



Prognostic Factors for Root Coverage

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Abstract

Gingival recession, characterized by the apical migration of the gingival margin, is a common dental condition with aesthetic and functional implications. Various surgical procedures have been developed to address this condition, with complete root coverage (CRC) as the ultimate goal. Several factors, including anatomical, patient-related, and practitioner-related elements, influence the success of these procedures. This article reviews key prognostic factors for root coverage, including recession classifications, site-specific anatomical features, and clinical outcomes. Understanding these factors is critical for optimizing treatment planning and achieving predictable outcomes.

Keywords: Gingival Recession; Root Coverage; Prognostic Factors; Periodontal Surgery; Keratinized Tissue; Gingival Biotype

Abbreviations

CEJ: Cementoenamel Junction ; CRC: Complete Root Coverage ; MRC: Maximum Root Coverage ; MGJ: Mucogingival Junction ; CAL: Clinical Attachment Loss ; NCCL: Non-Carious Cervical Lesions ; CAF: Coronally Advanced Flap ; CTG: Connective Tissue Graft

Introduction

Gingival recession is defined as the apical migration of the marginal gingiva in relation to the cementoenamel junction (CEJ). Clinically, it is measured from the CEJ to the most apical extension of the marginal gingiva [1].

The primary indications for root coverage surgical procedures include aesthetic concerns, treatment of dentin hypersensitivity, and increasing the width of keratinized tissue to reduce the risk of defect progression. The primary clinical aim is to achieve complete root coverage (CRC), defined as the marginal gingiva reaching a position slightly coronal to the CEJ with no residual probing depth or detectable inflammation [2].

Complete root coverage is the proportion of treated defects where the marginal gingiva reaches or exceeds the CEJ, representing the most significant outcome for patients with aesthetic concerns (Consensus report, Periodontal regeneration around natural teeth [3]).

A research group recently suggested a method to predetermine the maximum root coverage level (MRC) based on the calculation of the ideal height of anatomical interdental papillae [4]. This line should coincide with the anatomical CEJ when it is not clinically detectable on a tooth with Miller Class I or II gingival recession. In Miller Class III, where the ideal anatomical conditions for complete coverage are not fully represented, this line is placed more apically than the anatomical CEJ [5].

Materials and Methods

This article is a comprehensive review of the literature on prognostic factors influencing root coverage outcomes. It categorizes these factors into site-related anatomical variables, patient-related

characteristics, and practitioner-related elements. Relevant studies and clinical data were analyzed to identify trends and evidence-based recommendations for treatment planning.

Results and Discussion

Classifications of gingival recessions and predictability of root coverage

Several classifications of gingival recessions have been reported in the literature.

Miller (1985) (6) proposed a classification of marginal tissue recessions into four classes, based on the position of the marginal gingiva in relation to the mucogingival junction (MGJ) and the status of the underlying alveolar bone

- **Class I:** The recession does not reach the MGJ, with no interproximal bone loss (Figure 1).
- **Class II:** The recession reaches the MGJ, still with no interproximal bone loss (Figure 2).
- **Class III:** The marginal gingiva is at or beyond the MGJ, with interproximal bone loss and/or poor tooth positioning (Figure 3).
- **Class IV:** Significant interproximal bone loss and/or severe malpositioning of the teeth (Figure 4).



Figure 1: Recession class I of Miller, RT 1 of Cairo.



Figure 2: Recession class II of Miller.



Figure 3: Recession class III of Miller, RT2 of Cairo.

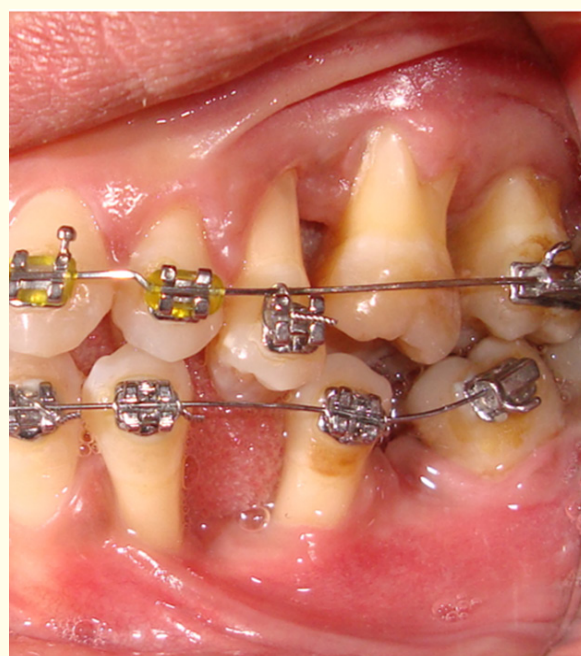


Figure 4: Recessions Class IV of Miller, RT3 of Cairo.

Clinical variables related to gingival recession could also be assessed to anticipate the prognostic of root coverage outcomes. Miller (1985) hypothesized that

- CRC is achievable for Class I and II (Figure 1, 5, 6, 7)
- Partial root coverage is possible for Class III (Figure 3, 8)
- No root coverage is expected for Class IV.

Over the past two decades, Miller’s classification has become very popular and widely used. However, some criticism includes

- Difficulty in differentiating between Class I and II.

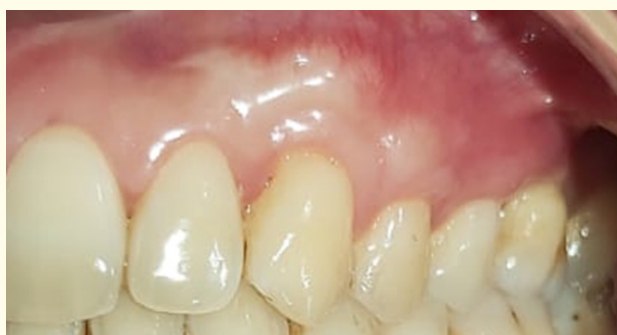


Figure 5: Complete root coverage of recession class I of Miller, RT 1 of Cairo.



Figure 6: Recession Class I Miller Rt1 Cairo.



Figure 7: Complete root coverage of recession class I of Miller, RT 1 of Cairo.

- Lack of clear guidelines for evaluating the amount of soft or hard tissue loss in the interproximal region to distinguish between Class III and IV.
- Imprecise influence of poor tooth positioning [7].



Figure 8: Treatment by FGG for of recession Class III of Miller.

[8], suggested a new classification based on the level of interproximal clinical attachment loss (CAL). It provided a better taxonomy and was validated by reliability studies

- **Recession Type 1 (RT1) (Figure 1):** Gingival recession without interproximal attachment loss. The interproximal cemento-enamel junction is not clinically detectable mesially and distally on the tooth.
- **Recession Type 2 (RT2) (Figure 3):** Gingival recession associated with interproximal attachment loss. The amount of interproximal attachment loss is less than or equal to the vestibular attachment loss.
- **Recession Type 3 (RT3) (Figure 4):** Gingival recession associated with interproximal attachment loss. The amount of interproximal attachment loss is greater than the vestibular attachment loss.

According to Cairo's study (2011), Class RT1 recessions showed a significantly greater reduction in recession (0.57 mm) compared to Class RT2 recessions after treatment, despite initially similar recession levels. This emphasizes the importance of the presence or absence of interproximal attachment loss for the prognostic of gingival recession treatment.

In Class RT2, 24% of defects (8 out of 33) achieved CRC after various procedures. Although Miller (1985) [6] suggested that only partial coverage can be obtained in the case of interdental bone loss.

RT3 recessions, treated solely by free gingival graft (FGG) to increase attached gingiva without aiming for root coverage, showed slight coronal improvement in the gingival margin at six months

(mean recession reduction (Rec Red) of 0.4 ± 0.9 mm). This improvement is likely due to creeping attachment after FGG (Matter, 1980). This suggests that reconstructing interproximal hard/soft tissues is essential before considering a predictable root coverage procedure at the vestibular site in RT3 cases [8].

The success of root coverage is influenced by the stability and blood supply provided by the interproximal soft tissues to the flap/graft during the healing process. Cairo's study (2011) [8] suggests that assessing interproximal clinical attachment loss can be used both to classify gingival recession defects and to predict the final root coverage outcomes.

Prognostic factors

Achieving more or less complete root coverage with an optimal aesthetic outcome is a key goal in periodontal plastic surgery. Various factors influence the success of this procedure and can be categorized into site-related anatomical factors, patient-related factors, and practitioner-related factors.

Anatomical site-related factors

In periodontal plastic surgery aimed at achieving more or less complete root coverage, several anatomical factors play a crucial role in determining the success and aesthetic appearance of the outcome. These include

Dimensions of gingival recession (Figure 9)

wide recessions are considered more difficult to treat than narrow recessions [10], and the curvature of the root can also impact the outcome of root coverage. Prominent roots have a larger avascular area, which can complicate treatment [11].



Figure 9: Wide recession RT1 of Cairo.

On the other hand, the effect of the initial recession depth on the percentage of root coverage remains controversial. Some studies suggest that a deeper initial recession is associated with a lower percentage of CRC or partial root coverage [12-14], while other studies observed a greater reduction in recession for deeper defects [15-17].

Dimensions of the adjacent papilla

The size of the papilla also plays a crucial role in the predictability of root coverage outcomes. The papilla acts as an essential vascular support. Once it is de-epithelialized, it serves as a vascular bed to anchor and suture soft tissues onto the exposed root.

Studies have shown a significant positive correlation between papilla height and the percentage of CRC. A papilla height of 5 mm or more is associated with 100% root coverage [18-20]. However, other research [11,21] observed more frequent CRC in sites with a papilla of lesser height. This could be explained by differing measurement methods between studies, with the CEJ level influencing the measured papilla height.

Papilla width is also positively correlated with root coverage success. A narrow papilla may limit the extent of horizontal incisions at the CEJ, which could impair blood supply to the coronal-apical area during healing. However, some studies contrast with these findings.

Additionally, factors such as tooth rotation, tooth extrusion, occlusal abrasion, and root prominence can alter the interdental papilla height, even in the absence of attachment loss or interdental bone loss [18].

A recent method using interdental papilla height to predict the final position of the marginal gingiva showed 71% accuracy three months after surgery [5]. This measurement was conducted on a tooth with gingival recession without malposition, and on a similar tooth with malposition. Horizontal projections at the recession margin identify two points connected by a line representing the "root coverage line" [5].

Gingival thickness (Figure 10)

The thickness of the gingival tissues, particularly the attached gingiva, is also a key factor in the success of root coverage. According to a study by Huang, *et al.* (2005) [21], if the initial gingival thickness is greater than 1.2 mm, the chances of achieving 100% root coverage are higher. This observation is also confirmed by an-



Figure 10: The amount of keratinized tissue.

other study by Baldi, *et al.* (1999) [22], which reports that CRC is more likely when the thickness of the tissue at the alveolar mucosa level is greater than 0.8 mm. A thick biotype favors postoperative stability and improves surgical outcomes [23].

Amount of keratinized tissue (KT) (Figure 10,11)

The presence of keratinized tissue (KT) around the recession defect is essential for the success of periodontal surgical procedures such as the coronally advanced flap (CAF) or laterally positioned flap (LPF). Although there is no universal threshold for the amount of residual KT needed. Studies suggest that the presence of a certain amount of KT apically or laterally to the root surface is important for achieving CRC. A thick tissue or a greater amount of residual KT is generally associated with more predictable outcomes for CRC (Huang *et al.*, 2005) [21], whereas a lack of keratinized tissue around recessions compromises long-term stability [23].



Figure 11: The amount of keratinized tissue.

Presence of non-carious cervical lesions (NCCL) (Figure 12, 13)

The presence of non-carious cervical lesions (NCCL), such as abrasion due to mechanical forces, corrosion, or abfraction, can make it difficult to locate the CEJ on teeth with recession defects [4].



Figure 12: Presence of non-carious cervical lesions.



Figure 13: Presence of non-carious cervical lesions.

Correct determination of the clinical CEJ is crucial because it allows to assess the outcomes of root coverage when the reference anatomical landmark (the CEJ) is difficult to locate. The presence of abrasion or surface irregularities is not correlated with a lower percentage of root coverage, and positive results have been noticed when surgery is performed on a previously restored root surface. Restorative/periodontal treatment of a cervical abrasion associated with gingival recession can improve final aesthetic outcomes [24].

The treatment requires apical repositioning of the CEJ using a composite restoration at the predetermined root coverage line, followed by mucogingival surgery to cover the apical portion of the exposed root. This approach can give a satisfactory aesthetic result [18]. Pre-determining the root coverage line facilitates restorative and surgical treatments, enhancing the overall aesthetic and hygienic outcomes. Combining restorative (pre-surgical) and periodontal (post-surgical) treatments is more effective for addressing recession-abrasion defects than isolated restorative or mucogingival procedures, Both in terms of aesthetics and hygiene.

Tooth location

Although not statistically significant, maxillary teeth appear to achieve CRC more predictably than mandibular teeth [21,25].

Patient-related factors

Age, Sex, and Ethnicity

These factors do not appear to have a significant influence on the outcome of root coverage [21,26], although the researches on these influences are limited.

Smoking

Smoking has been shown to negatively impact clinical outcomes. Smokers are less likely to CRC [27-29].

Traumatic tooth brushing

Traumatic brushing influences the development and progression of facial gingival recession [30], but there is little evidence that changes in brushing habits significantly impact the long-term maintenance of surgical outcomes [31,32]. A long-term study (14 years) on gingival recessions treated with the CAF technique [7] observed loosening of the soft tissue margin and speculated that this might be due to the resumption of poor brushing habits in patients with good oral hygiene, even when they followed a strict follow-up protocol.

Plaque control

Patient participation in the supportive care program seems to play a major role in maintaining long-term results. However, the influence of a non-traumatic brushing technique following surgery on the stability of the marginal tissues has yet to be demonstrated in a controlled setting [32].

Practitioner-related factors

The clinical experience is an important factor that can influence case selection, judgment, and surgical skills [21,26]. A recent mul-

ticenter study comparing the CAF technique and CAF + connective tissue graft (CTG) in the treatment of simple recessions demonstrated a consistent effect based on the center where the surgery was performed [17].

In this study, the results obtained by one of the centers were generally better than those of the other centers. This is linked to potential variations in the execution of procedures, even though all surgeons were trained and calibrated to perform the surgical techniques in a standardized manner. Additionally, the time required for the procedure varies depending on the surgeon's experience and the complexity of the case. For example, the use of a connective tissue graft under a CAF resulted in a longer operative time.

Finally, the practitioner's judgment regarding case selection and surgical technique, as well as their technical skill, play a crucial role in the prognostic of surgical procedures. A practitioner's ability to choose the most appropriate treatment for each individual case can influence clinical outcomes.

The influence of individual surgical skills can explain the variable results obtained when different clinicians perform the same surgical procedure, as observed in systematic reviews [33-35].

Conclusion

The prognostic factors must be carefully considered when planning and performing surgical procedures to ensure the best chances of achieving satisfactory aesthetic and functional outcomes for the patient.

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Conflict of Interest

Any financial interest or conflict of interest.

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