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The Supracrestal Soft Tissue Height as a Guide for Surgical Crown Lengthening Procedures

Surgical crown lengthening (SCL) is a predictable method of increasing the availability of supragingival tooth structure for biologic, esthetic, and/or restorative reasons. However, the literature demonstrates a lack of precision when performing this common procedure due to a number of factors. Among those factors, the use of standardized measurements and reference points will be presented, as well as the limitations inherent to the classical surgical protocol. This review discusses the importance of individualizing supracrestal soft tissue dimensions during SCL interventions and the use of appropriate diagnostic tools while taking into account the phenotypic characteristics of the patient in both functional and esthetic crown lengthening. *Int J Periodontics Restorative Dent 2026;46(suppl):xxx–xxx. doi: 10.11607/prd.7653*

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Surgical crown lengthening (SCL) is a therapeutic procedure that aims to increase the availability of supragingival tooth structure for biologic, esthetic, and/or restorative reasons.[1] This is achieved by apical relocation of the gingival margin, with or without the removal of bone tissue. It is important to note that this therapeutic objective—crown lengthening—does not necessarily require surgical intervention, as it can also be fulfilled through orthodontic tooth movements, particularly when combined with supracrestal fiberotomy. However, the focus of this review is on SCL, as it is the most prevalent treatment modality.[2,3]

SCL interventions have been categorized according to their primary objective as either esthetic or functional. In esthetic crown lengthening, the main objective is to improve the appearance of the smile by increasing the exposure of the anatomical crown, or to achieve symmetry or harmony in the gingival margins in the anterior region when placing esthetic restorations.[4]

Frequently, conditions of altered passive eruption such as Coslet Type 1B and Type 2B[5] and gingival enlargement are corrected by increasing the anatomical crown as well.[4,5] Conversely, functional crown lengthening is mainly indicated for restorative purposes when there is a need to expose healthy tooth structure, such as in the presence of fractures, subgingival caries, and/or deep margins.[4–6]

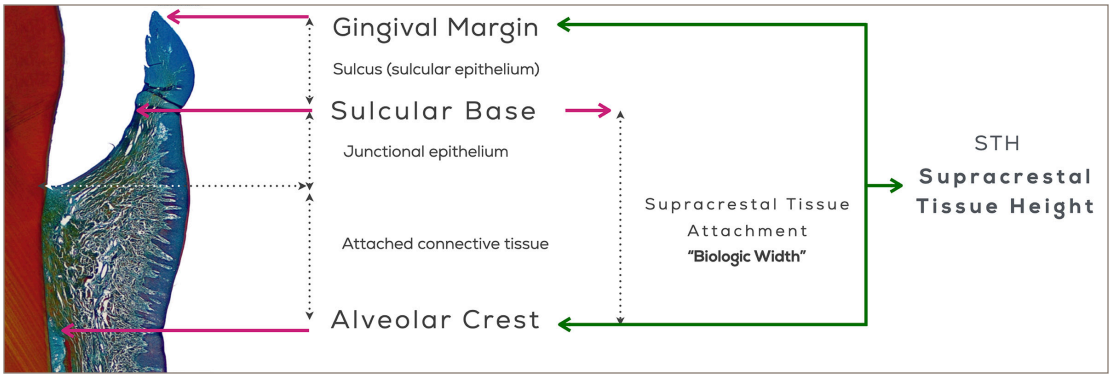
In both indications, SCL interventions need to restore the space for the supracrestal tissues, if this physiologic dimension is not available. This space has historically been referred to as the *biologic width*[7] and comprises the supracrestal dimensions necessary for the epithelium attachment to the enamel and the gingival connective tissue fibers to the root cementum. However, given the variability of the epithelial dimension depending on tooth morphology, the recent EFP-AAP World Workshop concluded that the critical space necessary for achieving a stable position of the gingival tissues was the space for the supracrestal connective tissue attachment (defined as the distance from the bone crest to the cementoenamel junction [CEJ]). Failure to achieve this can result in gingival inflammation or gingival enlargement or otherwise lead to bone resorption and/or gingival recession.[8]

In SCL procedures with high esthetic expectations, it is critical to achieve a stable, ideal gingival margin position. However, this outcome is not always predictable, and in most of the published studies evaluating this surgical procedure, there is a frequent progressive marginal soft tissue rebound reported.[8] Different factors have been identified influencing this outcome, such as the position of the gingival margin in relation to the bone crest,[9,10] the extent of the ostectomy performed,[9] the patient's periodontal phenotype,[11] the healing time,[12] and the surgeon's experience.[13] Furthermore, the type of surgical intervention itself has been proven to play a role in the clinical outcome, as was recently demonstrated in a randomized clinical trial comparing two SCL surgical interventions.[14]

In order to enhance the probability of attaining favorable outcomes, it is imperative to consider multiple factors during the planning phase of an SCL procedure. Primarily, it is essential to establish a precise target reference position, such as the tooth CEJ or the designated restorative margins.[4,14] Then it is fundamental to establish the needed supracrestal dimension and assess the amount of ostectomy needed to allow the insertion of the gingival connective tissue fibers and the establishment of a gingival sulcus in the selected position. It is imperative to note that the calculation of this dimension should not be conducted using mean values. Rather, the resulting position of the gingival margin should be customized to align with the desired esthetic/functional objectives.[15] In this review, we discuss the importance of individualizing supracrestal soft tissue dimensions during SCL interventions, using appropriate diagnostic tools while taking into account the phenotypic characteristics of the patient. In particular, this paper proposes using the supracrestal tissue height (SCTH) as a surgical guide when performing SCL as well as the value of using a double-stent technique to improve the accuracy of its diagnosis.

Surgical Interventions

In order to displace the gingival margin or modify its shape or scalloping by SCL, it is necessary to develop a biologically healthy environment in which the gingival supracrestal tissues are free of inflammation and remain stable over time. This objective can be achieved through two distinct surgical interventions: *(1)* a gingivectomy, in which the position of the attached gingival connective tissue (CT) is maintained but the dimensions of the gingival sulcus and the junctional epithelium (JE) are reduced; or *(2)* a flap procedure incorporating ostectomy/osteoplasty, thus enabling the apical displacement and repositioning of the attached supracrestal tissues after creating the necessary space. In patients exhibiting a thick gingival phenotype, frequent rebound is observed following these procedures, as the tissues tend to regain their initial position and dimension.[8] Consequently, it is imperative to individualize these measurements by creating optimal space for stable tissue attachment. Classical studies aimed to establish the attached soft tissue height dimensions, otherwise termed *biologic width*, and reported standard

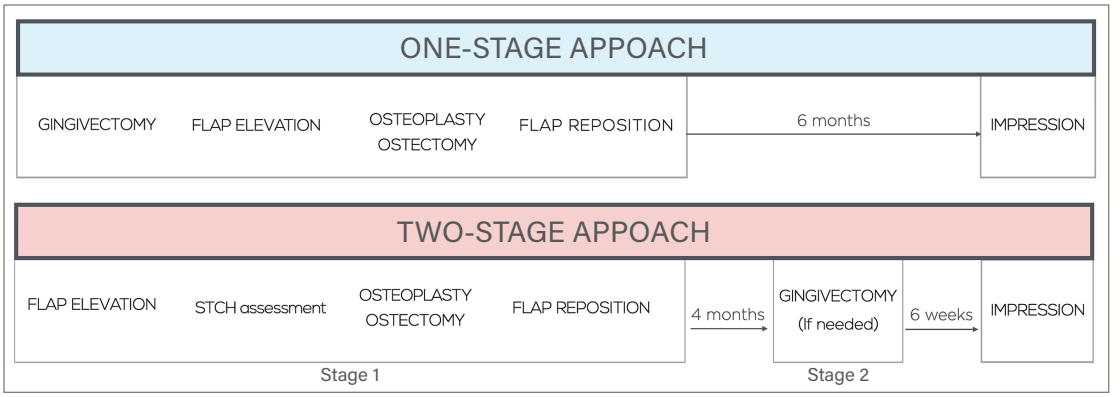


▲ **Fig 1** Histology of periodontal tissues. The SCTH is composed of the supracrestal attached tissues (JE and CTA) and the sulcus depth. It is important to individualize these measurements during the SCL procedure to obtain a stable and healthy result.

dimensions of the JE and the attached CT totaling approximately 2 mm (0.97 and 1.07 mm of JE and CT, respectively).[16,17] However, it should be noted that because these values represent means, there are significant clinical variations depending on factors such as tooth type, arch, phenotype, and surface, all of which will influence the final gingival margin stability after the SCL procedure.[18] Furthermore, the classic study by Gargiulo et al,[16] where most of these anatomical references are derived, was based on histologic data from a population of deceased soldiers whose gingival health was unknown. A comprehensive review of 14 studies published between 1924 and 2012 was conducted by Schmidt et al.[19] These studies evaluated the biologic width dimensions in humans and reported significant heterogeneity, with intra- and interindividual variations ranging from 0.2 mm to 6.73 mm. Notably, the length of the JE appears to be particularly influenced by the history of periodontitis and response to dental treatment, among numerous other variables. Consequently, given the wide anatomical diversity and the different clinical scenarios that may be encountered in clinical practice, it is not only impractical but also unfeasible to establish a standard "biologic width" dimension that can be universally used for therapeutic purposes. It is therefore essential to individualize these dimensions as well as the sulcus depth for each patient and for each individual tooth, whose shape, position, and dental history may influence the SCTH (Fig 1). Unfortunately, the accurate identification of these dimensions presurgically remains challenging, and various approaches have been proposed.

In the conventional one-stage SCL, the final gingival margin position is partially calculated by designing submarginal scalloped incisions, followed by removal of a variable amount of marginal gingival tissue and elevation of a full-thickness flap beyond the mucogingival junction. The creation of an adequate space for the supracrestal soft tissues and an ideal anatomical bone contour is then achieved by combining ostectomy and osteoplasty and finally by replacing and stabilizing the flap at the bone margins using the appropriate suturing,[20,21] while also providing, if needed, sufficient ferrule for teeth that may be unrestorable in their current state. It is worthy to note that the concept of intentionally suturing flap margins at the bone level significantly delays the reestablishment of biologic width, sulcular maturation, and subsequently the delivery of the final restoration. Therefore, this protocol is not considered the standard of care in contemporary crown lengthening.

The bone remodeling step is usually calculated using fixed landmarks, either the position of the CEJ or a prosthetically oriented guide, and then bone recontouring by ostectomy or osteoplasty until the desired dimension for the gingival tissue attachment is achieved. In this surgical intervention, the calculation of the amount of submarginal scalloping is guided by the preoperative assessment of the location and morphology of the CEJ line or planned prosthetic margin, either by transgingival probing and/or radiographic



▲ **Fig 2** Schematic representation of the SCL protocol performed as a one-stage approach vs a two-stage approach.

examination. However, the reliability of this information is questionable,[22] which can result in poor clinical decisions and unfavorable outcomes, such as marginal tissue rebound or the development of gingival recessions (Fig 2).

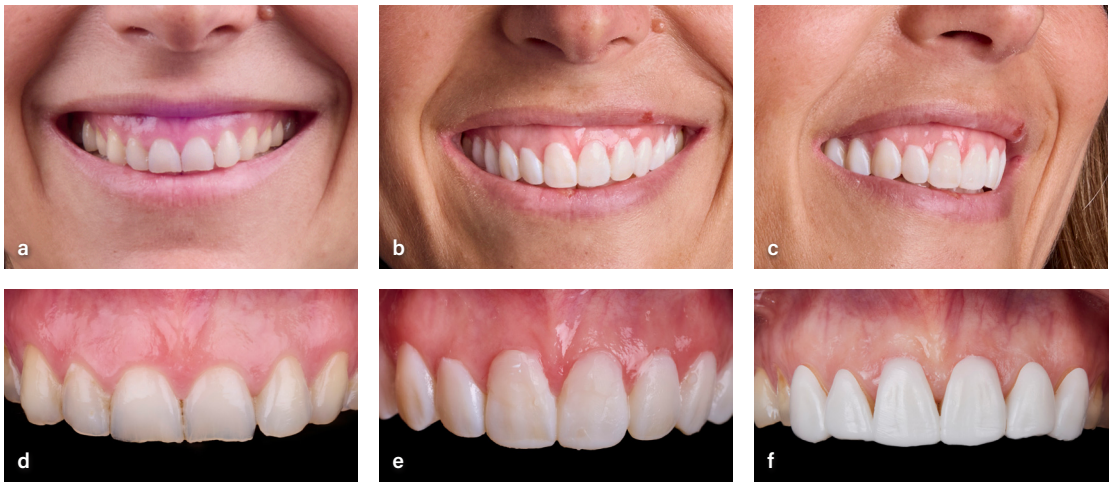
In order to address these significant limitations, a contemporary two-stage surgical approach has been proposed,[14] as originally mentioned by Sonick.[23] The initial incision is made at the gingival margin or through intracrevicular incisions, followed by the elevation of a full-thickness flap, not necessarily beyond the mucogingival junction. Subsequent to this, the necessary osteoplasty and selective ostectomy are performed to restore optimal bone morphology and to achieve the ideal dimensions for soft tissue attachment. The final step involves replacement of the flaps and the application of sutures without any attempt at apical repositioning. This technical modification facilitates the analysis of the dental and bone anatomical characteristics, and the creation of the individualized dimension for the soft tissue attachment surgically by bone recontouring, before any resective procedure is performed. However, the final gingival margin position is not guided by the surgical intervention but rather by the individual's healing response.[14] Subsequent to a period of approximately 3 to 6 months, when the position of the supracrestal soft tissues has reached a sufficient degree of maturation and structural stability, a second surgical procedure is performed to achieve the ideal gingival margin contours. This second surgical intervention is a minimally invasive gingival recontouring or, in many cases, not even needed due to a bone-guided soft tissue apical relocation.

The two-step SCL procedure is intended to mitigate the risk of inadequate or excessive removal of gingival marginal tissue during the initial surgery, while ensuring that the establishment of soft tissue attachment dimensions is guided by intrasurgical anatomical references that are fixed and reliable. This will ensure proper and stable healing, thereby reducing the need for provisional restorations during the early healing phase of treatment. This is particularly relevant in cases where the surgical intervention results in pronounced exposure of tooth structure and therefore may cause esthetic concerns and/or dental hypersensitivity. In these esthetically significant cases where maximum precision is imperative, the two-stage SCL has been shown to offer benefits and enhance the prospects for safer and more accurate outcomes.[14]

Key Factors in the Planning and Execution of an Esthetic Crown Lengthening Procedure

Establishment of a Reference Target

The position of the CEJ or final restorative margin objective must be precisely determined before surgical intervention. In both situations, the final gingival margin position must be validated by the patient using a mock-up.[3] Unfortunately, the position of the CEJ is not easily diagnosed due to



▲ **Fig 3** The mock-up technique facilitates the validation of a precise target reference position, such as the tooth CEJ or the intended restorative margins. This technique serves not only as a communication tool with the patient *(a to c)* but also as a reference target during the surgical procedure *(d to f)*.

different anatomical considerations and/or radiographic values. The employment of a two-stage SCL approach facilitates a more precise surgical reference dimension, thereby enhancing the accuracy of the procedure (Fig 3).

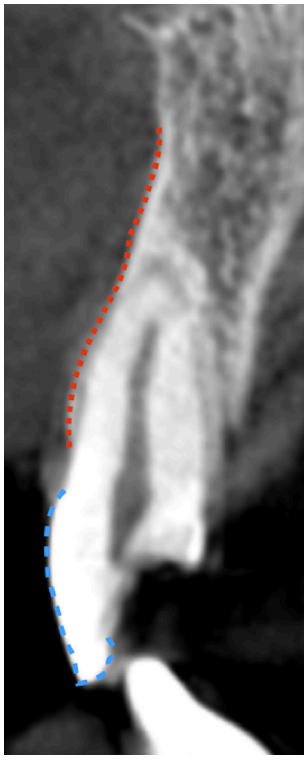
Determination of the Alveolar Bone Position

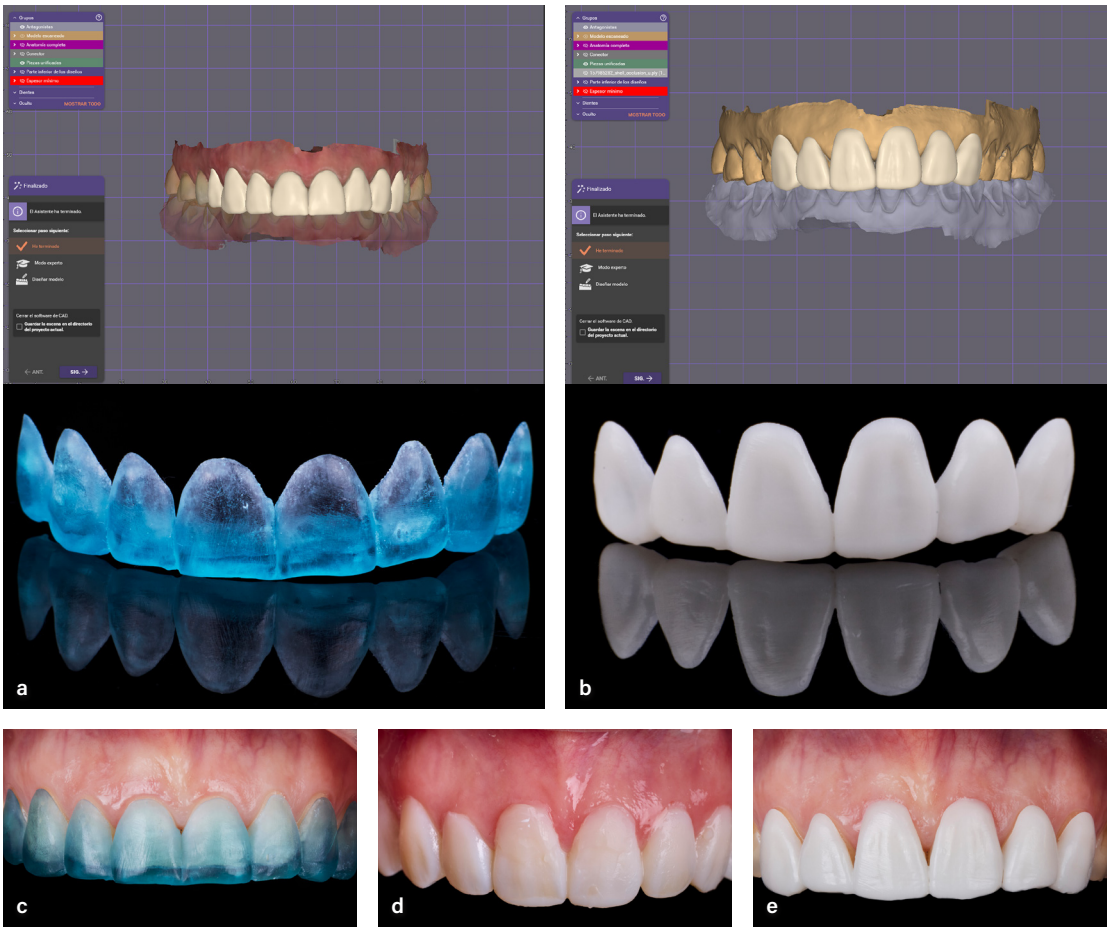
The second reference point pertains to the position and shape of the alveolar bone crest. The use of transcrevicular probing or transmucosal probing prior to flap elevation[24] has not been proven to be an accurate diagnostic method.[25] While contemporary radiographic technology has enhanced the precision of determining the position and shape of the alveolar bone crest prior to elevating the flap, the presence of metal and other clinical conditions can compromise its accuracy[26] (Fig 4). Christiaens et al[22] used clinical and radiographic diagnostic methods, including vertical relative probing attachment level, analog and digital intraoral radiography, and bone sounding, before and after flap elevation. The study concluded that all evaluation techniques significantly underestimated the actual bone level, likely due to the low sensitivity of both bone sounding and radiographic methods.[22]

Accurate Probing of the Sulcus

In order to measure sulcus depth, it is essential to accurately probe the sulcus, given that the final dimension of the supracrestal tissue attachment will be the distance from the alveolar bone to the gingival margin, minus the sulcular depth. This is of particular relevance in cases of gingival enlargement with the presence of pseudopockets of deep "sulci," in which case the SCL could be achieved solely from a gingivectomy.

▶ **Fig 4** Radiographic examination of the teeth to be lengthened helps to anticipate potential limitations and also provides information on the anatomical references before elevating the flap. The *red dotted line* shows the contour of the alveolar ridge, and the *blue dotted line* shows the contour of the anatomical crown, extending to the CEJ.





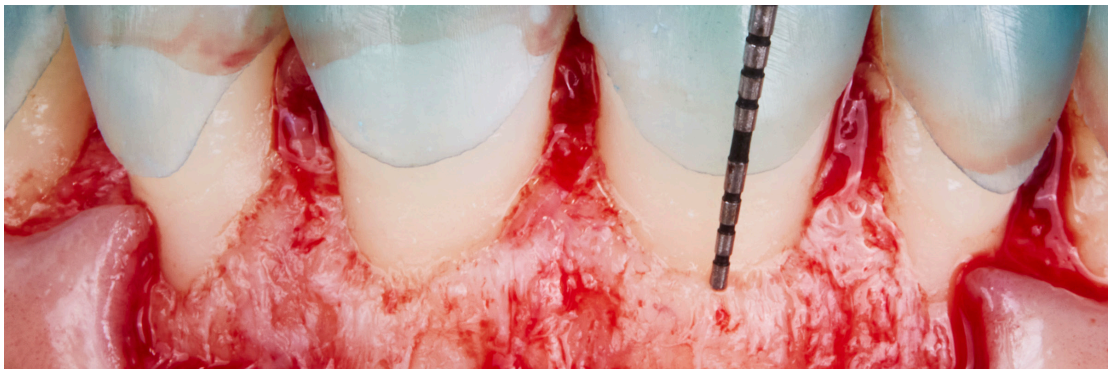
▲ **Fig 5** *(a to e)* The double-stent technique allows precise measurements to be obtained to optimize the surgical procedure while also preserving this information after flap elevation for subsequent follow-up. *(a and c)* The first stent reproduces the current position of the gingival margin. *(b and e)* The second stent is a digital copy of the *(d)* analogic or digital mock-up approved by the patient, with the second stent showing the final gingival margin position. .

Accurate Measurement of Keratizined Tissue Dimension and Periodontal Phenotype

Accurate measurement of the keratinized tissue (KT) dimension and the periodontal phenotype is imperative because, in cases of minimal KT, the use of gingivectomy is contraindicated. The measurement of gingival width (thin versus thick phenotype) can be determined using STL-DICOM file superimposition, which has proven to be as reliable and reproducible as direct transmucosal probing measurements performed with an endodontic spreader.[27] However, recent findings have indicated that CBCT measurements have comparatively low accuracy and reliability for assessing thin buccal bone thickness.[28] This presurgical diagnostic information is of paramount importance when performing SCL, namely a gingivectomy, because inaccurate diagnostic information may result in inappropriate gingival margin position and soft tissue rebound.

SCTH as a Guide

Taking all of the above factors into consideration, we propose using the individual SCTH as a guide to perform the ostectomy necessary to allow space for apical soft tissue relocation during SCL. Due to the difficulty in diagnosing these critical factors, especially in cases where CBCT is not used, two-stage SCL may offer advantages over one-stage SCL by increasing the likelihood of achieving a final stable supracrestal soft tissue

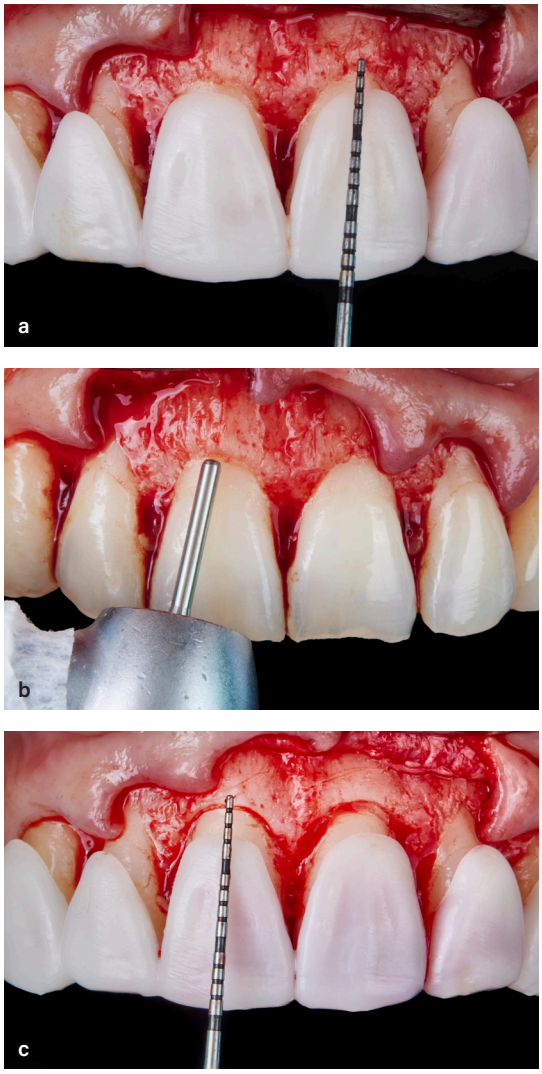


▲ **Fig 6** By using the first stent after flap elevation, the SCTH is measured accurately and precisely.

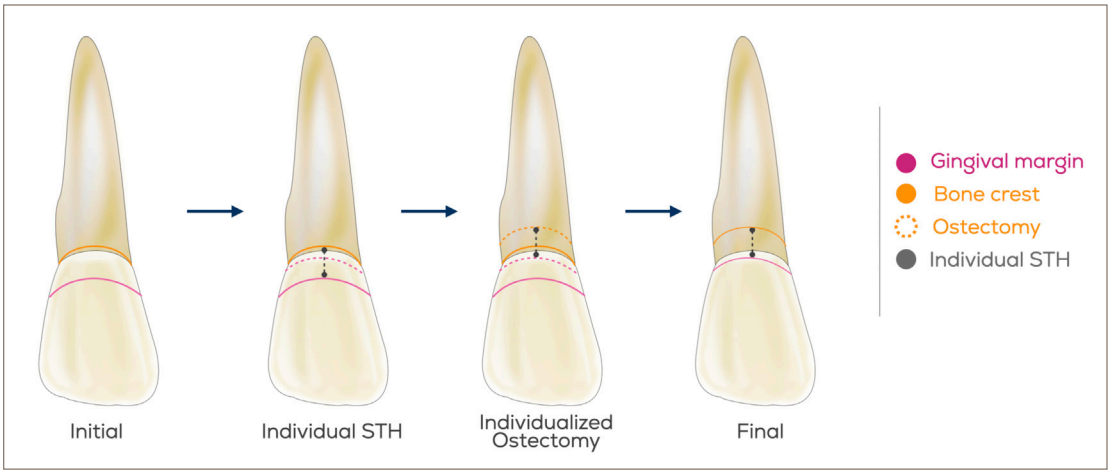
insertion with ideal gingival margin position. The proposed two-stage intervention benefits from a two-stent surgical procedure (Fig 5), with the first stent serving as a replica of the preoperative gingival margin position. Following the elevation of the full-thickness flap, the SCTH is accurately measured and individualized using a periodontal probe to determine the distance from this first stent to the bony crest (Fig 6). The second stent serves as a replica of the mock-up or digital blueprint, which has been validated for the specific patient. Subsequent to measuring the SCTH, this second stent facilitates precise reduction of the bone crest, thereby ensuring that the individual measurement is respected for each tooth in every position (Figs 7 to 13).

Discussion

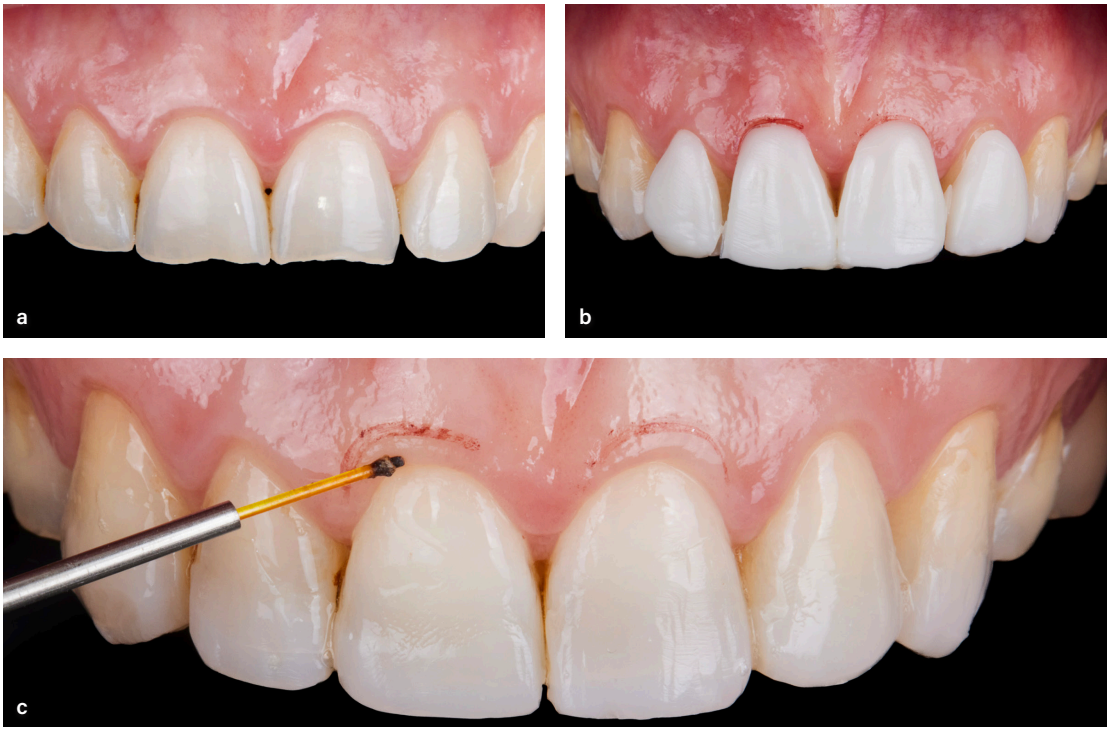
Despite the abundance of case reports and case series in the periodontal literature describing the performance of SCL procedures, there is a paucity of comparative studies and clinical trials assessing the efficacy and efficiency of this surgical intervention. A 2016 systematic review sought to assess the clinical evidence relevant to SCL, identifying four nonrandomized and one randomized controlled clinical trial.[29] However, these few studies were considered at high risk of bias, and no study had a longer follow-up than 6 months, nor did any study compare different SCL interventions.



▲ **Fig 7** *(a to c)* After assessing the SCTH, these dimensions are used to perform the ostectomy and osteoplasty. The second stent will help as a reference to locate the restorative goal or final gingival margin position and will serve as the reference point to perform the osseous reduction.



▲ **Fig 8** Illustrations demonstrating the use of the individualized SCTH as a reference for performing the ostectomy during SCL. The preoperative measurement of the SCTH must be reproduced using the second stent as the final surgical target.





▲ **Fig 9** *(a to d)* Limited gingivectomy may be required 3 to 4 months after the ostectomy. The second stent is again used as a surgical reference to perform the excision of the tissue after a remodeling period.







▲ **Fig 10** *(a to c)* Minimally invasive tooth preparation 6 to 8 weeks after gingivectomy. The tissues are stable and healed for the restorative procedure.





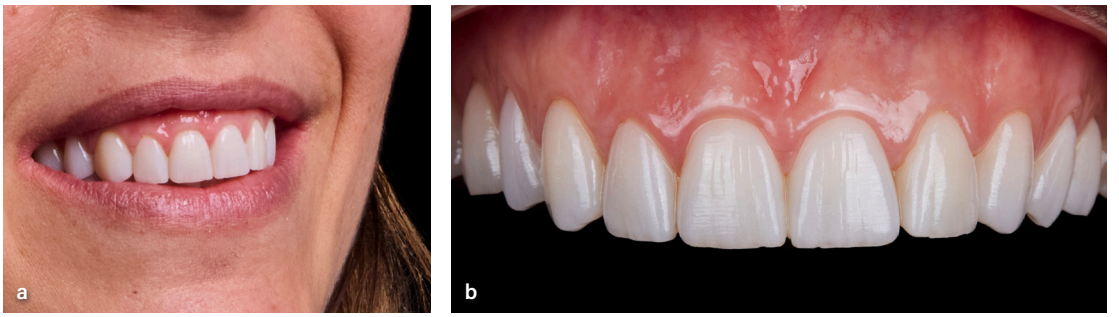
▲ **Fig 11** *(a and b)* Laboratory work consisting of minimally prepared feldspathic veneers and posterior veneerlays. Platinum foil was the chosen technique to minimize the thickness of the restorations while improving strength (laboratory work: Daniel del Solar, DT).

▶ **Fig 12** *(a to c)* Final restorations.









▲ **Fig 13** *(a and b)* Follow-up and final smile of the patient.

The classical description of the SCL procedure by Smukler and Chaibi[15] established the protocol for SCL, recommending the use of individual measurements to calculate the postsurgical soft tissue attachment dimension. This was achieved by transgingival probing to the bone crest as a diagnostic guide and subsequent submarginal incisions and removal of sufficient alveolar bone to create a supracrestal gingival tissue dimension between the actual or anticipated finish line of the preparation and the alveolar crest. However, current evidence suggests that the final positioning of the soft tissue dimensions will occur irrespective of the extent of gingival marginal excision during SCL. Instead, it is the amount of bone recontouring, rather than marginal tissue removal, that will guide the supracrestal soft tissue attachment. The amount of soft tissue excision will be contingent upon the presence of either an excess of soft tissue (hyperplasia) or deep probing depths. In healthy periodontal tissues, gingivectomy often results in the reformation of the predetermined amount of STCH, with no significant gain in clinical crown length. This is especially true in cases where a misdiagnosis occurs as a consequence of the already explained limitations. Consequently, in most cases where tooth lengthening is required, SCL with osseous resection will be necessary.

A recent randomized clinical trial evaluated the efficacy of SCL procedures to facilitate restorative therapy in the anterior maxilla: one-stage vs two-stage crown lengthening.[14] A total of 30 patients, equally divided between the two groups (15/15), completed the study. After a 12-month follow-up period from the initial surgical procedure, the final gingival margin position was found to be comparable between the two groups with respect to the planned position (AC-1 conventional one-stage CL = 0.2 ± 0.4 mm; AC-2 two-stage CL= −0.2 ± 0.5 mm; P = .075). At the conclusion of the study, it was observed that all gingival margins were within ± 1.0 mm of the preoperative plan in both groups. Intriguingly, only minimal gingival contouring (≤ 1 mm) was required in 27.7% of teeth treated in the AC-2 group 4 months after the initial phase of surgery. These findings suggest that the increase in final clinical crown dimensions was primarily due to an appropriate bone surgery based on the SCTH measurements rather than the removal of gingival tissue. However, factors such as healing after raising flaps, the thickness of the bone crest, and the impact of restorative procedures may also influence this outcome.

It is noteworthy that both groups used an individualized SCTH as a guide to perform the ostectomy, in addition to a prosthetically driven surgical guide. Given the variability in the dimensions of the space available for supracrestal tissue attachment between and within subjects, even around the same tooth,[18] the extent of osseous resection at different sites in this study was not standardized but rather individualized after a meticulous preoperative and intraoperative analysis of each site. The results of this randomized controlled trial (RCT) confirmed that meticulous planning based on a thorough clinical and radiographic examination leads to the achievement of the planned treatment results with both SCL modalities.

The absence of precise measures to ascertain the final position of the gingival margin may be

the reason why most published studies report a lack of precision and stability in the postoperative gingival dimensions. Herrero et al[13] reported that the proposed minimum desired distance of 3 mm from the planned restoration margin to the alveolar crest, termed the *biologic width*, was not routinely achieved in the study. They recommended a more aggressive approach during SCL procedures to achieve the proposed goal of a 3-mm biologic width. Deas et al[9] also reported insufficient crown lengthening measured in the postsurgical follow-up, arguing that excessive tissue rebound occurred due to the flap position relative to the alveolar crest. They hypothesized that the key factor for stable results in SCL was proper osseous resection. Interestingly, osseous resection of ≤ 1 mm was performed at 56% of midfacial sites, while the same amount was performed in 90% of the line angles.[9] Despite the existence of studies reporting a stable postoperative mean gingival margin position, a percentage of teeth have experienced unwanted displacement of the gingival margin during the healing process, primarily during the first 3 months postoperatively.[30] In general, this undesirable rebound has been attributed to technical (flap positioning, amount of osseous resection) and anatomical (periodontal phenotype) factors.[8] However, we hypothesize that the key factor in achieving stable long-term outcomes is the use of individualized SCTH references. However, long-term RCTs designed to assess this variable are required.

In addition, we advocate the implementation of a two-stage SCL procedure, as it facilitates individualized bone contouring without the necessity of excessive soft tissue resection. This approach enables the creation of a wider band of keratinized tissue, obviates the requirement for unnecessary provisional restorations, and facilitates optimal gingival marginal tissue positioning through a minimally invasive second surgical intervention, which is not always necessary. Furthermore, the use of a two-stent surgical procedure facilitates visualization of the bone and controlled contouring to create the necessary space for the supracrestal tissues following the restorative plan, as opposed to relying predominantly on preoperative bone probing and radiographic data, which may not provide sufficiently accurate information.[22] Moreover, it ensures the preservation of preoperative and objective referenced data throughout the procedure, thereby ensuring a safer and more accurate procedure.

Conclusions

In conclusion, individualization of the SCTH can be recommended when performing SCL, especially in the anterior sector. The use of the double-stent technique preserves the necessary information during the surgical procedure, improving the accuracy and stability of the result obtained.

Acknowledgments

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