Update of techniques for the treatment of periodontal recessions.

Actualización de las técnicas para el tratamiento de las recesiones periodontales.

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ABSTRACT

Background:

Along the years, a remarkable variety of periodontal surgical protocols has been proposed, the focus of which has shifted from the mere resolution of a soft tissue defect to the performance of predictable and minimally invasive procedures. Initially, the free gingival graft was used. Subsequently, many different techniques were experimented, including those using soft tissue substitutes, such as the Alloderm membrane.

Nowadays, the association of the connective tissue graft with the coronally advanced flap is considered the gold standard. Finally, the Pinhole technique, being a more conservative method in terms of tissue preservation and aesthetic outcome, was proposed.

Objectives:

The aim of this review was the comparison of the updated techniques for the treatment of multiple periodontal recessions, affecting both maxilla and mandible. The procedure outcome was assessed in terms of complete root coverage, recession reduction, gain in height and volume, aesthetic outcome, patient's post-operative pain and morbidity of donor and recipient sites.

Material and methods:

Electronic and hand searches were performed to collect split- mouth studies, randomized controlled clinical trials, case series, pilot studies, periodontal books, case studies, systematic reviews and meta-analysis, including maxillary and mandibular multiple gingival recession defects of all four Miller's classes, for its extensive evidence.

Results:

Thirty-four publications were included and data regarding the surgical techniques outcome were extracted from eighteen articles. The clinical evaluation analyzed the amount of complete root coverage, recession reduction and gain in height and volume, while the patient's perspective was expressed in terms of aesthetic satisfaction and possible postoperative complications. Procedures in the last ten years showed better results in all the above-mentioned factors.

Conclusion:

Procedural predictability and long-lasting treatment stability embody the factors driving the technique election process and adding value to more updated procedures. Progress was observed both at an aesthetic level, by reducing the discrepancies between the surgical region and the surrounding tissue, and at a postoperative level, by reducing patient discomfort. The challenges inherent to this branch could soon find answers thanks to its prompt evolution, which allows for further advances to be conceived.

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Key words:
Dentistry, gingival recession, periodontal plastic surgery, root coverage, connective tissue graft. Key words: Dentistry, gingival recession, periodontal plastic surgery, root coverage, connective tissue graft.

INTRODUCTION

A gingival recession is defined as the migration of the gingival margin apically to the cemento-enamel junction, with the consequent tooth's root exposure. Due to the periodontal components involved in this process, the term periodontal recession is regarded as a synonym of this term (Dominiak et al., 2014). Depending on the etiological factors, a gingival defect can present itself as asymptomatic or as a variety of impairments in need of clinical interventions.

Any manifestation of the periodontal disease, such as a soft tissue defect, is treated by following an established therapeutic protocol, which indicates the non-surgical basic periodontal procedures as the starting point. When these actions are insufficient to restore the physiological conditions, a surgical approach is required. It will intend to achieve the root coverage through the soft tissue displacement, as well as to improve the quality of the recipient site, increasing the tissue volume. However, even when the further necessity of a surgical procedure can be foreseen, a basic treatment must always be performed first, as it comprises the only means through which a baseline stability can be achieved (Imber et al., 2021; Caton et al., 2014).

Along the years, a remarkable variety of surgical protocols has been proposed. Their focus has shifted from the mere resolution of a soft tissue defect to the performance of highly predictable and minimally invasive procedures (De Sanctis et al., 2014). Some of these are listed below.

Free gingival graft (FGG):
It was the most widely used mucogingival technique during 70's and 80's. Commonly obtained from the hard palate, at the level of the first and the second molar.

The graft was made of connective and epithelial tissues, leaving part of the former covering the donation site. This process was designed to increase the amount of keratinized tissue in the recipient site (De Sanctis et al., 2014; Cairo et al., 2014).

Coronally advanced flap (CAF):
First described by Allen and Miller in 1989, it consisted of two divergent vertical releasing incisions, performed together with a sulcular incision. Finally, a full thickness flap was raised and relocated in a coronal position (De Sanctis et al., 2014; Cairo et al., 2014; Alghamdi et al., 2009).

Envelope flap:
It is the coronally advanced flap technique modification, proposed by De Sanctis and Zucchelli in 2007. It implied the reduction of the vertical releasing incisions to a horizontal cut. It also involves a new flap dissection approach, consisting of split thickness elevation of the surgical papillae, full thickness flap elevation 3 to 4 mm apical to the bottom of the gingival recession and split thickness flap elevation in its most apical portion. De-epithelization of the anatomical papillae was performed, for the surgical papillae to be sutured over and the muscle insertions were eliminated to favour the flap mobilization (Alghamdi et al., 2009; Zucchelli et al., 2009; Cortellini et al., 2012).

No. 40, Vol 1, 18-29 2024 | ISSN:2215-5740

Coronally advanced flap with connective tissue graft (CAF + CTG):
Described by Zucchelli and De Sanctis, it implied the placement of a 4 mm height and among 1,5 and 2 mm width of connective tissue graft. It did not reach the apical portion of the defect, as it did not aim to achieve complete root coverage in the recession site, but the purpose was the stabilization of the coronal flap, improving in the long-term (Stefanini et al., 2018; Pini-Prato et al., 2010; Zucchelli et al., 2014; Azaripour et al., 2016).

Both the European Federation of Periodontology and the American Association of Periodontology indicated this approach was the gold-standard (Tian et al., 2021; Dodge et al., 2018; Skurska et al., 2015; Tavelli et al., 2019).

Tunnelling technique:
Proposed by Raetzke, it consisted of an intrasulcular incision, which left the interdental papillae untouched. Also, a continuous split thickness flap elevated up to the mucogingival junction and the undermined dissection of the buccal mucosa, to obtain the flap mobilization coronally to the cementoenamel junction (Skurska et al., 2015; Ozenci et al., 2015; Zhur et al., 2020; Gobbato et al., 2016; Osorio et al., 2022).

Vestibular incision subperiosteal tunnel access (VISTA):
It consisted of a single vestibular incision, performed about 3 mm from the gingival margin, split thickness elevation of the attached gingiva and a tunnel carried out in the papillary areas. Finally, the whole complex was advanced coronally (Rajeswari et al., 2021; Mansouri et al., 2019).

Pinhole technique:
It consisted of a horizontal incision, extended for 2 to 3 mm, a supraperiosteal dissection of the muscular and fibrous adhesions and the tissue elevation in an apicocoronal direction, involving the interdental papillae.

A collagen membrane was placed, through the hole, increasing the amount of tissue in the interproximal areas.

This promoted the coronal self-holding of the complex, since the muscular insertions elimination favoured its passive mobilization (Agarwal et al., 2020; Reddy, 2017).

An accurate case selection is of paramount importance, before starting to act. The identification of the etiological factor implied in the gingival margin migration, as well as the recession type (single or multiple), its location and associated aesthetic affectation, along with the patient's gingival phenotype are the elements that drive the professional's choice of a specific technique rather than the other.

The main objective was to compare the updated techniques for the treatment of periodontal recession, following their historical development, and to analyse the advantages inherent in the more recent approaches with respect to the older ones.

The secondary objective was to examine the treatment outcome in terms of CRC (complete root coverage), RecRed (recession reduction), KT gain (keratinized tissue gain), aesthetic outcome, patient's post-operative pain and morbidity, to justify the advantages of one technique over another.

MATERIALS AND METHODS

A literature review was conducted considering the publications obtained from the following databases: Medline, through PubMed, Wiley

No. 40, Vol 1, 18-29 2024 I ISSN2215-5740

Online Library and Cochrane Library Advance Search. Additionally, hand searching directed at Journal of Clinical Periodontology, Journal of International Academy of Periodontology, Journal of Periodontology, The International Journal of Periodontics and Restorative Dentistry was performed.

The inclusion criteria consisted of the following:

- Publications in English language.
- Released between 2006 and 2021.
- Articles including multiple gingival recession defects, affecting both maxilla and mandible.
- Publications including all four gingival recession Miller's Classes, thanks to the evidence extension.
- Split-mouth-studies, randomized controlled clinical trials, case series, pilot studies, periodontal books, case studies, systematic reviews and meta-analysis.
- Two publications of a single case report for the treatment analysis of Miller's Class III and IV, due to the limited available literature.

The exclusion criteria consisted of the following:

- Preclinical studies.
- Publications including periodontal treatment associated to implant surgery.
- Studies analysing localized gingival recession defect only.
- Research without a post-operative assessment during a specified follow-up period.
- Publications that did not include the term "gingival recession".

Information sources and search equations:

- The MEDLINE, through PubMed, on December 5, 2021. The search equations were: ("Gingival recession") AND ("Etiology") [catalog]; ("Gingival recession") AND ("Etiology") AND ("Occurrence") [full text]; ("Gingival recession") AND ("Classification") AND ("Miller") [full text]; ("Coronally advanced flap") AND ("Zucchelli") [full text]; ("Tunnel technique") AND ("Connective tissue graft") [full text]. Additionally, the advanced search was limited to publications in English language and between the year 2000 and 2021.
- Wiley Online Library, on December 5, 2021. The search equations were: ("Periodontal recession") AND ("Connective tissue graft") NOT ("Free gingival graft") [full text journal]; ("Root coverage") AND ("Prediction") [full text journal]; ("Root coverage") AND ("Connective tissue graft") AND ("Meta-analysis") [full text journal]. Additionally, the advanced search was limited to publications in English language and between the year 2000 and 2021.
- Cochrane Library Advance Search on November 8, 2021. The search equations were: ("Comparison") AND ("Surgical techniques") AND ("Gingival recession") [Review]; ("Root coverage") AND ("Patient's morbidity") [trial]. Additionally, the advanced search was limited to publications in English language and between the year 2000 and 2021.

No. 40, Vol 1, 18-29 2024 | ISSN:2215-5740

- Hand searching included: Journal of Clinical Periodontology, Journal of International Academy of Periodontology, Journal of Periodontology, The International Journal of Periodontics and Restorative Dentistry.

Data extracted from eighteen publications were examined, to offer a visual comparison between the different surgical techniques, confronting their outcome in terms of complete root coverage (CRC), recession reduction (RecRed) and keratinized tissue augmentation (KT gain).

CRC was expressed in percentages. Every percentage was calculated by making the average of the values expressed in the different publications and referred to the same technique. RecRed and KT gain were expressed in mm.

Every value was extracted from numbers expressed using the standard deviation and calculated by making the average of the measures shown in the different publications and referred to the same technique.

Additionally, values related to aesthetics and possible post-operative complications were considered, in the attempt to provide a data analysis that considered the patient's perspective as well.

The level of patient's satisfaction, in terms of aesthetic outcome and postoperative pain and morbidity was expressed according to the Visual Analogue Scale (VAS), including values from 1 to 100, and where a higher number was associated to a better result.

Data depicted according to the Root Coverage Aesthetic Score (RES) were converted to their equivalent in the VAS, while publications reporting the patient's point of view with words were excluded, as they could not be represented with numerical values.

RESULTS

Through a hand search and the analysis of three different databases, 105 publications were collected and progressively screened down to 34 (Figure 1). Afterwards, limited to 24, considering only those publications indexed in PubMed.

The data extraction process considered 18 publications, examined in terms of CRC, RecRed, KT gain, aesthetic outcome, patient's postoperative pain and morbidity of the donation and recipient site.

The comparison between one technique with the other was carried out facing clinical situations that differed for some characteristics, such as the recession depth, the keratinized tissue volume in the recipient site or the soft tissue defect location. Each surgical protocol is indicated to treat cases with specific characteristics. For example, a coronally advanced flap or an envelope flap is not indicated if the area to be treated has an insufficient vestibular sulcular depth, as well as the tunneling technique is not suggested to treat very deep recessions, due to the reduced coronal mobility of this type of flap.

Amongst the surgical techniques considered, the percentage of CRC varied from 9%, being the lowest achieved value, and 93%, representing the highest.

The worst outcome was linked to the free gingival graft procedure, while the tunneling and the VISTA technique turned out to be equally effective in showing the best result (Figure 2).

No. 40, Vol 1, 18-29 2024 I ISSN2215-5740

The profit, expressed in mm, relatively to the KT gain and the RecRed varied respectively from 0.57 mm to 3.03 mm for the former, and from 1.40 mm to 3.43 mm for the latter. The envelope flap technique showed the worst outcome for the KT gain, as the VISTA did for the RecRed. On the contrary, the VISTA achieved the best result in terms of KT gain, as the free gingival graft did in terms of RecRed (Figure 3).

According to the VAS scale and following the historical evolution of the analyzed surgical techniques, the aesthetic outcome and the postoperative pain and morbidity varied from a value of 60, reported from those patients that underwent the free gingival graft procedure, to a value of 95 and 75 respectively, as the Pinhole technique is performed. Nevertheless, in terms of aesthetics, the highest value was associated with the envelope flap and with the tunneling procedure. Instead, considering the postoperative pain and morbidity, the highest value presented with the envelope flap, while a negative result appeared with the VISTA technique (Figure 4).

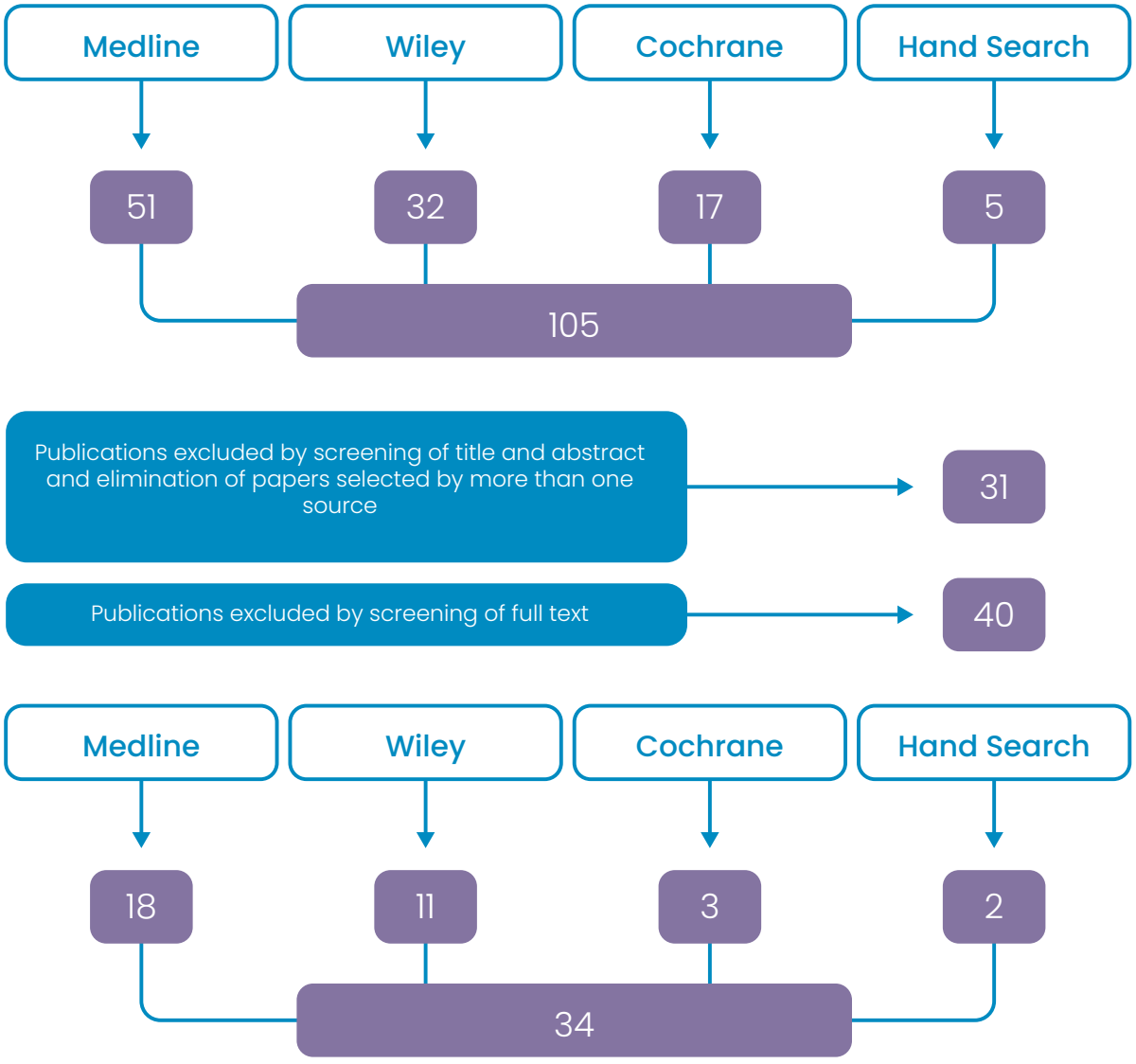

Figure 1. Study selection process.

No. 40, Vol 1, 18-29 2024 | ISSN:2215-5740

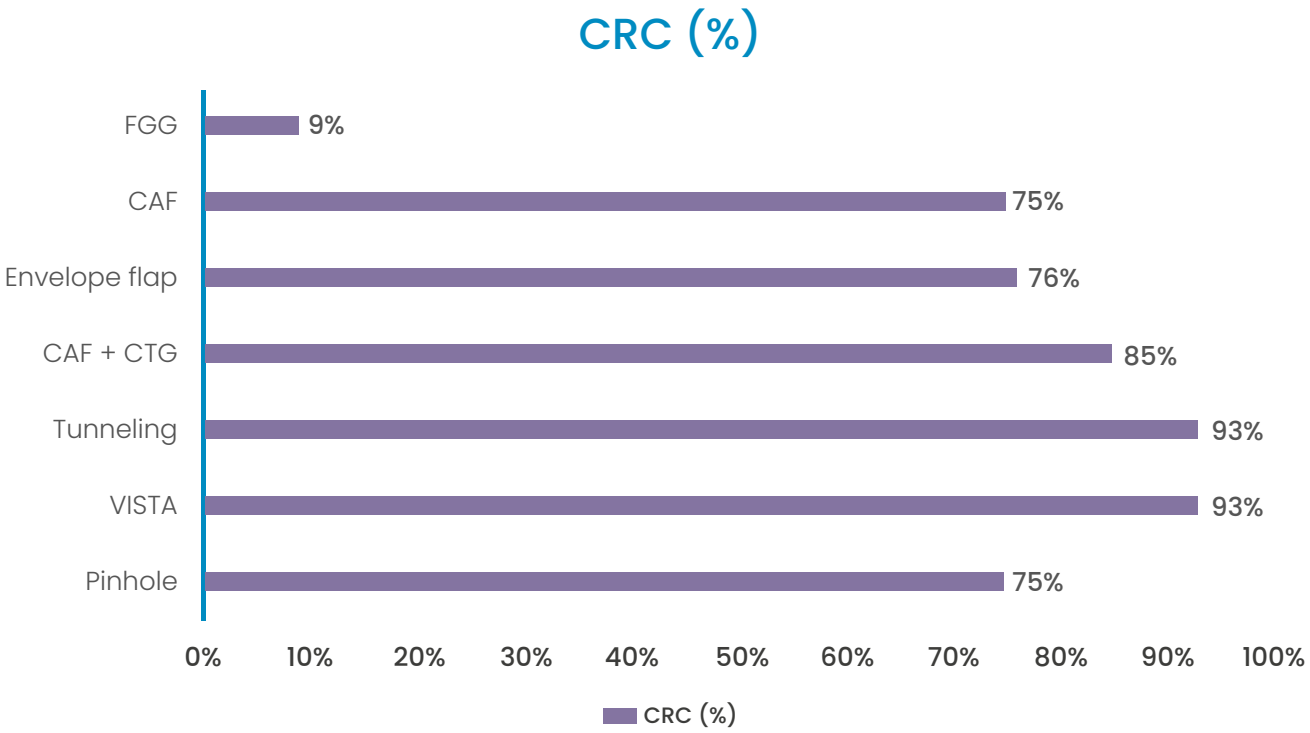

Figure 2. Surgical techniques comparison in terms of complete root coverage (CRC).

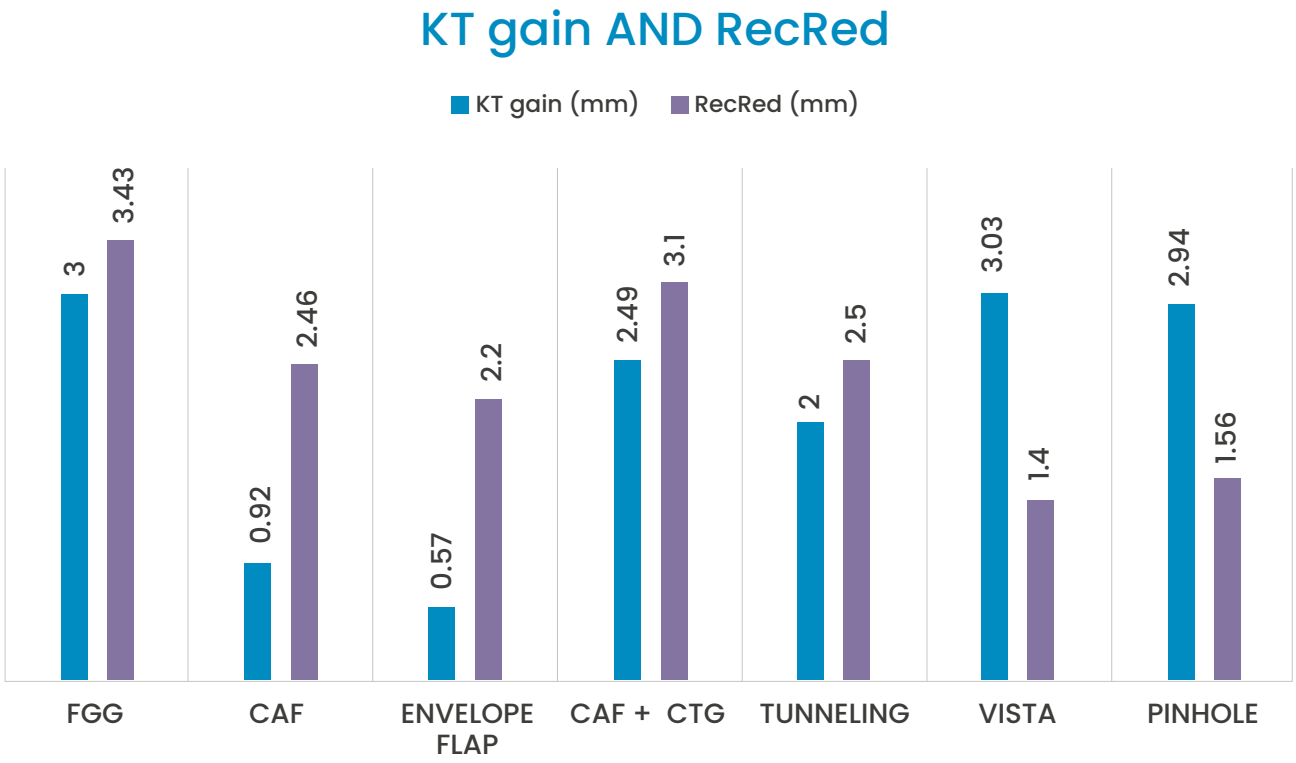

Figure 3. Surgical techniques comparison in terms of keratinized tissue gain (KT gain) and recession reduction (RecRed).

No. 40, Vol 1, 18-29 2024 I ISSN2215-5740

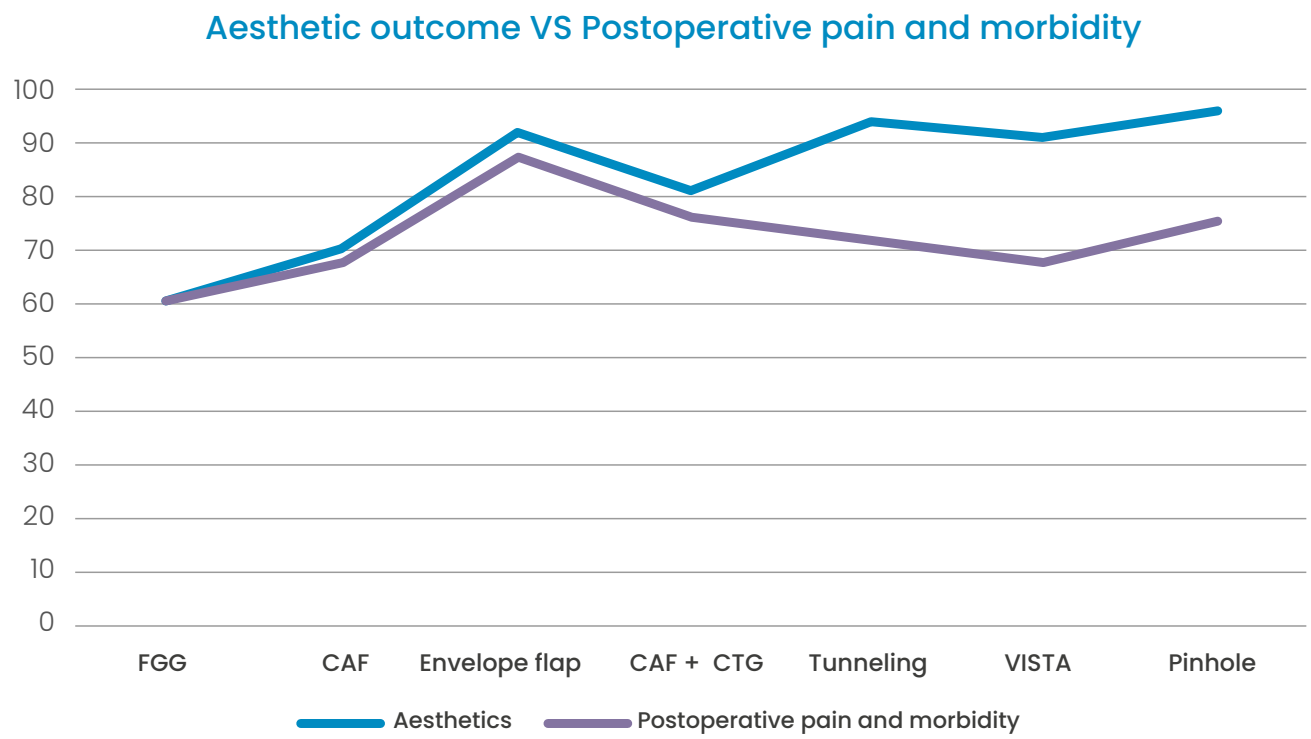

Figure 4. Surgical techniques comparison in terms of aesthetic outcome and patient's postoperative complications.

DISCUSSION

The focus of this review lied in the identification of the oldest techniques' limitations and in their compensation through the improvements introduced with the newer procedures. The formerly predominant idea of a direct association between abundant amount of keratinized tissue and healthy periodontal status led to the setting of the free gingival graft procedure as the golden standard for the achievement of KT gain (3 mm) at the recession site. Nevertheless, the frequent relapses, associated to its short-term stability, caused this technique to occupy the worst position in the historical perspective concerning the amount of CRC (9%) and RecRed (3.43 mm).

Moreover, the disparities in tissue colour and texture blending between the treated area and the surrounding resulted in an aesthetically unacceptable outcome (VAS 60). This was aggravated by a difficult postoperative due to a double surgical site (VAS 60), which lead to a progressive disregard of such procedure (De Sanctis et al., 2014; Cairo et al., 2014).

Hence, the CAF technique was introduced, eliminating the solution of continuity between the flap and its base and thus providing an almost identical appearance to the surrounding area. As demonstrated by Cairo et al. (2014), it showed a greater potential for CRC (75%), as well as for RecRed (2.46 mm), which allowed for an elevation of the aesthetic degree (VAS 70).

Additionally, the presence of a single surgical site limited the morbidity and the patient's discomfort (VAS 67) (De Sanctis et al., 2014; Cairo et al., 2013; Alghamdi et al., 2009).

For minimal invasiveness, Zucchelli and de Sanctis (2009) enhanced the previously modified CAF procedure, derived from the

No. 40, Vol 1, 18-29 2024 | ISSN:2215-5740

elimination of the vertical releasing incisions, with the split-full-split thickness flap technique, which lead to the development of the envelope flap. The tissue manipulation was reduced, by limiting the full thickness approach to the tissue apical to the recession defect, resulting in a better postoperative for the patient (VAS 87).

Despite sharing the same procedural drawback of the traditional CAF, identified in the sufficient amount of keratinized tissue needed close to the recession site, the envelope technique proved a higher rate of success in terms of CRC (76%) and, therefore, a superior aesthetic outcome (VAS 92).

Nevertheless, remaining limited by a very low value of KT gain (0.57 mm) (Alghamdi et al., 2016; Zucchelli et al., 2009; Cortellini et al., 2012).

In the attempt to broaden the indications for the coronally advanced flap, along with its modification, the association with the harvesting of connective tissue was proposed. It increased the amount of KT gain at the recession site (2.49 mm), enhanced the RecRed (3.10 mm) and provided an additional source of blood supply, preventing the marginal shrinkage (Pini -Prato et al., 2010; Azaripour et al., 2016; Tian et al., 2018; Dodge et al., 2018).

Firstly, intended to accommodate the accomplishment of CRC (85%), it was lately demonstrated by Zucchelli et al. (2018) that the real enhanced benefit was the considerable degree of treatment stabilization reached in the long term, once the lack of tissue was compensated through the graft. Thanks to its efficiency, the association of CAF with CTG established as the gold standard technique, despite its worse morbidity derived from a double surgical site (VAS 76) (Stefanini et al., 2018; Zucchelli et al., 2014). In the clinical practice, patients subjected to this type of surgery most commonly refer to the donation site as the main cause of their postoperative pain.

Aiming at enhancing the patient's comfort, the visible cuts on the tissue surface and the anatomical papillae detachment were eliminated with the tunneling technique, leading to an uneventful healing (VAS 72).

As demonstrated by Tian et al.(Tian et al., 2021), this technique allowed an optimal CRC (93%), a greater recession reduction (2.5 mm), a better aesthetic outcome (VAS 94) and an increased keratinized tissue gain (2 mm). Apart from exhibiting a significant long-term stability, this procedure admitted the reduced gingival amount at the recession site as one of its indications (Tian et al., 2021; Gobbato et al., 2016; Osorio et al., 2022).

With the repurposing of a flap elevation that followed the same fashion as the tunnelling technique, while changing for a single vertical incision, gave way to the development of the the vestibular incision subperiosteal tunnel access technique. Such modification led to an improvement of the aesthetic outcome, in terms of post-surgical colour, tissue contour and shape. For those reasons it became the procedure of choice for situations with high aesthetic demand (VAS 91).

This technique gained relevance as it: accomplishes a greater CRC (93%), compared to that reported by the CAF technique (even in its association with a CTG), minimizes invasiveness, eases the procedure and reduces the surgical chair time, decreases the patient's pain perception and discomfort during and after the treatment, (Rajeswari et al., 2021; Mansouri et al., 2019).

No. 40, Vol 1, 18-29 2024 I ISSN:2215-5740

Culminating this historical excursus is the Pinhole technique, associated to the least invasive tissue manipulation and therefore achieving the highest tissue preservation.

This procedure usually manifests a minimal discomfort during the surgical procedure, as well as a negligible pain after the intervention (VAS 75). It allowed for an immediate CRC (75%), clinically evident, and also granted aesthetic improvement from the patients' perspective. This, in turn, increased their satisfaction (VAS 95) (Agarwal et al., 2020; Reddy, 2017).

It must be pointed out that a decrease in the numeric values representing the clinical outcomes of this procedure, when compared to the other surgical techniques, may be related to the short spectrum of accessible scientific literature, currently limited to a few case reports and, therefore, yet not sufficient to be considered fully reliable.

CONCLUSION

As the aesthetic concern increases amongst patients, the historical evolution in the field of periodontal surgery has made advancements to cover their demand.

The minimization of the differences between the treated site and the surrounding area and physiological gingival profile reestablishment, have been the main achievements so far. Minimal patient discomfort, limited post-operative pain and reduced morbidity are the additional elements driving the process for choosing the right technique. Procedural predictability and long-lasting treatment stability embody the factors clinicians look for as they add value to the updated techniques.

To date, considerable improvements, in the above-mentioned aspects, have been made through the development of renovated surgical procedures. Nevertheless, despite the significant progress that has taken place, this exciting branch of periodontal surgery is still to be regarded as a quickly evolving field. Many challenges remain, therefore further advancements are to be expected.

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The authors declare that they have no conflicts of interest.

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Author contribution statement

Conceptualization and design:
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Literature review: DS
Methodology and validation: DS, EGI
Formal analysis: DS
Investigation and data collection: DS
Resources: DS, EGI
Data analysis and interpretation: DS, EGI
Writing-original draft preparation: DS, MMC, GGA
Writing-review & editing: DS, MMC, GGA
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Project administration: MMC

No. 40, Vol 1, 18-29 2024 | ISSN:2215-5740

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No. 40, Vol 1, 18-29 2024 I ISSN2215-5740

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No. 40, Vol 1, 18-29 2024 | ISSN:2215-5740