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Review Article

Classification and types of flaps in endodontic surgery

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ABSTRACT

The success of endodontic surgeries can be significantly associated with the selected dental flap. Many flaps have been reported among studies in the literature with variable frequencies of advantages and disadvantages and with different indications for each flap. This literature review discusses the most commonly reported types of endodontics flaps along with the reported advantages and disadvantages, in addition to the uses, applications, and most probable indications and contraindications for each designed flap. Among the reported flap designs, clinical success and favorable outcomes were observed with the ones that limited the damage to the root-attached tissues. Moreover, crestal bone loss has been reported to be minimal when using the full mucoperiosteal flap designs. Many previous studies have reported that using triangular and rectangular flap designs has been associated with favorable events regarding crestal bone loss, with the observed complete healing of the resorption damaging events and absent alternations of the heights of the crestal bone that were potentially affected. Further details of each flap design are provided within the full manuscript of this article based on the obtained evidence from previous investigations.

Keywords: Flaps, Endodontics, Management, Classification

INTRODUCTION

The definition of a dental flap is a piece from the surrounding mucosal or gingival tissues that are designed to be surgically elevated from the corresponding and underlying tissues, which give a significant access point to the surgeons for adequate management of root and bone tissues.[1] There are two main components of surgical access in such situations, including the manipulative and the visual. While the visual perspective makes the surgeon able to view the whole operative field, the manipulative one enables him to properly conduct all the surgical steps. The success of endodontic surgeries can be significantly associated with the selected dental flap. Many flaps have been reported among studies in the literature with variable frequencies of advantages and disadvantages and with different indications for each flap.[1] This literature review discusses the most commonly reported types of endodontics flaps, together with the reported advantages and disadvantages, in addition to the uses, applications,

and most probable indications and contraindications for each designed flap.

METHODS

This literature review was based on an extensive literature search in Medline, Cochrane, and Embase databases on 4th June 2021 using the medical subject headings (MeSH) or a combination of all possible related terms. This was followed by the manual search for papers in Google Scholar and the reference lists are included at the end of this research.[2,3] This research discusses the types of endodontics flaps that were screened for relevant information. There are no limits on date, language, age of participants, or publication type.

DISCUSSION

Classification of dental flaps has been a common issue for dental researchers and clinicians over the years. Many studies have been previously published to report the various types and classifications of dental flaps together with the observed clinical advantages and disadvantages. Figure 1 shows a classification that has been proposed by Gopikrishna and colleagues.[4] Among the proposed classifications, the one published by Gutmann and Harrison remains the most commonly used and widely accepted classification of dental flaps.[5] The classification is divided into two main categories including the limited and full peri-radicular mucoperiosteal flaps. To differentiate between the two main categories of this classification, the location where the horizontal component has been incised is the main hallmark that can be used for this purpose. Intrasacular horizontal incision is mainly observed with the full mucoperiosteal flaps, in addition to the interdental and marginal reflections of the gingival tissues, being independent parts of the designed flap. On the other hand, limited mucoperiosteal flaps are usually designed without the presence of gingival tissue reflections, and the main parts are mainly designed by horizontally-oriented or horizontal sub-marginal incisions.[5]

Furthermore, a previous investigation by Luebke and Ingle was conducted to report novel plane geometric terms aiming at easy identification and classification of the peri-radicular surgical flaps. According to the intended surgical incision, the peri-radicular surgical flap designs can be classified into two main categories including the full and the limited mucoperiosteal surgical flaps, as previously mentioned. The full mucoperiosteal flaps can be furtherly subclassified into triangular (with one vertically released incision), rectangular (with two vertically released incisions), horizontal (with no vertically-released incisions), and trapezoidal (a broad-based rectangular incision). On the other hand, the limited mucoperiosteal flaps can be furtherly subclassified into the sub-marginal or the semilunar curved flap and the Ochsenbein-Luebke or the sub-marginal scalloped flap.[5] Each of these flaps will be discussed in the following sections.

Subclassifications of the full mucoperiosteal flaps

Triangular flaps

To design such flaps, an intrasulcular horizontal incision is performed with an incision that is vertical releasing. Enhanced wound healing has been reported as the major advantage with this type of flap due to the minimal affection of the underlying vasculature. Facilitated re-approximation of the ends of the incised tissues was also reported with these flaps, in addition to the minimum number of the required sutures.

On the other hand, the limited access to the tissues beneath this flap is the major disadvantage of its design which is attributable to the presence of a single vertical releasing incision, which makes it difficult to reach the apices of the underlying long teeth. It has been reported that within the gingival sulcus and following the teeth contours, the primary incision of this flap is made. Surgeons must care for leaving a sufficient space over any underlying defects to prevent any potential impact of this process on healing. It has been reported that this incision is usually designed from the gingival margin to the corresponding attached gingiva. Appropriate performing modalities should be used when performing such operations to prevent any potential development of jagged edges which have been previously reported to be hard to suture. Within the normal settings, the corresponding papilla should be preserved and it should be noted that the incision should not be deep within the sulcus beyond the limits to prevent any potential complication leading to extended bleeding.[6] In mandibular and maxillary posterior surgeries, placing the vertical releasing incision must be done at the mesial end of the horizontal incision and not the distal, which is usually associated with better access to the underlying structures and minimizes any potential trauma and intraoperative complications.[7] On the other hand, when performing anterior surgeries, placing of the vertical releasing incision is indicated to be done to an end of a vertical incision which can be considered suitable to the performing clinician. Besides, further access might be needed by the surgeon after the reflection of the triangular flap. In such cases, a distal relaxing incision is indicated and is done opposite to the vertical releasing incision and within the extent of the horizontal incision and is done within the attached and marginal gingiva.[8] It can also be helpful in cases of increased tension of the retracted flap. As a result of the potential fast wound healing and minimal complications observed with this type of flap, it should be frequently recommended in surgical settings.[9,10] Studies show that this flap design is the only suitable type of flaps that can be indicated for the mandibular posterior teeth, in addition to other indications in the posterior and maxillary incisors teeth.[5]

Rectangular and trapezoidal flaps

Similar to the triangular flaps, too design the rectangular flaps, an intrasulcular horizontal incision is performed with

two incisions that are vertical releasing. The designed two vertical releasing incisions allowing more and favourable access to the underlying root apices. It has been previously recommended to be used for various teeth, including multiple teeth, teeth with long roots, and anterior mandibular teeth.[11] On the other hand, the main disadvantage of conducting this modality is the difficulty to approximate the margins of the flap postoperatively, which furtherly makes wound healing even more difficult. Besides, it was previously reported that postsurgical stabilization is more feasible with the triangular flaps than the rectangular ones. Accordingly, the flap should not be indicated in cases of posterior teeth endodontic management approaches.

This is done because flap dislodgment post-surgically tends to be more frequent with the rectangular flaps. After all, the flapped tissues are stabilized in their positions by sutures only. In a similar context, the trapezoidal incisions can be done similarly to the rectangular ones, however, an obtuse angle is observed between the two vertical incisions and the intrasulcular horizontal incision. This is approached in this design to make a broad-based flap where the sulcular portion is less wide than the vestibular one. Previous clinicians preferred the use and designs of such flaps is because they offer better blood supply to the performed locations of soft tissues. However, within the peri-radicular surgeries, such flaps are not recommended because of the current poor evidence, despite being widely used with other tissues, including the skin. The main disadvantage of the flap design is the reported effects related to the blood supply, which may complicate the peri-radicular surgeries, and, therefore, they should not be indicated for such surgeries.[12,13] This is because the vertically oriented incisions which are angled are in line with the vertical anatomical design of the collagen fibers and blood vessels within the mucoperiosteal relevant tissues that are being operated on.[14] This can significantly lead to disruption of the relevant vasculature of the underlying tissues leading to more bleeding and potential shrinkage of the flapped operated on tissues.[12,13,15-17]

Horizontal flaps

This flap can be designed similar to the aforementioned full mucoperiosteal flaps. However, there are no vertical releasing incisions are conducted. In this flap design, the mid-col position refers to the interdental papilla, and the scalpel blade is positioned near the vertical position by the operating surgeon. It has been reported that using a no. 15 scalpel blade should be conducted around the margins of the tooth, while on the other hand, a no. 12 blades should be used within the interdental mid-col position.[18] When investigating the root surface, horizontal flaps have been recommended in such situations (for example, when the clinician is searching potential root fractures). Nevertheless, they are not recommended with the root tip potential issues because they do not usually offer adequate access to such locations. However, in such situations similar to the latter mentioned one, vertical releasing incisions might be recommended, transforming the horizontal flap to rectangular or triangular-based ones, according to the number of vertical releasing incisions as previously discussed. As a result, limited surgical access to many vital locations when using this type of flap, as it has been reported to be of limited application within the periarticular surgical settings. However, within the endodontic settings, some applications were reported for the horizontal flaps, including hemi-sections and root amputations, in addition to cervical defect repair (as resorption, caries, and root perforations).

Subclassifications of the limited mucoperiosteal flaps

The semilunar or sub-marginal curved flaps can be done by induction of incisions that are curved to the adjacent soft tissue structures. It has been reported that the flap begins from the alveolar mucosa to the gingiva and then returns to the point where it has started. No merits and favourable events have been reported with this surgical flap while many disadvantages as poor wound healing and limited surgical access have been reported. Therefore, this type of flap is no longer recommended for periarticular surgeries.[19] The Ochsenbein-Luebke or sub-marginal scalloped flap is similar to the design of the rectangular flaps. However, unlike the latter, the horizontal incision is placed within the labial or buccal relevant gingiva, not the attached gingival sulcus. Scalloping of the horizontal incision is done above the free marginal groove and following the marginal gingival contour. The main advantage of this flap design is the minimal or no exposure of the crestal bone, in addition to the absent involvement in the interdental and marginal gingiva.[20]

On the other hand, the presence of a vertical incision with these types of flaps poses a greater risk of bleeding and delayed healing, resulting in scar formation due to the horizontal pattern of the underlying collagen fibers and blood vessels.[21,22] Therefore, it should be noted that the flap should only be designed over hard bones when approached within surgical settings. Moreover, careful and adequate examination of the underlying flap tissues should be done for fear of any potential missing of a flap margin that is not attached to the bones.

Evaluating the size and extent of the postoperative peri-radicular inflammation is also indicated with these types of flaps to maintain adequate and proper reapproximation.[23,24] On the other hand, it has been reported that some alterations within the underlying levels of crestal bones and soft-tissue attachments, which indicate the need not to involve the gingival margins and sulcus within the horizontal incisions. However, it has been observed that limited alterations are possible when adequate re-approximation and soft-tissue management have been successfully conducted.

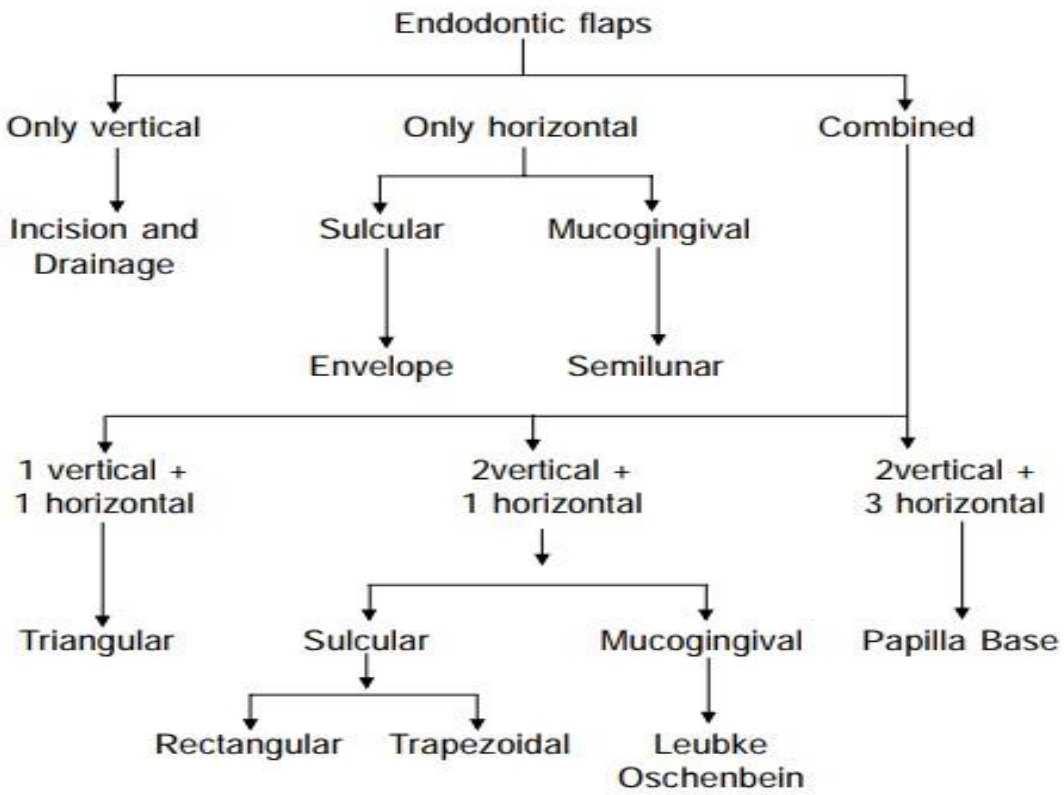

Figure 1: A proposed classification system of flaps in endodontic surgeries.

CONCLUSION

Among the reported flap designs, clinical success and favourable outcomes were observed with the ones that limited the damage to the root-attached tissues. Moreover, crestal bone loss has been reported to be minimal when using the full mucoperiosteal flap designs. Many previous studies have reported that using triangular and rectangular flap designs has been associated with favourable events regarding crestal bone loss, with the observed complete healing of the resorption damaging events and absent alternations of the heights of the crestal bone that were potentially affected.

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