

PERIODONTAL STABILITY IN SURGICAL CROWN LENGTHENING PREPROSTHETIC INTERVENTIONS -A SYSTEMATIC REVIEW

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Abstract: Statement of the Problem: the periodontal stability after surgical crown lengthening procedures is an important item for the final prosthetic restoration success. The appropriate time for healing is still controversial in the specific published literature. Purpose: this review aims at answering a specific PICO question: what is the optimal time for the final fixed prosthetics procedures, after the surgical crown lengthening techniques are performed in clinically healthy patients, with good periodontal condition, to ensure predictable stable periodontal results. Materials and methods: applying standard selection criteria for studies, detailed search strategies were developed for each database, data collection was undertaken using specially designed data extraction forms and quality assessment was done. Results: in the limitations of the review we performed, we believe that the answer to the initial question can only be a recommendation: in clinically healthy patients with good periodontal condition, it is recommended a waiting period of 12 months compared to 3 or 6 months, the studies made between these periods showing a tendency to stabilization of the periodontal structures at all levels. Conclusions: drawing a conclusion based on scientific data requires the development of standardized studies on this topic, on a larger period of time.

INTRODUCTION

Clinical crown lengthening is defined as the procedure used to expose healthy tooth substance, with or without the loss of the alveolar bone, for restorative purposes.(1) This procedure is recommended in many clinical situations, such as: the presence of deep subgingival margins of restorations that prevent the correct dental impression, reduced clinical crown height, in combination with root amputation, surgical tunneling procedures, to provide the necessary access for cleaning, improving the aesthetics for the patients with “gummysmile”.

Clinical crown lengthening can be achieved through periodontal surgery and/or orthodontic treatment. After surgical crown lengthening, a common question is related to the optimum moment for the final prosthetic restoration. A determinant key for initiating therapy is establishing the free gingival margin position, especially in cases where the main motivation is restoring the aesthetic function. Individual healing characteristics, different gingival biotypes, biological width reorganization, surgically created positive bone architecture, marginal flap positioning after surgery, delaying restoration procedures and postoperative plaque control are just a few factors that help maintain the tooth structure obtained after the crown lengthening surgical procedures.

After the surgical procedures are complete, the healing phase starts. Timothy J. Hempton and John T. Dominici, (2) Ernesto A Lee, (3) Guy Huynh-Ba, Urs Brägger, Niklaus P Lang (4) demonstrated that, when the clinician creates an apical positioned flap and a bone resection, the biological width is restored at an apical level. Researchers have found that when the edges of the flap are positioned at the bone crest, there will be a 3 mm post-operative supracrestal soft tissue. This undergoing coronary tissue advancement healing takes place according to Lanning and colab. (5) studies, 3 months after surgery, after 6 months there being no other significant vertical positioning of

the free gingival margins changes observed. Bragger and colab. (6) noted that during the 6 months of healing after the coronary lengthening intervention, the periodontal tissues were stable, with minimal changes to the gum line. From this research, it is concluded that prosthetic treatment after such intervention must be done after 6 months.

Periodontal tissue deformities were reported in the study of Vander Velden (7) and observed by different authors (8-10), who monitored postoperative intra-osseous defects treated by apical repositioning flap technique with bone recontouring.

In these studies, it was found that the elongation of the gum after surgical crown lengthening over a period of 6-12 months post-intervention is into a more coronary position, and it remains constant after 5-7 years (9-10), thus demonstrating a predictable result for patients with proper oral hygiene.

Regarding the healing period after the surgical procedure, systematic summaries published since 2001 on the subject submitted the following conclusions:

- Jorgensen (11) recommends a period of six months, especially in areas with aesthetic requirements, taking into account the gingival biotype: for the thin biotype is recommended to extend the period while for the thick one stabilization can be achieved faster than half a year.
- Plancianus (12) recommended in areas with aesthetic requirements that prosthetic reconstruction does not commence earlier than 6 weeks.
- Camargo (13) concluded that the healing is usually complete in 6 to 8 weeks after surgery, the soft tissue remodelling may continue in the period of 6-12 months.
- Guy Huynh-BA (4) recommended a waiting period of six months until the final prosthetic reconstruction, when saving 3 mm from the preparation to the alveolar crest is essential for the periodontal stability.

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- Hampton (2) and Oh SL (14) determined by their analysis a 6-month delay period of the final prosthetic.

PURPOSE

The purpose of this study is to evaluate the optimal time for the final fixed prosthetics procedures after accomplishing the surgical crown lengthening techniques, to ensure periodontal stable results.

Following PICO MODEL: we define the following objectives of the systematic research theme framing it in the therapeutic category of interest.

The final wording of the question PICO systematic synthesis of information from the literature is: for patients (clinically healthy, with good periodontal status), who underwent surgical procedures to increase the clinical crown it is recommended a healing period of 12 months compared with the three or six months needed for the periodontal stability of the final prosthetic restoration?

In the selected studies, we intend to analyze whether periodontal stability is influenced by: the sutured flap position to the alveolar ridge, the amount of the resected bone, gingival biotype, surgical technique, sutures removing time, the type of postsurgical treatment, cigarette consumption, occlusal pressure, and brushing technique.

MATERIALS AND METHODS

Criteria for considering studies for this review

- *Types of interventions* – we have included studies that have approached the surgical procedure to increase the clinical crown as the primary or secondary theme. We excluded articles that addressed orthodontic or laser techniques.
- *Types of studies* – we aim to identify controlled studies pursued in time. We eliminated systematic review, meta-analysis on selected theme, articles from peer-reviewed publications, “gray literature” – summaries of conferences, meetings, unlisted in the databases MEDLINE, COCHRANE, EBSCO, presentations of cases or descriptions of surgical techniques.
- *Type of investigated group* – we included studies made on humans, adult patients with permanent dentition, clinically healthy, with healthy periodontium. We excluded in vitro studies, studies on patients with various systemic diseases. We have also excluded research that does not specify the criteria for inclusion / exclusion in the study group.
- *Year of publication* – articles published between 2000-2013.
- *Language* – articles published in English and Romanian.

Electronic search

For the identification of studies included or considered for this review, detailed search strategies were developed for each database. These were based upon the search strategy developed for MEDLINE but revised appropriately for each database to take into account differences in controlled vocabulary and syntax rules.

- *Databases searched* electronic search through the END-NOTE program in the following databases: MEDLINE, COCHRANE respecting the inclusion and exclusion criteria and the keywords.

Keywords: dental crown lengthening, surgery, wound-healing, biological width, gingivoplasty

- *Cross-checking references* – References from original papers and abstracts, reviews, systematic reviews and meta-analyses were checked to identify any additional studies.
- *Hand searching* – manual search for the keywords in the content of the journals: International Journal of Prosthodontics, Journal of prosthodontic research, Journal

of Periodontology, Periodontology 2000, Journal of Prosthetic Dentistry.

- *Review* of all the abstracts and full text analysis according to the search criteria, the wound healing data being an essential one.

Data collection and analysis

All potentially relevant articles and reports were assessed using a previously prepared inclusion criteria form. Two review authors initially assessed the relevance of each article independently and in duplicate.

The steps for obtaining the studies on which the review is conducted are:

1. Search for the keywords in the title and abstract;
2. The 28 articles were searched in full-text version, excluding those ones under surveillance, the patients with systemic diseases, the case presentations or the descriptions of surgical techniques;
3. The search continued manually in reference logs.

Data extraction

Agreement between review authors was assessed using Kappa statistics. There was agreement between the review authors. Data collection was undertaken according to the following criteria using specially designed data extraction forms.

The grid analysis for the studies was used to help us assess heterogeneity and external validity of the trials.

Quality assessment

The methodological quality of included studies was assessed using the following criteria:

Each item received a quality score with a maximum possible score 17.(25,26)

The two evaluators awarded points as it follows: randomized clinical studies (4) nonrandomized (3), clinical studies without control group/cohort (2), clinical case series studies or case-control studies.(1) One point is awarded for each of the following characteristics: the number of subjects who were included in the study, the number of subjects in the control group, the operator's experience, the inclusion of the demographic description, the treatment procedures fully described, the presence of an independent evaluator, the description of complications occurred after following treatment, the standardization of measurements, the clear description of the evaluation methods, the purpose of treatment, the description and stratification statistics.

Data synthesis

Clinical heterogeneity was assessed by examining the types of participants, interventions and outcomes in each study. Meta-analysis was used with studies of similar comparisons reporting comparable outcome measures in similar participants. Main differences are combined for continuous data.

RESULTS AND DISCUSSIONS

Garber said “The tissue is the issue, but the bone sets the tone”(15) - this concept also applies to the results obtained in the periodontal surgery.

1. Description of studies

- *Journal publication:* most of the articles that met the established criteria for systematic review were published in the Journal of Periodontology.
- *Type of studies:* Most of the selected articles are retrospective cohort type. This kind of study analyses a group (cohort) of healthy individuals within a period in relation to the occurrence or not of a disease. In cohort studies, the study group is homogeneous in terms of “exposure” and in the data analysis stage, it is tried to find factors correlated to the studied phenomenon. Ganji's (16)

article is the only randomized trial.

- *Inclusion and exclusion criteria in the groups selected for study:* although mentioned in all the articles included in our analysis, they are variable both in number and as a requirement. Stating from the outset that no criterion was unanimously considered, most articles and subjects were selected on the basis of general and periodontal health. However, only two indicated the importance of the absence of gingival inflammation, the absence periodontal stress during the orthodontic treatment or evaluation of crown-root ratio before crown lengthening intervention. An item that caught our attention is that only four articles selected for analysis excluded patients that were smokers in the study group, although currently documented literature provides enough evidence of the many negative impact that tobacco has on periodontium and on any healing process after intraoral surgery.
- *The informed consent of patients:* it is also watched in the trials, being one of the quality score criteria, if the selected patients were informed about the interventions and if they signed consent – all items selected in the synthesis indicated its existence, except Pontoriero.
- *Characteristics of the study group*
- 1. *Analysis of the number and demographic classification of patients in the studied groups.* The number of patients selected in the studies, on the basis of inclusion and exclusion criteria, was from 11 to 30. Most important group was analyzed in the studies of Pontoriero (17) and in that of Deas (18), averaging 20.5 and a 23 median. Regarding demographic classification, only Perez's (19) study states breed division in selected patients without concluding any influence of this factor in the results obtained.
- 2. *Analysis of age in the study group.* The mean age of the patients included in the study is a summary of between 24.9 and 40.5 years. But we note the selection of subjects that are 19 years and some that are 72, which raises the question of hierarchy and uniformity criteria for inclusion/exclusion applied. To know the particulars physiological and pathological age-related general is important to the outcome of the periodontal intervention. We also note that two of the studies – Perez (19) and Deas (18) – do not take into account or fully communicate the age factor in the study group. Also, in none of the studies the age factor is not statistically correlated with the results.
- 3. *Analysis of gender distribution in the studied group.* Gender of patients is noted in only four of the studies employed in our synthesis, inconstant males being represented in percentages ranging from 9% to Cairo's (20) article to 72% in that of Deas (18). In none of the articles synthesis the sex factor is associated with the results, and in three of them is not even mentioned.
- *Characteristics of teeth undergoing clinical crown lengthening intervention.*

The number of teeth on which the intervention was performed in the selected batch was between 19 and 58, the results reported on the highest number of interventions being communicated by Pontoriero.(17) Two of the studies mentioned the number of patients selected but not the teeth number on which the clinical crown lengthening intervention was made.

- Only four authors state what teeth they conducted interference on, Deas (18) and Diniz (21) focusing on the molars and premolars, the others choosing interventions in all areas of the arch.
- Analysis of the study group in terms of biotype gum is made only in one study – Pontoriero (17) – who reported that restoration of the soft tissue and the size of the initial

crown are more common in thick gum biotype.

- *Analysis of the selected studies design*
- All studies initially provided to the patients in the experimental group initial periodontal therapy procedures to remove all periodontal irritants factors, antiinflammatories and periodontal stabilization, as well as maintenance instructions of oral hygiene. The authors performed measurements before surgery and at intervals proposed for observation. The number of those who completed the examination, surgical interventions and evaluation may be a factor influencing the outcome of the study. Four studies standardize this variable by calling a single person, a periodontist physician, while Deas (18) turns to students and residents who were in stage during the observation period for the assessments. The only ones who resorted to an independent, trained and calibrated evaluator, in the measurements that they made during the experiments, are Cairo (20) and Perez.(19)

The difficulty we encountered in trying to compare the selected studies is related to the heterogeneity manifested in:

- standardizing measurement method, both in terms of the measurement instrument and also in the starting point of the measurement- the instrument was the periodontal probe in 5 cases and digital radiography ruler for the rest of the cases.

Benchmark from which the measurement was made was represented in four of the articles by a thermoformed acrylic confirmatory which had made ditches guide for the periodontal probe. The other three studies, however, have considered the incisal edge, enamel-cement limit or bone ridge top on retroalveolar radiographs.

- levels at which measurements were made and their number.
- results' mode of expression: mm, percentages, averages
- period of time the patients participated in selected studies ranged from 3 to 12 months. Assessments were also conducted at different intervals according to each author.
- *Quality score* – according to the quality criteria for the selected items included in the systematic review they showed scores ranging from 8 to 12, 41% meeting all the criteria in the grid.
- *Items related to the surgical procedure performed*

Apically positioned flap surgical technique has been well detailed in the articles selected, particular issues were presented regarding:

- *the final apical sutured flap position regarding the alveolar ridge* – 4 items stated its position after bone resection at 3 mm to the bone crest, in Diniz's (21) study the flap position was established at 2mm and in Lanning's (5) article at the crest. We believe that further development and the results were influenced by the variability of the supracrestal soft tissue.
- *complications occurred during or after the surgical procedure* are reported in three studies- related to patients failing to present at the assessment intervals, among which the loss of teeth, Ganji (16) reported the absence of any complications while two studies did not specify whether further assessment post-surgical intervention was performed on the initial number of teeth.
- *the treatment type used to prevent or combat complications* – postsurgical treatment and maintenance was communicated in all selected studies and consisted of NSAIDs, rinse twice daily with 0.12% CHX, plaque control, scaling and cleanings every 3 months.
- *applying surgical cement* – only in four situations surgical cement was used – it is a factor that can influence the quality and time of healing .
- *removal of sutures* was performed at different intervals between 7 and 14 days.

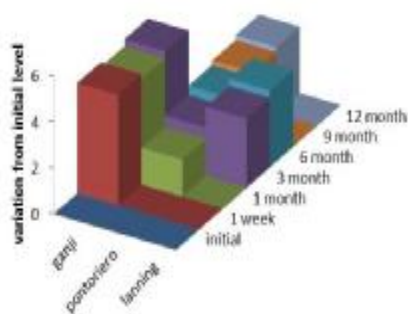
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- *modification of the occlusion during the experiment* – temporary prosthetic restoration may affect periodontal stability, as the correct transmission of masticator forces during mandible dynamics is an important requirement for maintaining periodontal balance. Unfortunately, from this point of view articles showed no homogeneity, the teeth in the study being prosthetic restored at varying periods since surgery: from 2 weeks in Diniz's (21) study to 24 weeks in Deas's study.(18)
- *Stability of the clinical crown lengthening surgery outcome.*

To compare the results of the studies that reported measurements equal period, we have taken and calculated the mean value for each item, each time on each level of measurement.

- *The free gingival margin* – measured between reference and free gingival margin (figure no. 1).

Figure no. 1. The free gingival margin variation

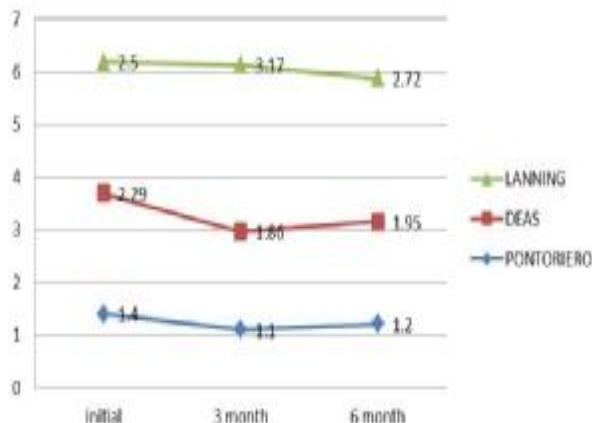


Differences in the free gingival margin position were not significant, they were 0.2 mm between 1-3 to 6 months so that Ganji (16) concluded that there are no major changes in this period. Pontoriero (17) is the only one who had a one-year period of analysis throughout the lot and its results reveal a continuous coronary movement of the marginal periodontium which after 3 months shows a difference from the postsurgical situation with 2.1 mm coronal and this difference continued to increase to 2.9 after 12 months. This development brings the free gingival margin in the range of 12 months at a distance from the landmark with only 1.2 mm apical than pre-surgery situation. Pontoriero (17) associated statistically significant this result to thick gingival biotype and to the different amount of bone resection, whereas we note the flap sutured position at the bone crest. Lanning (5), on his turn, supports that periodontal stability appears between 3 to 6 months, the differences being insignificant compared to the benchmark. Deas (18) shows in his study a statistically significant relationship between the positioning level of the sutured flap to the bone crest and the soft periodontal tissue reconstruction at the previous surgery level tissue – “tissue rebound”. If the distance the flap is sutured to the bone crest increases from 1 mm to 4 mm, the healing process is constant at six months. Therefore, the gingival margin keeps the level on which they were located after surgery.

- *The depth of the gingival sulcus*

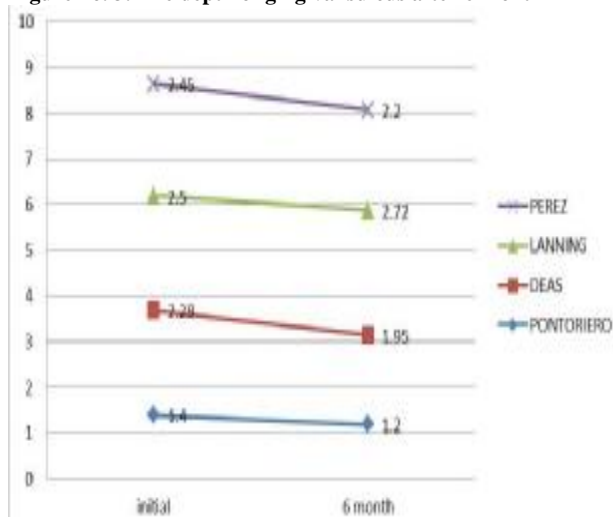
Calculated as the distance between probing depth and free gingival margin, or by subtracting from the clinical attachment level the value reference – free gingival margin (figure no. 2).

Figure no. 2. The depth of gingival sulcus after 3 and 6 month



Lanning's (5) study shows an increase in size of gingival sulcus after three months with a return near to the baseline value after six months, but differences were not statistically significant. Deas (18) obtains after 3 months a reduction in the size of the gingival sulcus with a subsequent return to a value close to the initial in six months time. Pontoriero (17) supports the same trend of the gingival sulcus as Deas (18), his values in 9 months time were 1.2/1.3 and in 12 months time, insignificant differences supporting the periodontal stability after 3 months (figure no. 3).

Figure no. 3. The depth of gingival sulcus after 6 month



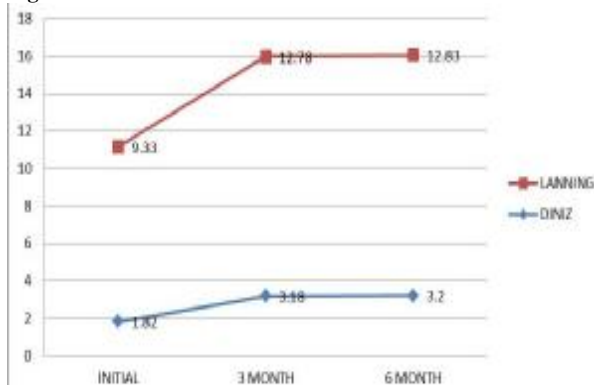
Perez's (19) study shows a difference of 0.20 mm between the initial situation and the six months one, statistically significant, it is explained by periodontal inflammation consecutive surgery which causes a deeper penetration of the probe and thus recording a higher value.

- *Bone crest level*

Lanning (5) shows that the bone crest level is undergoing a significantly initial resorption, after that the levels stabilizes in 3 to 6 months time, in 90% of cases being reduced more than 3 mm during surgery. Diniz (21) reports computerized results measured in both mesial and distal region. By averaging these values at 3-6 months intervals, we see the same stability as in Lanning's (5) study. After 12 months the value is relatively constant – 3.18 (figure no. 4).

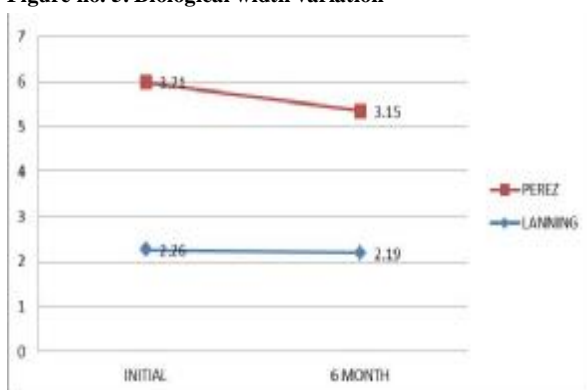
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Figure no. 4. Bone crest level variations



- **Biological width.** It is the distance between the bone crest and the bottom of the gingival sulcus and it represents the space occupied by connective tissue with root cementum and junctional epithelium (figure no. 5).

Figure no. 5. Biological width variation



The biological width records in Lanning's (5) study, in the first quarter, a drop of 0.3 mm, but in 6 months it returns to the original size showing its tendency to recover towards the bone crest. Ganji (16) confirms the same hypothesis by noticing changes of this factor, over a period of three months, its significant variation between the first and third week, constant until the sixth week, and again significantly different after 3 months, when returning close to baseline. Perez's (19) study contradicts the idea of a constant value of biological width, showing a decrease of 0.56 mm after 6 months and drawing attention to the fact that the previous surgery biological width will not always be replicated after surgery.

- **Clinical crown height.** Clinical crown height was calculated postoperative by Cairo (20) at 10.26 mm, recording a 0,13mm difference after 6 months. Deas (18) reported in his study a 0.7 mm loss at the same period of time.

CONCLUSIONS

In the limitations of the systematic review that we performed, we believe that the answer to the initial question of the systematic review can only be a recommendation: in clinically healthy patients with good periodontal condition, it is recommended a temporisation period of 12 months, studies accomplished between 6 and 12 months showing a tendency to stabilisation of the all levels periodontal structures

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