

# THE RATIO IN CHOOSING ACCESS FLAP FOR SURGICAL ENDODONTICS: A REVIEW

C. GRANDI, L. PACIFICI

*Sapienza University of Rome  
Dental School  
Department of Clinical Dentistry III  
Chairman: Prof. L. Pacifici*

## SUMMARY

### *The ratio in choosing access flap for surgical endodontics: a review*

In Surgical Endodontics we face complex situations that require the knowlflap and application of both principles of endodontics (cleansing shaping and filling) in the root management, and the principles of surgery (asepsis, non harmfulness and hemostasis) in the phase of access to the root. Among the factors of surgical relevance that for which have been proposed with the largest number of alternatives is the design of access flap. That clearly indicates that not only one flap design can be ideal in all clinical situations. In this article all proposed access flap designs are evaluated in the light of their degree of compliance with ideal requirements in different circumstances. A clear pattern in the decision-making criteria for the selection of access flaps is proposed.

**Key words:** surgical endodontics, access flap, selection.

## RIASSUNTO

### *La ratio nella selezione del lembo di accesso in endodonzia chirurgica: revisione della letteratura*

In Endodonzia Chirurgica affrontiamo situazioni complesse che richiedono la conoscenza e l'applicazione sia dei principi della endodonzia, detersione sagomatura e otturazione nella fase di gestione della radice, sia dei principi della chirurgia, asepsi, atraumaticità ed emostasi, nella fase di accesso alla radice. Tra i fattori di pertinenza chirurgica quello per il quale sono state proposte il maggior numero di alternative è il disegno del lembo di accesso. Ciò indica chiaramente come non esista un disegno di lembo ideale per tutte le situazioni cliniche. Il presente lavoro prende in esame tutti i lembi di accesso proposti in letteratura alla luce del loro grado di rispondenza ai requisiti ideali nelle diverse circostanze. Viene illustrato un chiaro schema decisionale che indica i criteri per la selezione dei lembi di accesso in endodonzia chirurgica.

**Parole chiave:** endodonzia chirurgica, lembi di accesso, selezione.

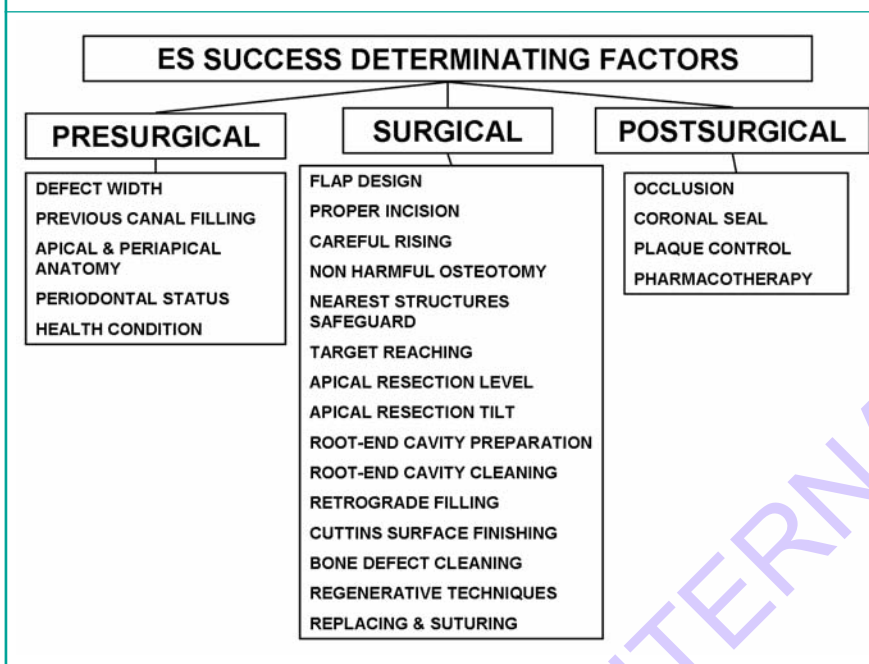
## Introduction

Endodontic surgery (ES) represents an alternative in cases of endodontic failures which are not treatable in a non surgical way. Thanks to the possibility to obtain a bio compatible apical seal (1, 2). Many Pre Surgical, Intra surgical and post surgical factors (Table 1) influence ES results. A large number of Studies based on Radiographic criteria (5, 6) have indicated a periradicular healing percentage up to 98% (7, 8). Many au-

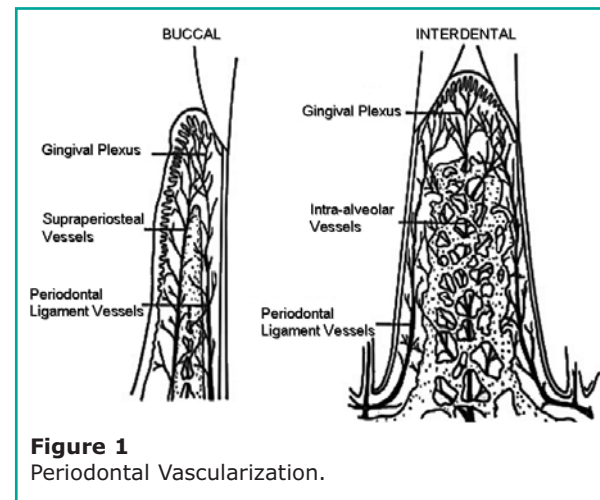
thors recommend a periodontal therapy before the ES surgery (9, 10). Jansson (11) and Ehnevid (12) showed that the presence of endodontic infection worsen the healing of periodontal tissues. In ES, as in all other fields of dentistry, natural periodontal aesthetic is to be included in achieving optimal, final results, because it reflects good oral health as well as hard tissues conditions (13, 14).

Knowlflap of this necessity brings to no longer accepting "pink astetics" abnormalities as a normal consequence of every periodontal surgery, and leads us to developing non harmful and con-

**Table 1** - Success determinating factors in endodontic surgery.



servative techniques (15, 19) together with the introduction of microsurgical instruments and the adoption of the operatory microscope (20, 21) both in periodontology and SE. These surgical techniques require a knowlflap of complex anatomy of marginal periodontum (22, 23). Tarnow in 1992 (24) demonstrated the width of the papilla depends on the height of inter-dental space, specifically showing the distance between the interdental bony peak and the contact point. Holmes in 1965 (25) had already pointed out that when the papilla is sectioned and replaced, it often does not maintain its dimension nor fill the interdental space any longer. Knowledge of periodontal vascularization is an additional important factor in the planning of periodontal tissue surgery. Periodontal vascularisation comes from several different structures; Gingival plexus, Intra-alveolar vessels, Supraperiosteal vessels, Alveolar capillaries (Fig. 1) (26-31). For that reason, marginal tissues severed by sulcular or sub-marginal incisions, are able to receive sufficient blood flow, however the principal blood flow comes from the buccal area (32).



## Pre-Surgical Evaluation

In Surgical Endodontics, we face complex situations that require both knowlflap and application of the principles of endodontics, cleansing, shaping and filling (Shilder H., 1983) in root management. Both principles of surgery and asepsis are non harmful and hemostasis (Halsted W.S., 1913)

in the phase of access to the root. Among the factors of surgical relevance, as flap design, flap raising, access osteotomy, cavity cleaning, hemostasis and suture, that for which the largest number of alternatives have been proposed, is the design of access flap

Planning of every flap design, you must consider and respect the anatomical characteristics of the tissues it goes through. According to Arens (1981) (33) a few fundamental factors must be considered before starting the surgical procedure.

1. Number of teeth involved
2. Root shape
3. Surgical Provoked bone defect width
4. The presence and depth of Peridontal pockets
5. The amount of attached gum
6. The position of muscle insertion and frenulums
7. Vestibule depth
8. The nearest anatomical structure position
9. Bone quantity covering the surgical target
10. Necessary access width
11. Crown presence on teeth involved and adjacent to.

Additional factors to consider:

12. Natural bone defect presence and width

13. Estetical value of the area involved in the procedure

14. Involved tissue vascularisation.

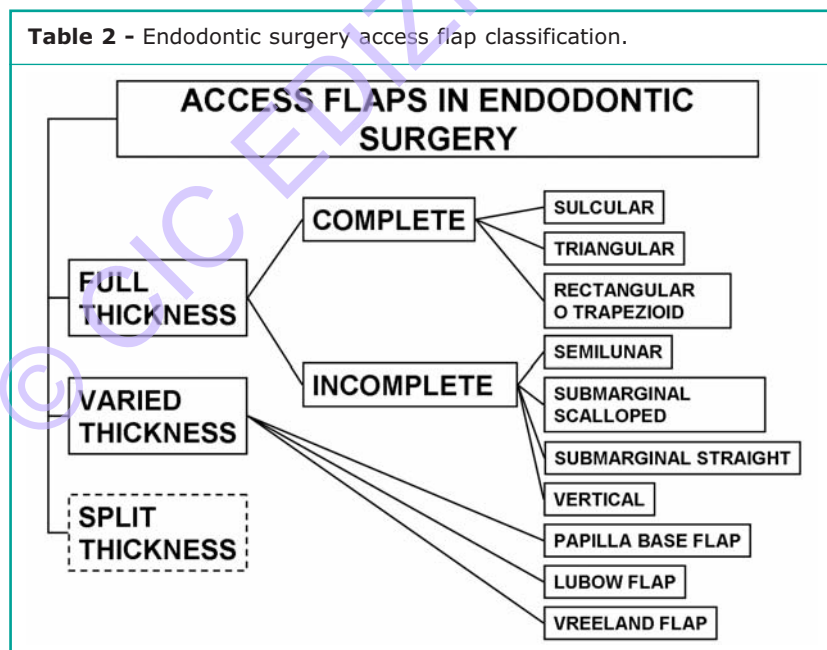
## Microsurgical approach

In order to improve both hard and soft tissue healing in ES, many authors have proposed microsurgical techniques(34).

## ES access flap classification

Even though some authors have suggested split thickness flaps (35), almost all ES flaps are full or varied-thickness. The full-thickness flaps are broken down into groups (1) complete, shown as sulcular, triangular and rectangular (or trapezoid), and (2) incomplete, presented as semi-lunar, sub-marginal scalloped, sub-marginal straight and vertical. The varied-thickness flaps are the “Papilla Base”, Lubow flap and Vreeland flap (Table 2).

**Table 2** - Endodontic surgery access flap classification.



## Sulcular flap

### Tecnique

The sulcular flap is made up of a single incision that runs through the gingival sulcus (Fig. 2), and not one releasing incision is made. This flap involves at least two or more adjacent teeth surrounding the target tooth. It is possible to extend the incision involving a larger number of teeth in order to increase flap mobility for the following flaps having horizontal components.



**Figure 2**  
Sulcular Flap.

### Advantages

The sulcular flap is very conservative, there is no scarring involved, it is a really easy and fast procedure, resulting in low morbidity. As in every case of complete full thickness flaps, it exposes the entire buccal cortical and can eventually lead to the treatment of endo-periodontal defects.

### Disadvantages

This kind of flap has a limited amount of stretching due to the absence of releasing incisions, on-

ly permitting the visualization of the coronal part of the root. This fact permits the use of this flap in perforations, cervical resorption and stripping not involving the periapical areas. As always, when a sulcular incision is made, the healing process can result in gingival recession. Additionally complicating post surgical hygiene.

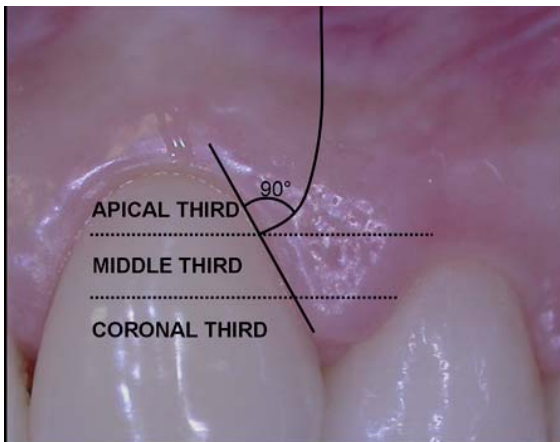
## Triangular flap

### Tecnique

The triangular flap is made of a sulcular incision and one only releasing incision which goes in apical direction from one end (more frequently that mesial) of sulcular incision (Fig. 3). Releasing incision starts from between middle third and apical third of the papilla with an initial direction in that point perpendicular to the gum margin, then bends vertically, parallel to the teeth long axis in order to avoid root eminences (Fig. 4), not extending in the vestibule as possible. Such rules can be applied to all releasing incisions.



**Figure 3**  
Triangular Flap.



**Figure 4**  
Releasing incision.

## Advantages

The triangular flap is conservative, is extremely easy to perform, replace and suture, resulting in low morbidity. As well as every complete full thickness flap, it exposes the entire buccal cortical and can eventually leads to the treatment of endo-periodontal defects.

## Disadvantages

Raising the flap is laborious. This kind of flap has a limited amount of stretching due to the presence of one only releasing incisions, usually permitting only the visualization of the medium third of the root. This fact permits the use of this flap in perforations, cervical resorption and stripping not involving the periapical areas, and in periapical surgery only involving shot roots. As always, when a sulcular incision is made, the healing process can result in gingival recession. Additionally complicating post surgical hygiene.

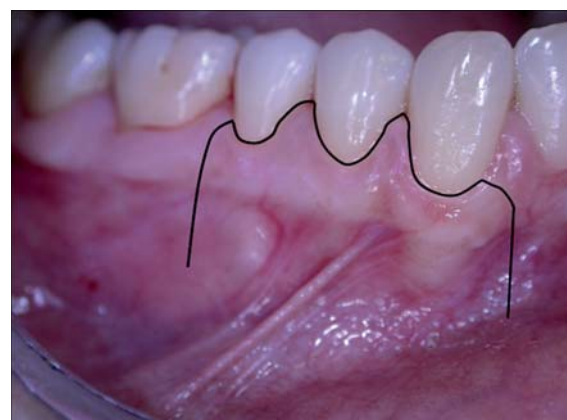
## Rectangular flap (or Trapezioidale)

### Tecnique

The rectangular flap (or trapezoid) is made of a sulcular incision and two releasing incision which goes in apical direction from ends of sulcular incision (Fig. 3). Sulcular and releasing incision proceed as already described. In the “rectangular” design releasing incisions go vertically, parallel to the teeth long axis in order to avoid root eminences (Fig. 5) (30, 36, 37), following the same direction of buccal vessels. In the “classic trapezoid” flap releasing incisions diverge in order to obtain a wider flap base.

### Advantages

The rectangular flap is conservative, is extremely easy to perform, replace and suture, resulting in low morbidity. This flap has a great mobility and permit to reach even very long roots. As well as every complete full thickness flap, it exposes the entire buccal cortical and can eventually leads to the treatment of endo-periodontal defects.



**Figure 5**  
Rectangular Flap.

## Disadvantages

Raising the flap is laborious. As always, when a sulcular incision is made, the healing process can result in gingival recession. Additionally complicating post surgical hygiene.

## Semilunar flap (acc. Partch)

### Tecnique

The Semilunar flap is made of curved horizontal incision, convex in marginal direction (Fig. 6) (38). Incision starts from the vestibule to at least one tooth from the target tooth . Drawing a curve incision moves towards marginal, keeping always at least 5mm from the edge of the expected bone defect, then back to the vestibule of the opposite side.

### Advantages

The semilunar flap is extremely simple to sever and raise. It permits a rapid exposition of periapi-



**Figure 6**  
Semilunar Flap (acc. Partch).

cal surgery area. It does not involve the marginal periodontum and does not result in gingival recession. Additionally a good post surgical hygiene is permitted.

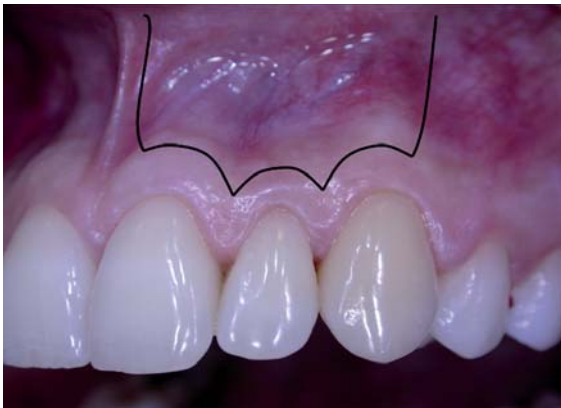
## Disadvantages

For its reduced extension this flap gives limited access and visibility in surgical area. Unforeseen event is extremely difficult to manage if width and position of bone defect are different than expected. The incision runs almost completely in alveolar mucosa and in can result in abundant bleeding and decreased visibility. This flap is intensely submitted to muscular tractions that provoke post-surgical pain and delayed healing. Lacking reference points make replacing flap difficult. In a high percentage of cases it results in a very visible scar.

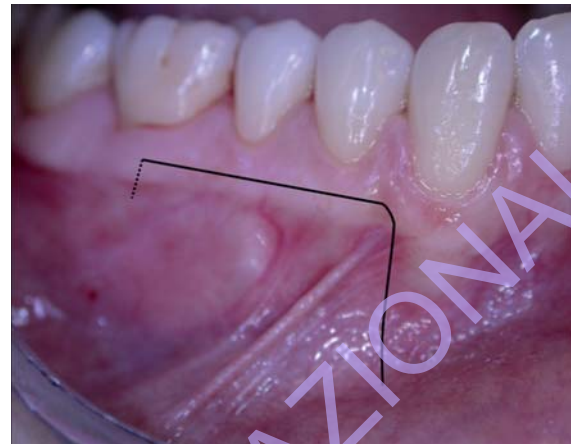
## Submarginal scalloped flap (acc. Oshenbein-Leubke)

### Tecnique

This flap is a variant of the rectangular one, replacing the sulcular incision with a scalloped submarginal one (Fig. 7) (39). It is made of a horizontal incision along the attached gingiva and two releasing incisions that, starting from the end of the horizontal incision, run apical. Horizontal incision runs along attached gingiva following the gingival scallops. In order to avoid dehiscences and gum recessions incision should not involve neither the gingival sulcus nor the junctional epithelium but should run between the bone margin and the mucogengival line (Fig. 8).



**Figure 7**  
Scalloped Submarginal flap (acc. Oshenbein-Leubke).



**Figure 9**  
Straight Submarginal Flap (acc. Wadhvani).

## Advantages

The Submarginal scalloped flap is simple and swift to perform, to suture and permits an absolutely exact replacing. Surgical area can be exposed without stretching the flap. It guarantees a good access to surgical area, even for long root periapical surgery. It does not involve the marginal periodontium and does not result in gum recessions. If carefully sutured with a proper technique it gives small or absent scar. Additionally a good post surgical hygiene is permitted.

## Disadvantages

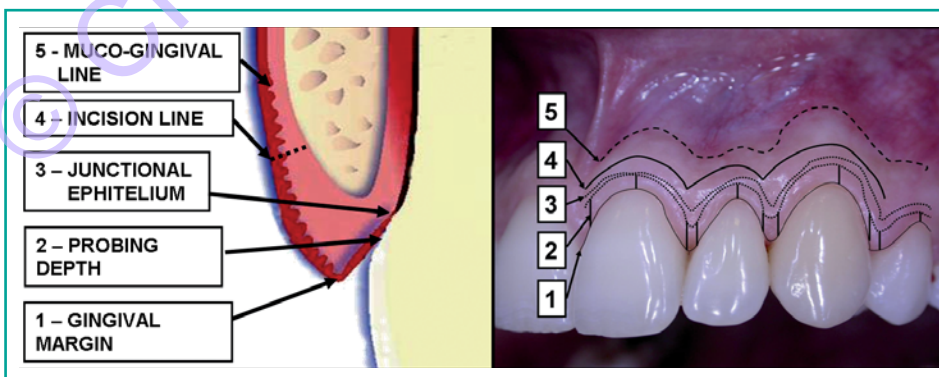
Requires of careful periodontal evaluations to be drawn correctly. Being an incomplete flap, does

not permit the treatment of endo-peridontal defects. Proper suturing asks for time and accuracy. If poorly replaced and sutured can result in visible scars.

## Submarginal straight flap (acc. Wadhvani)

### Tecnicque

This flap is a variant of the rectangular one, replacing the sulcular incision with a straight submarginal one (Fig. 9) (40). It is made of a horizontal incision along the attached gingiva and two re-



**Figure 8**  
Periodontal Evaluations for Scalloped Submarginal flap (acc. Oshenbein-Leubke).

leasing incisions that, starting from the end of the horizontal incision, run apical. Horizontal incision runs rectilinear along attached gingiva. In order to avoid dehiscences and gum recessions incision should not involve neither the gingival sulcus nor the junctional epithelium but should run between the bone margin and the mucogingival line.

## Advantages

According with the author the advantages of this flap are consisting in being a single clean incision, guaranteing enough access and visibility to the pathology area, less soft tissue trauma, easiness of replacing and greater possibility of primary healing, less tension of the suture, healing without recessions.

## Disadvantages

The disadvantages of this type of flap seem to be the same of the submarginal scalloped one: need of careful periodontal evaluations to be drawn correctly, impossible treatment of endo-peridontal defects. Moreover a not sufficiently rectilinear course of attached gingiva, as frequently happens, for example, in the inferior canines area, makes it difficult or impossible to perform. Finally if poorly replaced and sutured can result in visible scars.

## Vertical flap (acc. Eskici)

### Tecnicque

This flap is made of a single vertical incision (Fig. 10) (41). The incision runs vertically in the interdental zone immediately adjacent to the target, taking care of not crossing root eminences. No other incision is made. After raising the flap it should be stretched until to visualize the zone of interest.



**Figure 10**  
Vertical Flap (sec. Eskici).

## Advantages

The proposed flap is extremely simple and swift to perform and to suture. The surgical trauma is smallest. The flap margin are not submitted to muscular traction.

## Disadvantages

Obtainable access is smallest and limited to a minimal periapical area. It runs almost entirely in alveolar mucosa. Wound margin are very near the surgical target and their bleeding can easily result in hindering the operating field. The margin of the wound will easily lie above bone defect. It can cause visible scars.

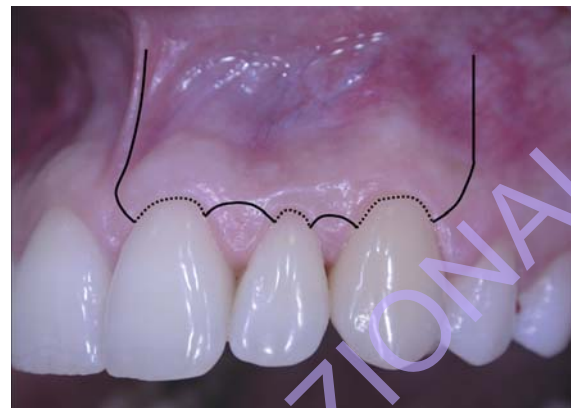
## “Papilla base” flap (acc. Velvart)

### Tecnicque

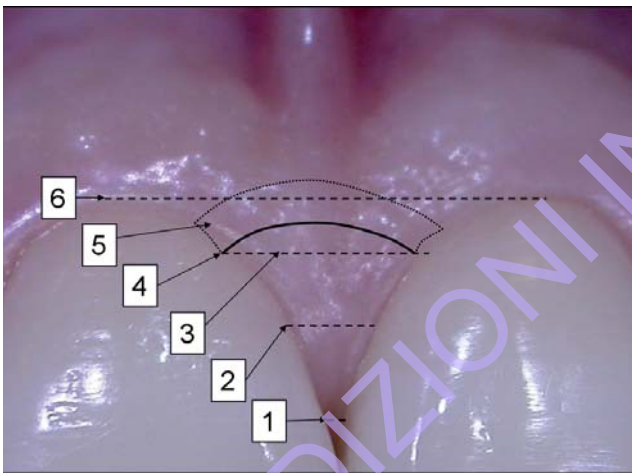
The “Papilla Base” flap is made of two vertical releasing incisions connected by an horizontal incision at the papilla base alternated with a sulcu-



lar incision (Fig. 11) (42). Releasing incision starts from between middle third and apical third of the papilla with an initial direction in that point perpendicular to the gum margin, then bends vertically. The horizontal incision is made of a "Papilla Base" incision in the interdental zone, alternated with a sulcular incision in the cervical teeth zone. The "Papilla Base" incision is made of two different incisions of the interdental papilla (Fig. 12). The first incision, shallow, starts perpendicularly to the gingival margin from the inferior third one of the papilla. Then it makes a light apical convex arch to the gingival margin of the adjacent tooth. This first incision is obtained with the scalpel perpendicular to tooth

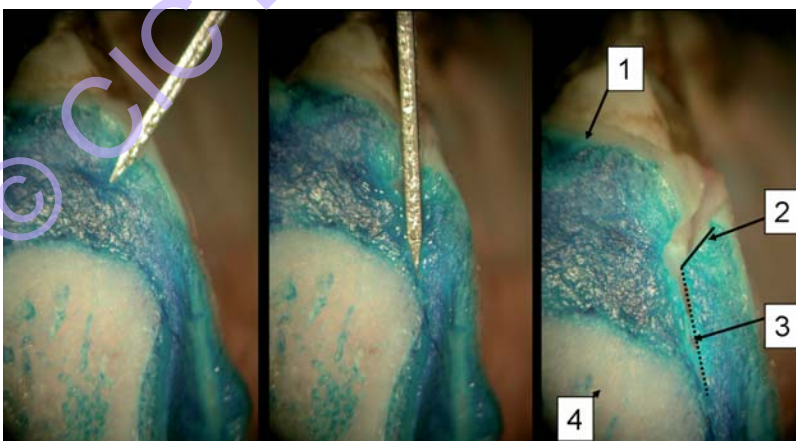


**Figure 11**  
"Papilla Base" Flap (acc. Velvart).



**Figure 12**  
Papillary incisions of del Lembo "Papilla Base" Flap (acc. Velvart):

1. Top of the papilla.
2. Apical third of papilla.
3. Middle third of papilla.
4. 90° incision beginning.
5. Vertical incision.
6. Papilla base.



**Figure 13**  
Section of "Papilla Base" Flap (acc. Velvart):

1. Top of the papilla.
2. 90 degrees incision.
3. Vertical incision.
4. Interdental septum.

long axis and carves epithelium and connective until a depth of 1.5 mm. The second incision starts from the previous one, now apically moving the scalpel parallel to tooth long axis till the bone margin, creating a papillary split thickness incision (Fig. 13). From that point on starts the full thickness part of the flap.

## Advantages

The main advantages of this flap are: absence of gingival recession, absence of papilla retraction, almost complete absence of scars. It also guarantees a large surgical area exposition without flap stretching, also permitting periapical surgery on long roots.

## Disadvantages

The “Papilla Base” is not simple to perform and asks for a good technical ability, likewise to the papilla preservation flaps for the GTR from whose drift. The careless manipulation of the papilla can cause the aesthetic disasters to avoid which it was conceived. This flap is time consuming to be carved, to be raised and to be sutured. It completely expose the buccal plate only in the central zone of the teeth and can make difficult endo-periodontal defect treatment.

## Lubow flap

### Technique

The Lubow flap is made of two vertical releasing incisions connected by a horizontal scalloped incision running in the gingival sulcus and at the base of the interdental papilla (Fig. 14) (43). The horizontal incision links the most vestibular points in the gingival sulcus of the teeth involved. The scalpel is placed in the depth of the

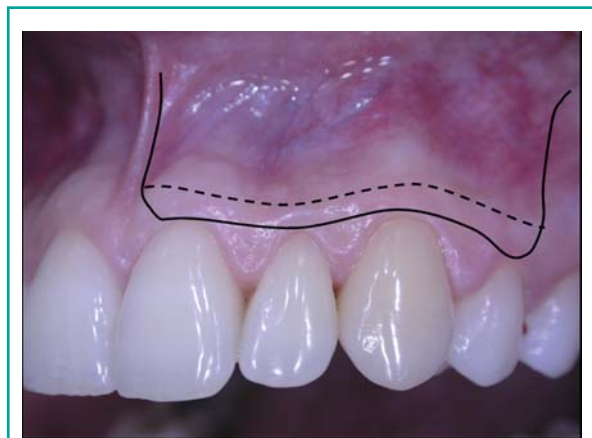
sulcus, vestibular to the more distal tooth involved. Than it is moved towards the same point of the successive tooth. Going through the interdental zone the papilla comes dissected with a bevelled cut that goes from the inferior third of the papilla to the bone surface.

## Advantages

This flap has the purpose of limiting gingival recession and papilla retraction. It guarantees a large surgical area exposition without flap stretching, also permitting periapical surgery on long roots.

## Disadvantages

The Lubow flap is not very easy to perform and asks for a good technical ability. The thin thickness incision of the papilla does not facilitate an exact replacing and can even cause the aesthetic alterations to avoid which it was conceived. It completely expose the buccal plate only in the central zone of the teeth and can make difficult endo-periodontal defect treatment.



**Figure 14**  
Lubow flap.

## Vreeland flap

### Tecnique

This flap, definite by author split/full-thickness, is a variant of the submarginal scalloped (acc. Oshenbein-Leubke), replacing the submarginal scalloped 90° incision with a submarginal bevelled scalloped incision (Fig. 15) (44). Its horizontal component is made of an inverted bevel incision that, following gingival scallops, runs at 1-2 mm distance from the gingival margin in apical direction reaching the bone surface 1-2 mm under the bone margin. From this point on the flap becomes a full thickness flap. In order to avoid dehiscences and gingival recessions it should not involve neither the gingival sulcus nor the junctional epithelium which should remain attached to teeth.

### Advantages

It guarantees a large surgical area exposition without flap stretching, also permitting periapical surgery on long roots. It does not involve marginal periodontum. If carefully sutured it can result in minimal scars.



**Figure 15**  
Vreeland Flap.

### Disadvantages

Also the Vreeland flap is not very easy to perform and asks for a good technical ability. The split thickness bevelled incision of marginal periodontum does not facilitate an exact replacing and can even cause the aesthetic alterations to avoid which it was conceived. Being an incomplete flap, it does not permit the treatment of endo-peridontal defects.

### Selection criteria

Different authors express a consensus on the requirements that an ES access flap should satisfy. Before all, they should be traced without to deprive of an adequate blood flow neither the flap base nor the flap itself. Furthermore it should be feasible have to cut and raise them in simple and non harmful way, in order to permit a proper view of target, to expose all the buccal plate enabling adoption of regenerative technique. Should be also easy to exactly replace and suture them without hindering healing, and finally do not result in gingival abnormalities.

### Blood flow safeguards

From blood flow point of view the Vertical flap is the less injurious. All of the complete flaps (sulcular, triangular and rectangular) consisting in raising of the entire buccal soft tissues without horizontal interruptions minimize the blood flow decrease. All of the flaps made of horizontal buccal deprive marginal periodontum incisions of the buccal vessels blood flow. They however receive sufficient vascular contribution from several structures, like the gingival plexus and the intralveolar vessels (26-32).

## Easy performing

Stating first that a therapeutic choice is not based on the alleged easiness of a technique but on its effectiveness, certainly the complete flaps (sulcular, triangular and rectangular), the semilunar flap and the vertical flap result simple and swift to perform. The sub-marginal flaps are enough simple to perform only asking for a careful planning. The “Papilla Base” flap particularly asks instead for a good training, likewise to the “papilla preservation” flaps for periodontal regeneration.

## Access to target

All examined flaps permits to reach the surgical area. The incomplete flaps result in a greater risk of failure in case of inaccurate planning. The Eskici vertical flap and sulcular flap particularly only expose very limited surgical area.

## Buccal bone exposure

The complete buccal bone exposure, an important aspect involving both inspection and regeneration chance, is guaranteed by complete flaps only (sulcular, triangular and rectangular). The Velvart “Papilla Base” only exposes the buccal plate in the central zone of the teeth. All of the incomplete flaps (semilunar and submarginals) and Lubow and Vreeland flaps hinder a complete buccal bone exposure.

## Easy replacing

An easier replacing will probably result in a more accurate replacing, then in a scarless rapid healing. Easier flaps to replace are the full thickness flap whose main incision runs either in attached gingiva or in gingival sulcus, that are complete flaps (sulcular, triangular and rectangular) and submarginal flaps (straight and scalloped). The

“Papilla Base” flap is more complex to replace but it permits as well to reach great precision. All flaps whose incision runs in alveolar mucosa (semilunar and vertical), as well as the varied thickness flap (Lubow and Vreeland flaps) are surely more difficulty to replace exactly.

## Easy suturing

Suture, likewise flap replacing, is important for rapid and scarless healing. In spite of crossing palate, suturing is easier in the complete flaps (sulcular, triangular and rectangular). Suturing semilunar and vertical flaps is simple as well despite higher overlap risk. Suturing submarginal and varied thickness flap, Lubow, Vreeland and “Papilla Base” flap above all, is to perform very carefully.

## Non harmfulness towards periodontal tissue

The semilunar and the vertical flaps are the less traumatizing towards marginal periodontum as they not even involve it. Also submarginal flaps are enough conservative. Complete flaps result in a greater periodontal damage. Different considerations are needed for varied thickness flaps. In spite of its complexity, “Papilla Base” does not injure gingival tissue when correctly and carefully performed. On the contrary Lubow and Vreeland flap sever the marginal periodontum in thin layers, and that can easily result in vascular suffering and scars (37).

## Marginal recession absence

All of the incomplete flaps (submarginal, semilunar, vertical) do not involve marginal periodontum. The amount of marginal recession produced by Lubow and Vreeland flap is hardly predictable (37). “Papilla Base” flap cause a very low risks of recession (36, 42, 45, 46). All of the complete

flaps (sulcular, triangular and rectangular) produce gingival recession (48, 49).

### Papilla retraction absence

Incomplete flaps (submarginal, semilunar, vertical) are virtually exempt from papilla retraction. Lubow flap and Vreeland flap can result in papilla deformity (37). Complete flaps (sulcular, triangular and rectangular) produce  $1,3 \text{ mm} \pm 0,9$  of papilla retraction in three months. Velvart "Papilla Base" flap produce not significant papilla alteration (retraction  $0,05 \text{ mm} \pm 0.39$  in three months) (36, 42, 45, 46). This flap in most cases (16/20) results in invisible or almost invisible papillary scars (42).

as they do not permit an adequate access to the surgical area. The Wadhvani Rectilinear Submarginal flap is an unnecessary and unlikely variant of the scalloped submarginal flap, that should be preferred. The Vreeland flap, another unnecessary variant of submarginal scalloped flap not to be used, in comparison with Oshenbein-Leubke flap has more risk of scars due to its thin bevelled incision. The Lubow flap has more difficulties and risks than the "Papilla Base" without permit reaching same results. So it is not used. Useful flap designs in ES are the sulcular, triangular and rectangular (that form the group of complete full thickness flap), the Oshenbein-Leubke scalloped submarginal flap (incomplete full thickness flap) and the Velvart "Papilla Base" flap (varied thickness).

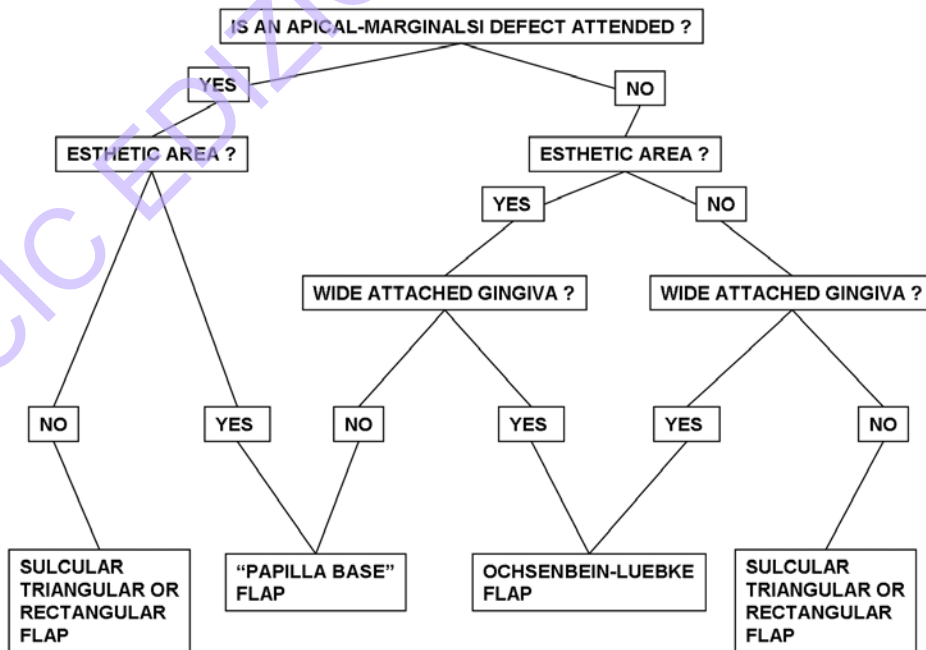
### Comparative evaluations

This analysis reveals inadequate characteristics of some flap design. The semilunar and vertical flap must be avoided

### Conclusions

Useful identified flaps belong to three different groups and are to be used without distinction in

**Table 3** - Outline for choosing endodontic surgery access flap.



all of cases. They have very different characteristics. From the clinician point of view they can be differentiated by three fundamental characteristics: the buccal bone exposure, the risk of aesthetic damage and the need of attached gingiva. The presurgical evaluation of those three features permits a correct choice now described (Table 3).

### 1. Is an apical-marginal defect expected?

When pathological situations needing complete exposure of buccal bone till coronal margin are expected or suspected incomplete flaps will be discarded. The correct choice is between the "Papilla Base" flap and a complete full thickness flap (sulcular, triangular or rectangular) according to the aesthetic relevance of the area. When complete exposure of buccal bone is not needed we still have all the choices and we have to wonder if we are in an aesthetic importance area.

### 2. Aesthetical importance area?

We will appraise if the surgical procedure area has aesthetic importance, considering the type of gingival exposition during while smiling (50), prescindig the anterior or posterior position of tooth involved. If an apical-marginal defect is expected the flap of choice is the "Papilla Base" flap if we are in aesthetic zone, whereas a complete full thickness (sulcular, triangular or rectangular) will be chosen if the zone has no aesthetic importance. When complete exposure of buccal is not needed, we are in aesthetic area or not, attached gingiva width must be evaluated for choosing the right flap.

### 3. Wide attached gingiva?

When a large zone of attached gingiva is present, without apical-marginal defect, we are in aesthetic area or not, the correct choice is the Oshenbein-Leubke submarginal scalloped flap. Without of a wide attached gingiva permitting to safely cut a submarginal flap, we should evaluate the aesthetic importance of the target zone. Without apical-marginal defect and without a large zone of attached gingiva, if we are in aesthetical importance area the proper choice is the Velvart "Papilla Base" flap. Without apical-marginal defect and without a large zone of attached gingiva,

if we are not in aesthetical importance area the proper choice is a complete full thickness flap (sulcular, triangular or rectangular).

A careful choice will permit obtaining a correct healing without hindrance of careless soft tissue management and without aesthetical damages.

## References

1. Friedman S, Stabholz A. Endodontic retreatment-case selection and technique. Part 1: criteria for case selection. *J Endod* 1986; 12: 28-33.
2. Danin J, Stromberg T, Forsgren H, Linder LE, Ramskold LO. Clinical management of nonhealing periradicular pathosis. Surgery versus endodontic retreatment. *Oral Surg Oral Med Oral Pathol Oral Radiol Endod* 1996; 82: 213-7.
3. Rud J, Andreasen JO, Jensen JF. A multivariate analysis of the influence of various factors upon healing after endodontic surgery. *Int J Oral Surg* 1972; 1: 258-71.
4. Friedman S. Treatment outcome and prognosis of endodontic therapy. In: Ørstavik D, Pitt Ford T, eds. *Essential endodontology: prevention and treatment of apical periodontitis*. Oxford: Blackwell Science, 1998: 388-91.
5. Ørstavik D. Reliability of the periapical index scoring system. *Scand J Dent Res* 1988; 96: 108-11.
6. Huuononen S, Lenander-Lumikari M, Sigurdsson A, Ørstavik D. Healing of apical periodontitis after endodontic treatment: a comparison between a silicone-based and a zinc oxide-eugenol-based sealer. *Int Endod J* 2003; 36: 296-301.
7. Gutmann J, Harrison J. Success, failure, and prognosis in periradicular surgery. In: Gutmann J, Harrison J, eds. *Surgical endodontics*. Oxford: Blackwell Scientific Publications, 1991: 338-84.
8. Rubinstein RA, Kim S. Short-term observation of the results of endodontic surgery with the use of a surgical operation microscope and Super-EBA as root-end filling material. *J Endod* 1999; 25: 43-8.
9. Chen S, Wang H, Glickman G. The influence of endodontic treatment upon periodontal wound healing. *J Clin Periodontol* 1997; 24: 449-56.
10. Zuolo ML, Ferreira MO, Gutmann JL. Prognosis in periradicular surgery: a clinical prospective study. *Int Endod J* 2000; 33: 91-8.
11. Jansson L, Sandstedt P, Laftman AC, Skoglund A. Relationship between apical and marginal healing in periradicular surgery. *Oral Surg Oral Med Oral Pathol Oral Radiol Endod* 1997; 83: 596-601.

12. Ehnevid H, Jansson L, Lindskog S, Blomlöf L. Periodontal healing in teeth with periapical lesions. A clinical retrospective study. *J Clin Periodontol* 1993; 20: 254-8.
13. McLean JW. Long-term esthetic dentistry. *Quintessence Int* 1989; 20: 701-8.
14. Allen EP. Use of mucogingival surgical procedures to enhance esthetics. *Dent Clin North Am* 1988; 32: 307-30.
15. Miller PD, Jr. Regenerative and reconstructive periodontal plastic surgery. *Mucogingival surgery. Dent Clin North Am* 1988; 32: 287-306.
16. Consensus report. Mucogingival therapy. *Ann Periodontol* 1996; 1: 702-6.
17. Rocuzzo M, Bunino M, Needleman I, Sanz M. Periodontal plastic surgery for treatment of localized gingival recessions: a systematic review. *J Clin Periodontol* 2002; 29 (Suppl 3): 178-94; discussion 95-6.
18. Hürzeler MB, Weng D. Functional and esthetic outcome enhancement of periodontal surgery by application of plastic surgery principles. *Int J Periodontics Restorative Dent* 1999; 19: 36-43.
19. Cortellini P, Tonetti MS. Microsurgical approach to periodontal regeneration. Initial evaluation in a case cohort. *J Periodontol* 2001; 72: 559-69.
20. Kim S. Principles of endodontic microsurgery. *Dent Clin North Am* 1997; 41: 481-97.
21. Carr G, Bentkover S. *Surgical Endodontics*. In: Cohen S, Burns R, eds. *Pathways of the pulp*. St Louis, MO; Mosby Inc 1998; 608-56.
22. Schroeder HE, Listgarten MA. The gingival tissues: the architecture of periodontal protection. *Periodontol* 2000 1997; 13: 91-120.
23. Kohl JT, Zander HA. Morphology of interdental gingival tissues. *Oral Surg Oral Med Oral Pathol* 1961; 14: 287-95.
24. Tarnow D, Magner APF. The effect of the distance from the contact point to the crest of bone on the presence or absence of the interproximal dental papilla. *J Periodontol* 1992; 63: 995-6.
25. Holmes CH. Morphology of the interdental papillae. *J Periodontol* 1965; 36: 455-60.
26. Nobuto T, Yanagihara K, Teranishi Y, Minamibayashi S, Imai H, Yamaoka A. Periosteal microvasculature in the dog alveolar process. *J Periodontol* 1989; 60: 709-15.
27. Keller GJ, Cohen DW. India ink perfusions of the vascular plexus of oral tissues. *J Oral Surg (Chic)* 1955; 8: 539-42.
28. Folke LE, Stallard RE. Periodontal microcirculation as revealed by plastic microspheres. *J Periodontal Res* 1967; 2: 53-63.
29. Castelli WA, Dempster WT. The periodontal vasculature and its responses to experimental pressures. *J Am Dent Assoc* 1965; 70: 890-905.
30. Mörmann W, Meier C, Firestone A. Gingival blood circulation after experimental wounds in man. *J Clin Periodontol* 1979; 6: 417-24.
31. Holmstrup P. Anatomy of the Periodontium. In: Wilson T, Kornmann K, eds. *Fundamentals of periodontics*. Carol Stream, IL: Quintessence Publishing Co Inc 2003: 21-38.
32. Mörmann W, Ciancio SG. Blood supply of human gingiva following periodontal surgery. A fluorescein angiographic study. *J Periodontol* 1977; 48: 681-92.
33. Arens DE, Adams WR, De Castro RA. *Endodontic Surgery*. Philadelphia : Harper and Row, 1981: 116.
34. Rubinstein RA, Kim S. Long-term follow-up of cases considered healed one year after apical microsurgery. *J Endod* 2002; 28: 378-83.
35. Morse DR. *Clinical Endodontology*, ed. 1, Springfield, Ill., 1974, Charles C Thomas Publisher, pp. 471-473.
36. Gutmann JL, Harrison WH. Flap designs and incisions. In: Gutmann JL, Harrison WH, eds. *Surgical endodontics*. St. Louis, Missouri: Ishijaku EuroAmerica, Inc., 1994: 162-75.
37. Velvart P, Peters C. Soft tissue management in endodontic surgery. *J Endod* 2005; 31: 4-16.
38. Carr G, Bentkover S. *Surgical Endodontics*. In: Cohen S, Burns R, eds. *Pathways of the pulp*. St Louis, MO; Mosby Inc 1998; 608-56.
39. Luebke RG. Surgical endodontics. *Dent Clin North Am* 1974; 18: 379-91.
40. Wadhvani KK, Garg A. Healing of soft tissue after different types of flap design used in periapical surgery. *Endodontology* 2005; 16.
41. Eskici, A. A new incision method in apicoectomy. *Dtsch Zahnarzt Z* 1971; 26 (3): 331-42.
42. Velvart P. Papilla base incision: a new approach to recession-free healing of the interdental papilla after endodontic surgery. *Int Endod J* 2002; 35: 453-60.
43. Lubow RM, Wayman BE, Cooley RL. Endodontic flap design: analysis and recommendations for current usage. *Oral Surg Oral Med Oral Pathol* 1984; 58: 207-12.
44. Vreeland DL, Tidwell E. Flap design for surgical endodontics. *Oral Surg Oral Med Oral Pathol* 1982; 54: 461-5.
45. Wennström J, Pini Prato G. Mucogingival therapy. In: *Clinical periodontology and implant dentistry*, 3rd ed. Copenhagen: Munksgaard, 1998: 550-96.
46. Velvart P, Ebner-Zimmermann U, Ebner JP. Comparison of papilla healing following sulcular full-thickness flap and papilla base flap in endodontic surgery. *Int Endod J* 2003; 36: 653-9.
47. Velvart P, Ebner-Zimmermann U, Ebner JP. Comparison of long term papilla healing following sulcular full thickness flap and papilla base flap in endodontic surgery. *Int Endod J* 2004; 37 (10): 687-93.
48. Zimmermann U, Ebner J, Velvart P. Papilla healing

- following sulcular full thickness flap in endodontic surgery. J Endod 2001; 27: 219.
49. Velvart P, Ebner-Zimmermann U, Ebner JP. Papilla healing following full thickness flap in endodontic surgery. Oral Surg Oral Med Oral Pathol Oral Radiol Endod 2004; 98: 365-9.
50. Philips E. The Classification of Smile Patterns. J Can Dent Assoc 1999; 65: 252-4.

---

*Correspondence to:*

Dott. Cristiano Grandi  
Via Dalmazia 18  
00198 Roma  
Tel. 068548733 - Fax 068548733  
Cell. 3397541931  
E-mail: cristianograndi@tiscali.it

© CIC EDIZIONI INTERNAZIONALI