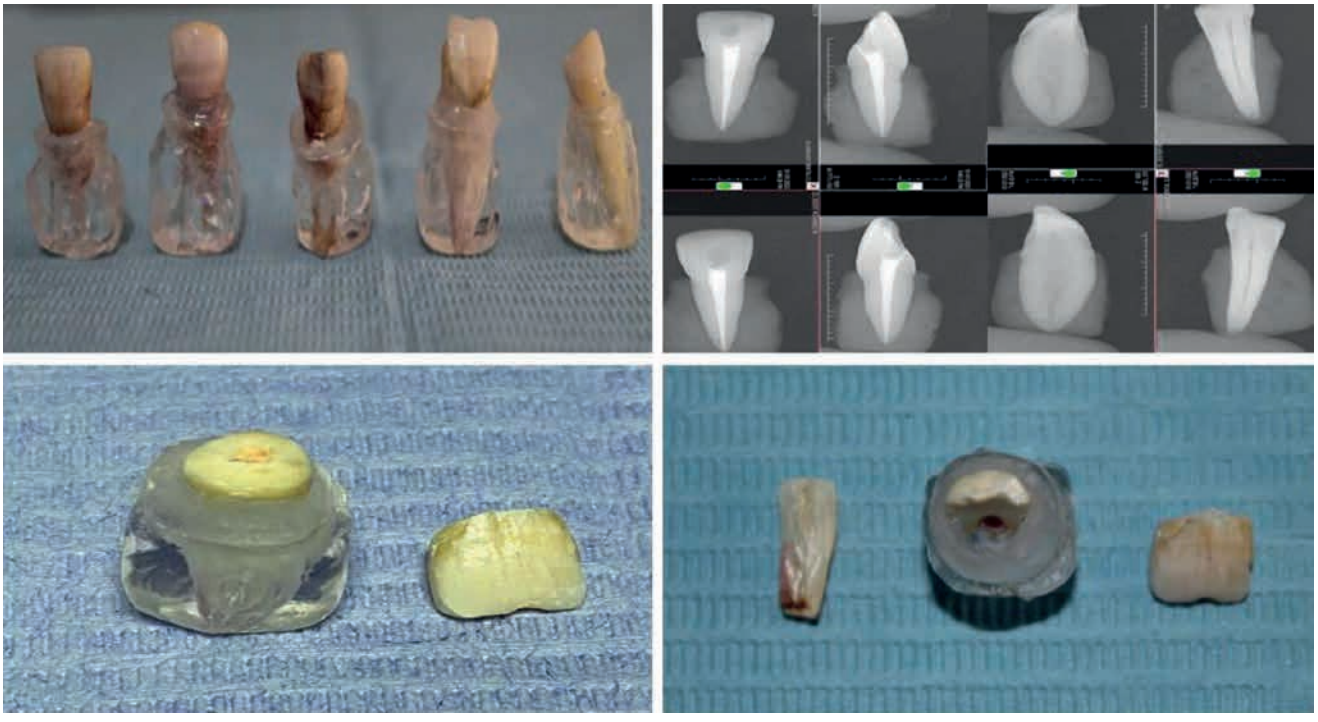

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FIGURE 1. A. Extracted teeth inserted in an acrylic block before sectioning. B. Periapical radiograph showing buccal and proximal aspects of endodontically treated maxillary central incisor, and non-endodontically treated maxillary canine. C. An extracted upper central incisor went decoronation using a long-shank fissure surgical bur. D. An extracted upper central incisor went a root splitting

midal flap (Mucoperiosteal flap). Two incision lines flap, composed of a gingival incision & one oblique incision. (Figure 2A) Working length was determined by the radiographic method (Ingle's method). With care given to protect the gingiva, decoronation of the tooth to the gingival level. This was done by using a long-shank fissure surgical bur (Figure 2B). The root canal is enlarged by means of manual files reaching working length to size #50 using K files (Figure 2C).

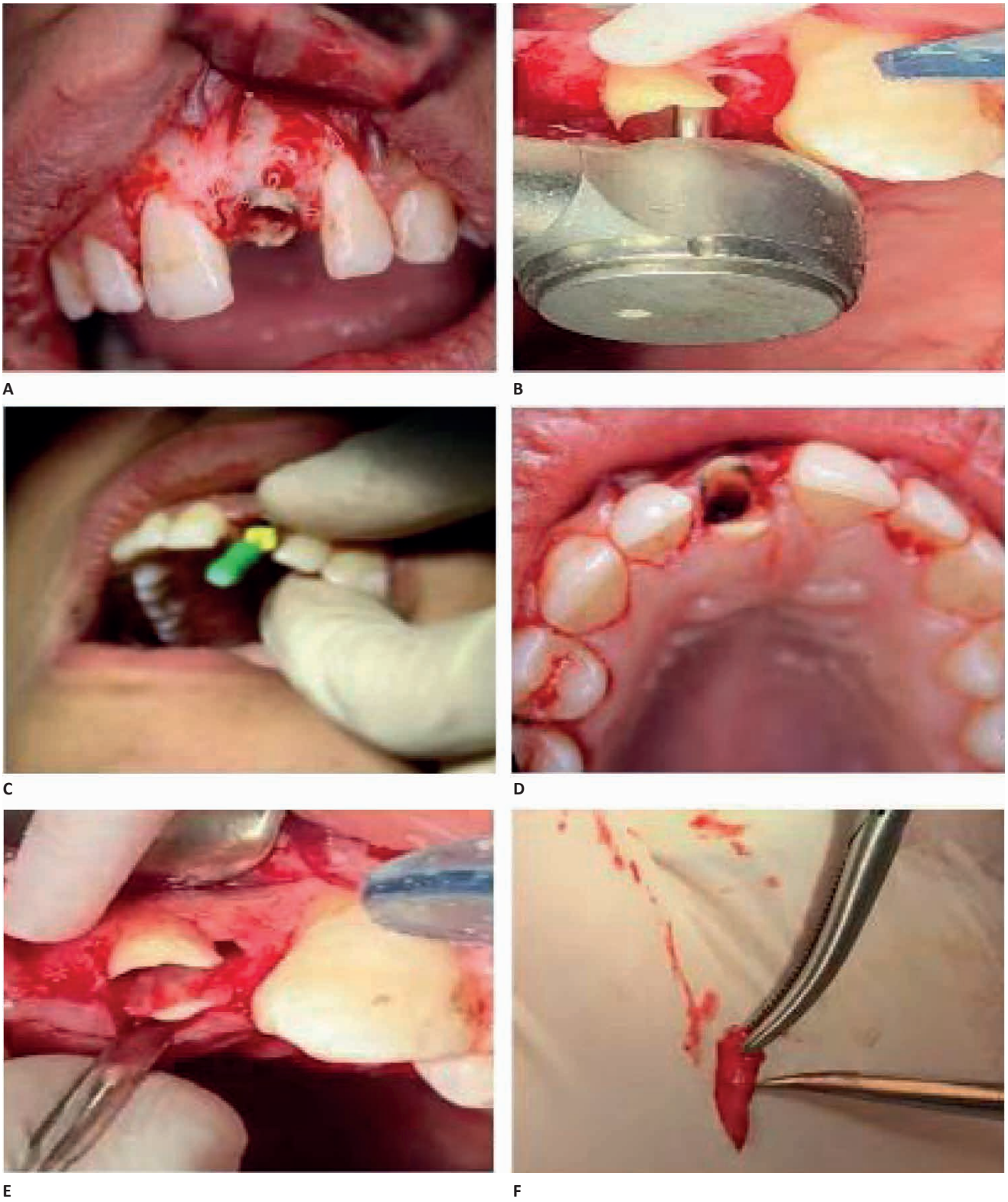

FIGURE 2. A. Full-thickness pyramidal flap with two lines incision flap. B. Decoronation of the tooth to the gingival level. C. Endodontic file size #35 is placed inside the root canal for enlarging the root canal. D. Following canal widening with Gates Glidden burs, Peeso Reamer drills. E. Palatal root segment was carefully displaced labially using a microperiotome instrument. F. Palatal fragment after root separation

Canals were further enlarged with Gates Glidden drills to size #6 sequentially. Following canal widening with Gates Glidden burs, Peeso Reamer drills were used directly down the root canal to the apex. Cutting through the root while using canal as a guide was done in mesiodistal direction to the full working length till the root was entirely separated into two parts (buccal & palatal) (Figure 2D). This was the start of apex removal and was one of the most important steps in the technique. Extreme caution was taken to avoid injuring nearby bone or teeth mesially or distally. A periapical radiograph was taken with a Peeso Reamer drill in the prepared site.

After the labial and palatal root halves were sufficiently separated, the palatal root segment was carefully displaced labially using a microperiotome instrument and retrieved with a curved hemostat (Figures 2E, F).

Maintaining a finger rest on the labial ridge was critical. This enabled tactile sensation when elevating the palatal root section in order to indicate movement of the socket shield or incomplete root sectioning. As a consequence of incomplete root sectioning, dislodgement of the labial root section will occur. A pointed probe was used to instrument the inside surface of the labial shield in order to check for any cracks or immobility.

Once the root section had been confirmed to be stable, all remnants of infection if present in the socket apex were to be properly curetted out and then thoroughly rinsed with saline solution. A round diamond bur was then used to reshape and form the coronal aspect of the root portion to the level of the alveolar bone crest. This was followed by reduction of the socket shield to approximately half of its thickness from the root canal to its labial limit, while ensuring that the apical root section is thicker than the coronal one (Figure 3A).

After completely rinsing the socket with physiological saline solution, sharp probe was used to check root portion for immobility. A periapical radiograph was performed to confirm absence of any sharp edges at the root surface, and no remnants in the socket.

Subsequently, according to the standard method of implant insertion, the implant bed was initially prepared, then the osteotomy was widened through the long axis of the remaining root using sequential implant drills according to the manufacturer's instructions till the final diameter of the selected implant. Drilling was done palatal to the shield with a gap of roughly 0.5-1 mm, contacting palatal aspect of the root, and leaving buccal aspect intact after implant bed preparation.

Finally, implant was inserted in the palatal bone near the root. The buccal wall was occupied by the retained buccal aspect of the root, which was made up of a thin layer of dentin followed by cementum, periodontal ligament, and bundle bone. Implant housing was made up of mesial, distal, and palatal bony walls (Figure 3B).

DISCUSSION

At the beginning of the study, two clinical cases passed through difficulties during the separation and preservation of the remaining root, a fracture of labial bone plate, and failure to reach the root apex during the separation. Long shank root resection bur was used to prepare the shield as far apical as possible. This was done in accordance with Gluckman et al. [4] recommendations, as they noted that preparing the socket shield as far apical as possible using a long shank root resection bur was more predictable, reproducible, and of low risk for the labial plate fenestration than the method described by Baumer et al. [5], who favored leaving only the coronal part of the labial shield during shield prepara-

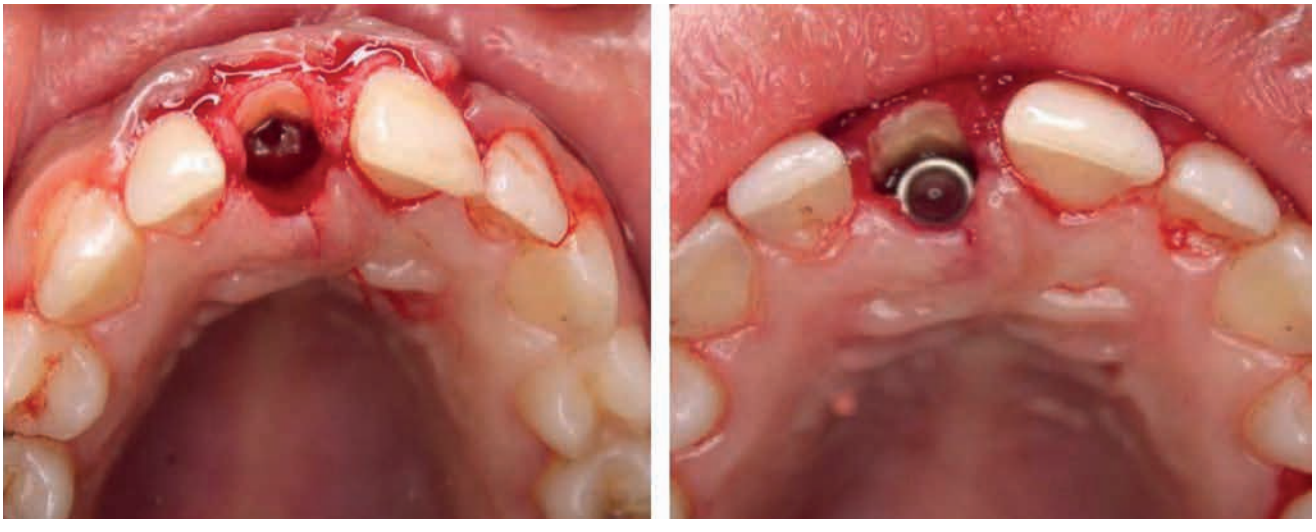

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FIGURE 3. A. Clinical photograph showing the labial shield after preparation. B. The implant housing

tion after tooth decoronation, without specifying a specific length. In the current study, we failed to reach the root apex with a long shank resection bur. In addition, neither Gluckman nor Baumer described the exact technique of root separation, and the tools used for sectioning the root atraumatically into two halves. We detected after two pilot cases that the failures were mainly due to a lack of standardization of the root separation and socket shielding technique, the absence of a standard technique that described the exact root separation, and the tools used for sectioning the root traumatically into two halves with preservation of the labial shield and surrounding soft and hard tissues. That took us to do an experimental study on extracted teeth before applying the technique to more patients. An in-vitro pilot study was done on 20 extracted single-rooted teeth was used in this phase; to standardize an accurate and significant technique of root separation, whether the root was endodontically treated or not. From the in-vitro study we had found that using Gates Glidden burs, and Peeso Reamer's drills with periapical radiographs in separating the root into two halves, with preservation of the labial shield and surrounding soft and hard tissues is a reproducible, reliable, and controllable technique with the reassurance of reaching the root apex and complete removal of the root apex without injury to the labial shield. Following the experimental study on extracted teeth, all patients' tooth shells remained intact during the follow-up period, there was no apical resorption. No, mobility or infection was recorded.

In the present study, the ingrowth of bone between the shield and the implant surface was encouraged by decreasing the thickness of the shield to 1.5 mm and giving it concave design. A balance must be struck between reducing the danger of shield exposure, retaining as much facial tissue as possible, and avoiding a thinner shield that is more prone to flexure, fracture, or movement. The ideal socket shield size in terms of length and thickness is still up for debate. According to Hurzeler et al. [6] the prepared shield thickness, which ranges from 1 to 2 mm, can change in the corono-apical direction, whereas Guirado et al. [7], advocated a thickness of 2 mm.

In the present study, the shield was prepared followed by implant bed preparation. The socket was thoroughly rinsed with physiologic saline solution to reduce the risk of heat generation. That was incompatible with Hurzeler et al. [8]. They stated that osteotomy was drilled through the roots and used methylene blue staining agent to the shield from the inside to visualize the possible cracks. Also, before preparing the shield, Baumer et al. [5], advised preparing implant bed through the tooth. He also noted that using new implant drills and keeping them stable in a vertical manner minimized chance of heat generation and root segment dislodging.

CONCLUSIONS

Using Gates Glidden burs, and Peeso Reamer's drills with periapical radiographs in separating the root into two halves, is reproducible, reliable, and controllable technique with the reassurance of reaching and complete removal of the root apex without injury to the labial shield. Preparing the shield at the level of the alveolar bone crest prevent exposure of the shield with no loss of the alveolar bone height.

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