




STABILITY OF GINGIVAL MARGIN SUBSEQUENT ESTHETIC CROWN LENGTHENING IN THICK PERIODONTAL BIOTYPE VERSUS THIN PERIODONTAL BIOTYPE; PROSPECTIVE CLINICAL TRIAL

Eman M. Abdulhady*, Omar Soliman**
and Mohamed Al Bahrawy***

ABSTRACT

Aim: This prospective trial aimed to evaluate stability of the marginal gingiva (MG) subsequent esthetic crown lengthening (ECL) surgery over a one year in subjects with thick periodontal biotype (PB) versus thin PB

Materials and methods: 20 subjects needed an ECL in the maxillary anterior esthetic zone were grouped into two groups; group 1 (G1) comprised of 10 subjects with thick PB and group 2 (G2) consisted of 10 subjects with thin PB. All subjects were assessed at baseline pre-surgery (BL), immediately post-operative (0M), 3 months (3M), 6 months (6M) and 12 months (12M) for the clinical outcomes; clinical crown height (CCH), width of keratinized tissue (WKT), Gingival Sulcus Depth (GSD) and Tissue Rebound (TR)

Results: Thick PB showed significant gradual regain in GSD and TR at 3M, 6M and 12M. Thin PB showed stable GSD and MG during the same periods with significant difference between both groups. WKT decreased significantly after BL and gradually regained some width at 12M. Loss of gained CCH was observed in thick PB and considered statistically significant at 12M follow up.

Conclusions: The biotype of the periodontium and respect of 3 mm osteotomy impact the stability of MG following ECL surgery. Notably, a significant degree of TR and regaining of GSD and CCH was observed in participants with thick PB at the 12M follow-up.

KEY WORDS: Periodontal biotype, Crown lengthening, Esthetic, Tissue rebound

* Lecturer of Oral medicine, Periodontology and Oral Diagnosis. Faculty of Dentistry, Horus University-Egypt.

** Associate professor of Oral medicine, Diagnosis and Periodontology, Faculty of Dentistry, South Valley University, Egypt

*** Associate professor of Oral medicine and Periodontology and Oral Diagnosis. Faculty of Dentistry, Ain Shams University, Egypt

INTRODUCTION

Indeed, cosmetic dentistry has experienced a remarkable advancements in recent years, becoming a dominant area of interest among patients. The heightened demand for a perfect smile reflects its growing importance, not only for aesthetics but for enhancing the overall quality of life. A beautiful smile not only improve physical appearance but also boosts self-confidence, enhances positive social interactions, and even positively impacts mental well-being. One notable cosmetic concern is the outrageous gingival display (GD), frequently common as a “gummy smile,” which often necessitates correction to improve overall quality of life.⁽¹⁾

GD of 3-4 mm when smiling is considered unacceptable.⁽²⁾ However, the etiology of excessive GD is multi-factorial and non-pathological including anterior dento-alveolar extrusion, vertical maxillary excess, hypermobile or short upper lip, and altered passive eruption (APE).⁽³⁾

APE is the inability of gingival tissue to migrate apically leading to excessive gingival tissue on the clinical crown. Teeth will emerge square and short due to the marginal gingiva is located coronal to the cemento-enamel junction (CEJ).⁽⁴⁾ Although APE is a non-pathological scenario, according to certain data, people with APE are more likely to acquire periodontal disease.^(5,6)

The best way to deal with excessive GD due to APE, is the ECL surgery. It comprised of a gingivectomy, associated with ostectomy and osteoplasty in some situations.⁽⁷⁾ The steadiness of new location of the marginal gingiva after ECL surgery is a crucial factor in the success and durability of the required esthetic outcomes. Many factors may affect the final location of the free GM in relation to the clinical crown for instance; the location of the marginal gingiva in relation to the new crestal bone level after ostectomy,⁽⁸⁾ patient's

periodontal phenotype,⁽⁹⁾ the amount of resected bone, surgical technique⁽¹⁰⁾, remodeling of the bone and individual variations in the biological width.⁽¹¹⁾ It is predominantly contingent on the distance between crestal bone and CEJ to determine the amount of bone to be resected and to maintain the stability of marginal gingiva over time.^(12, 13) Therefore, achievement of a stable gingival outline requires bone removal of at least 3mm from CEJ.⁽¹⁴⁾

Another essential parameter affecting the cosmetic outcome of ECL is the healing time after surgery.⁽¹⁵⁾ Optimum clinical results could be obtained with full understanding of the biology of the tissue. Many authors estimated 3M-6M to achieve complete healing after ECL surgery. However, *Pontoriero & Carnevale* reported that TR might be seen at 9M and 12M following surgical procedures⁽¹⁶⁾ According to literature, sites with thick PB seemed to be associated with a greater regrowth of soft tissue in coronal direction than sites with thin PB following ECL surgery.^(16, 17) Consequently, TR after ECL surgery could give rise to an unexpected cosmetic outcome along with change of the periodontal health specifically if restorative rehabilitation was planned.⁽¹⁸⁾

The current literature reveals a paucity of research evaluating the long-term permanence of the MG location subsequent ECL surgery, particularly in relation to different periodontal biotypes. Existing studies often include mixed cases of thin and thick PB and are typically limited to short-term follow-up periods. To date, no comparative clinical trials have specifically investigated the clinical outcomes between thin and thick PB over an extended period of one year post-ECL surgery. Hence, the primary purpose of this clinical trial was to appraise the positional changes of the MG following ECL surgery in patients with thin versus thick PB over a one-year follow-up period.

MATERIALS AND METHODS

In this study 20 patients having excessive GD and short clinical crowns due to APE were seeking for cosmetic solution were elected from outpatient clinic, the department of Oral Medicine, Periodontology, Oral Diagnosis, Faculty of Dentistry, Horus University-Egypt and Ain Shams University. Active recruitment began in February 2023 and continued until May 2023. This trial's design was approved by the Ethics Committee of Ain Shams University (FDASU-Rec IR092310). The study protocol was implemented in compliance with the Declaration of Helsinki's ethical guidelines.⁽¹⁹⁾

Study design: This prospective clinical trial comprised 20 subjects (100% females, aged 20 to 36 years). APE was diagnosed when the distance between the MG and the CEJ exceeded 2 mm.⁽²⁰⁾ Patients were equally assigned into two groups; group 1 (G1) comprised of 10 subjects with thick PB (gingival thickness ≥ 1.5 mm) and group 2 (G2) comprised of 10 subjects with thin PB (gingival thickness < 1.5 mm). Subjects were eligible to take part in the study if they provided written informed consent agreeing to undergo the procedure of interest and to have their photos used in publications. The diagnosis of APE was based initially on clinical finding of an improper proportion between the

length and width of the maxillary anterior teeth, characterized by short, square-shaped clinical crowns in all subjects. Other criterion for diagnosis are; when more than 4 mm of the gingival tissue is visible during the smiling and when the distance between MG and CEJ equal or greater than 2 mm in healthy tissue.⁽²¹⁾

To determine the PB, facial gingiva was anesthetized using a topical lidocaine spray. The gingival thickness was assessed mid-buccally 3 mm apical to the marginal gingiva using an endodontic spreader (size 20) fitted with a rubber stopper. The spreader was gently inserted to contact the underlying bone structure perpendicular to the long axis of the tooth.⁽²²⁾

The soft tissue thickness was then estimated on a digital caliper up to the 0.00 mm (Figure 1). To minimize measurement errors, a single individual conducted the measurements three times for each area, and the most frequently obtained readings were recorded as the final measurement. PB was considered thin if the measurement < 1.5 mm and considered thick if the measurement is ≥ 1.5 mm^(23, 24). Bone sounding was performed vertically to measure MG- Alveolar Bone Crest (ABC) distance to determine the need of crestal bone reduction pre-surgery using the periodontal probe (UNC 15, Hu-Friedy, Chicago, IL, USA) and few drops of local

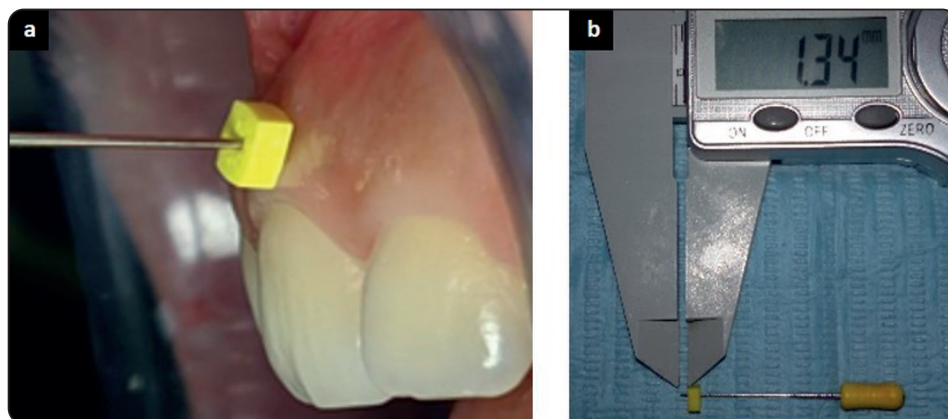


Fig. (1) a) Size 20 endo-reamer with a stopper pierced in the buccal gingival tissue 3mm apical to the free gingival margin. b) The distance measured on digital ruler up to 0.00mm

anesthesia. Measurement was done at mid-buccal point on each tooth from the crown edge trans-sucular to crestal bone parallel to the long axis of the tooth.^(25, 26)

Inclusion and exclusion criteria:

Inclusion criteria: (1) Adults 18 years old or more. (2) Absence of signs of gingivitis. (3) No interproximal clinical attachment loss and/or palatal osseous reduction. (4) Good compliance with the plaque- control instructions (PCI). (5) Non-smokers and individuals who smoked fewer than 10 cigarettes per day. Participants who smoked fewer than 10 cigarettes daily were asked to abstain from smoking for 7 days before and 14 days after the surgical procedure. *Exclusion criteria:* (1) Systemic contraindications for oral surgery. (2) Drug therapy associated with gingival enlargement. (3) Narrow WKM < 4 mm. (4) Poor compliance with PCI. (5) Uncontrolled periodontal disease. (6) Pregnancy or lactating females. (7) Presence of orthodontic appliance.

Sample size determination:

Based on previous study ⁽²¹⁾, a whole sample of 20 cases (10 case per group) was adequate to find out the alteration in the clinical outcomes in each group, with an 80 % power of analysis at 5% as a significance level. Sample size calculation was achieved using the PS program.

Study procedures

Phase I therapy

All subjects underwent phase I therapy three weeks pre-surgery. Full mouth supra and sub- gingival scaling and root planning was done manually and using ultrasonic device. Proper oral hygiene instructions and patient motivation were done. 0.12% chlorhexidine digluconate mouth

rinse was prescribed twice daily for 2 weeks (Kahira Pharma & CHEM.INO. Cairo-Egypt). Two days pre-surgery, patients returned to the clinic to confirm effective plaque control and to ensure the subsidence of any residual gingival inflammation, and review all surgical instructions.

Surgical procedures

A single operator carried out all surgical procedures and used the same technique for both groups. Local anesthesia was administered by blocking the anterior and middle superior alveolar nerves and the nasopalatine nerve, along with performing suprapariosteal infiltration. Bleeding points were demarcated using periodontal probe to estimate the desired place of the new gingival margin. (Figure 2)

A gingivectomy employing external beveled discontinuous incision was performed using 15c blade spanning from upper right second premolar to upper left second premolar. Following the excision of the tissue collar, intrasulcular incisions were performed along the buccal aspect. A split thickness flap was raised at the papillary site, while a full thickness flap was elevated using mucoperiosteal elevator without releasing it beyond the mucogingival junction (MGJ). Osteotomy and osteoplasty was performed from one line angle to the other, ensuring that bone supporting the interproximal regions was preserved. This was achieved using high-speed hand piece with end-cutting and diamond round burs under saline irrigation, targeting at an approximate 3 mm distance between CEJ and ABC. The flap was then repositioned to achieve a postsurgical placement of the MG approximately 3 mm coronal to the bone crest. Finally, single interrupted sutures (polypropylene 4-0) were utilized to secure the flap in place. (Figure 3)



Fig. (2) Thick PB case presentation a) Bleeding points. b) Discontinuous external bevel incision. c) Gingivectomy. d) Full thickness flap elevation & ostectomy. e) Flap repositioning using single interrupted sutures. f) 6M post-surgery. g) Pre-surgery. h) 12M post-surgery



Fig. (3) Thin PB case presentation a) Demarcation of the aimed surgical incision. b) Discontinuous external bevel incision. c) Gingivectomy. d) Full thickness flap elevation & osteotomy. e) Flap repositioning using single interrupted sutures. f) 3M post-surgery. g) Measuring CCH at 3M follow up. h) Pre-surgery. i) 12M post-surgery. j) 12M post-surgery.

Postoperative protocol

Participants were directed to take Diclofenac potassium, 50mg (PHARCO, Alexandria-Egypt), three times a day for a period of 5 to 7 days, Amoxicillin, 500mg, three times a day for 7 days (Misr Co. for pharmaceutical industries, for: OCTOBER PHARMA S.A.E-EYPT) and Chlorhexidine digluconate mouthwash (0.12%) twice a day for 2 weeks. All patients were advised to maintain proper oral hygiene, refrain from chewing solid foods, use ice packs on the surgical area for the first day, and then apply warm packs for the next two days. Patients were advised to resume brushing with a soft manual toothbrush in treated areas after 24 hours, while avoiding dental flossing in these areas during the first week following surgery. Sutures were removed 7 days post-surgery and follow-up examinations were performed at 3M, 6M and 12M. The overall level of oral hygiene and the condition of the soft tissues were also assessed, and further instructions were provided as necessary.

Parameters Assessment:

This was performed by an independent examiner, who was blinded to the study groups. The clinical outcomes were done at BL, 0M, 3M, 6M and 12M. All measurements were done using UNC-15 periodontal probe to the nearest half millimeter at mid-buccal aspect of the tooth. Clinical Crown Height (CCH): Measured from MG to mid-incisal edge. Gingival Sulcus Depth (GSD): Measured from the MG to the base of the gingival sulcus and evaluated at BL, 3M, 6M and 12M. Tissue Rebound (TR): Measured from MG to ABC by bone sounding after local anesthesia and evaluated at 6M and 12M. Both GSD and TR. Width of Keratinized Tissue (WKT): Measured at from the MG to MGJ. MGJ was identified by the rolling technique, where the mucosa was rolled until the non- movable portion of the attached keratinized tissue was seen.⁽²⁷⁾

Statistical analysis:

The patient was the unit of observation and mean values per patient were used in the statistical analysis.

Only the upper six anterior teeth were included in the analysis even if the premolars were included in the surgery. The intra-group analysis through different follow up intervals was tested using paired Student t Test. The differences between groups regarding all clinical parameters were analyzed using One-Way ANOVA. The collected data was tabulated and analyzed using Statistical Package for Social Science (SPSS® software version 22 (SPSS Inc., Chicago, IL, USA). Data were expressed as mean and standard deviation (SD). For all tests, P value ≤ 0.05 was considered significant.

RESULTS

All of the 20 candidates completed the study period of one year. All subjects finished the follow-up period without dropping out. 100% of the subjects were females with mean age of 25.4 ± 4.7 and 25.8 ± 4.2 for G1 and G2 respectively. All participants experienced postoperative pain and swelling for 3 to 5 days, which responded well to analgesics and ice packs. Healing was typically uncomplicated, with minimal swelling and no post-surgical complications.

Regarding GSD, at 0M it was ultimately zero for both groups and at 3M (1.23 ± 0.18) (0.76 ± 0.17) a statistical significant reduction in sulcus depth was observed when compared to BL (2.47 ± 0.36) (2.4 ± 0.36) through G1 and G2 respectively. Although G1 regained some depth at 12M (1.45 ± 0.08) which was statistically significant compared to 6M (1.15 ± 0.14), GSD remained stable in G2 all over the period of the study post-surgery. Nevertheless, there was a significant difference among both groups over the period of the study. (Table 1)

Comparing the means of GSD for each group through the different follow up intervals showed statistical significance at 12M when compared with 6M and 3M follow up for G1. However, for G2 there was only significant difference between different follow up intervals. (Table 3)

The assessment of TR was done at 6M and 12M. Among G1 there was a statistical significant increase

in TR between 6M and 12M ($P \leq 0.05$). However, there was an increase in TR within G2 but not statistically significant ($P > 0.05$). Comparing both groups, TR was statistically significant greater in G1 compared to G2 only at 12M time point without significant difference at 6M follow up. However, means of TR were statistically significant within G1 when comparing 6M and 12M follow up intervals. (Table 1 & Figure 4)

No significant differences regarding CCH were detected among both groups at BL, 0M and 3M time points with G2 having more stable crown height compared to G1. However, significant difference among groups was observed at 6M and 12M time points with greater means of CCH observed in G2

($P \leq 0.05$). (Table 1)

Comparing the means of CCH for each group through the different follow up intervals showed statistical difference between 0M and all the follow up time points and between 3M and 12M follow up for G1. However, for G2 there was only significant difference between 0M and 12M follow up. (Table 2)

A statistically significant reduction in WKT between BL and 6M and 12M was noticed among both groups ($p < 0.05$), without significant changes occurring in both groups between 6M and 12M time points. However, significant difference between both groups was found at BL without significant difference at 6M and 12M time points. (Table 1 & 3)

TABLE (1) Means of periodontal measurements (in millimeters) at baseline and follow-up intervals for both groups.

Variable	Follow-up	G1 Mean(SD)	G2 Mean(SD)	P-value
GSD	BL	2.47(0.36)	2.4(0.36)	0.70
	3M	1.23(0.18)	0.76(0.17)	0.00*
	6M	1.15(0.14)	0.73(0.2)	0.00*
	12M	1.45(0.08)	0.77(0.13)	0.00*
TR	6M	3.15(0.12) *	3.05(0.29)	0.34
	12M	3.51(0.19) *	3.19(0.28)	0.01*
CCH	BL	7.09(0.47)	7.05(0.36)	0.83
	0M	9.72(0.3)	9.94(0.33)	0.16
	3M	9.33(0.33)	9.61(0.37)	0.10
	6M	9.11(0.31)	9.56(0.42)	0.05*
	12M	8.85(0.28)	9.50(0.37)	0.00*
WKT	BL	7.94(0.74)	7.21(0.52)	0.026*
	6M	5.50(0.63)	5.18(0.57)	0.27
	12M	5.87(0.66)	5.28(0.64)	0.07

*Gingival Sulcus Depth (GSD); Tissue Rebound (TR); Clinical Crown Height (CCH); Width of Keratinized Tissue (WKT); Baseline (BL); Immediately post-operative (0M); 3 Months (3M); 6 Months (6M); 12 Months (12M); Standard deviation (SD); * Significant (P value ≤ 0.05).*

TABLE (2) Statistical analysis of means of CCH between follow up intervals for both groups using paired t-Test.

CCH	0M-3M	0M-6M	0M-12M	3M-6M	3M-12M	6M-12M
G1	0.017*	0.000*	0.008*	0.166	0.003*	0.078
G2	0.067	0.098	0.000*	0.264	0.061	0.340

* *Significant (P value ≤ 0.05).*

TABLE (3) Statistical analysis of means of GSD and WKT between follow up intervals for both groups using paired t-Test

	GSD			WKT		
	3M-6M	3M-12M	6M-12M	BL-6M	BL-12M	6M-12M
G1	0.363	0.004*	0.000*	0.000*	0.000*	0.250
G2	0.107	0.754	0.720	0.006*	0.000*	0.746

* Significant (P value ≤ 0.05).

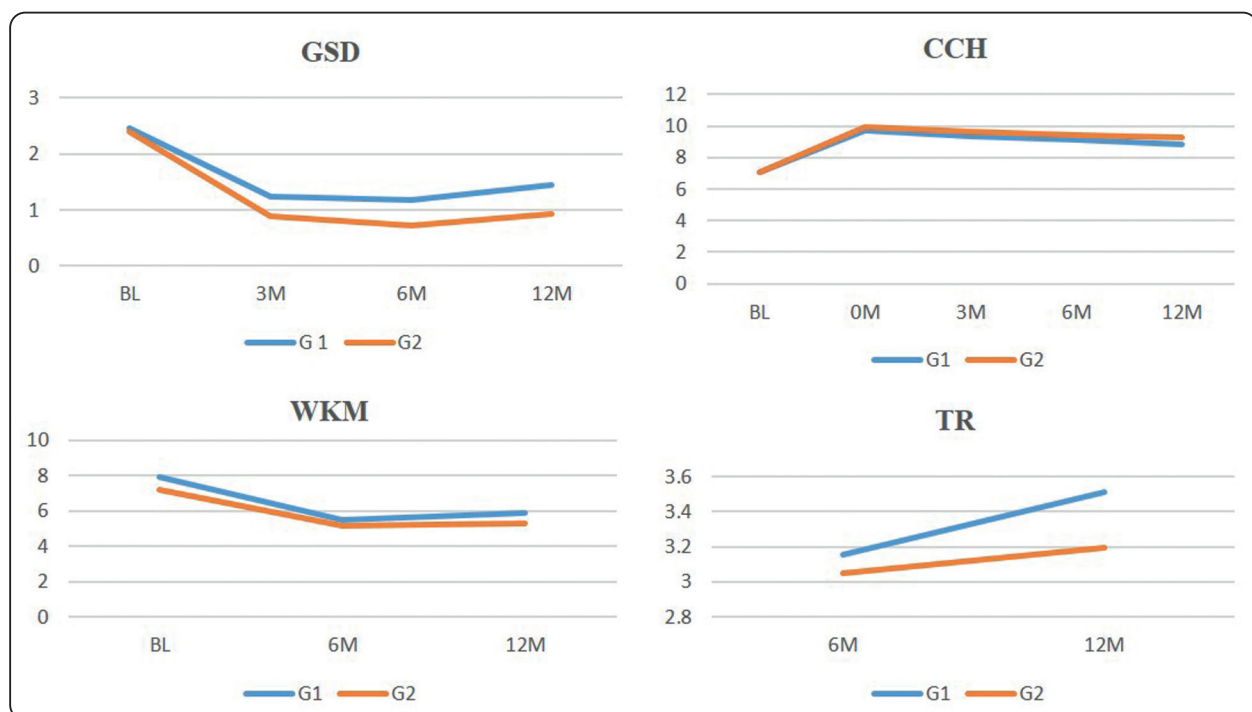


Fig. (4) Line charts indicates the relation between study variables and follow up time points among G1 and G2.

DISCUSSION

While numerous recent clinical trials have explored the esthetic outcomes of ECL surgery, there is a notable lack of studies evaluating the biological impact of ECL surgery on gingival marginal tissue across different periodontal biotypes. This current prospective trial is thus the first long-term (1-year) clinical investigation designed to assess the stability of marginal tissue in thin versus thick PB over the course of one year following ECL surgery. Since all participants in this study were female, the findings may have limited applicability to male patients. This could be explained by variability of aesthetic

preferences between genders. Research suggests that women tend to have a more pronounced desire for esthetic improvements in their smiles, which could influence the outcome of the procedure. This could also impact the way results are perceived or evaluated in studies predominantly conducted on female participants.⁽²⁸⁾ Future studies could benefit from including a more gender-diverse sample to enhance the generalizability of the results. Comparison between male and female participants could provide valuable insights into any gender-specific differences in response to the treatment or procedure. Additionally, hormonal or genetic

factors might influence outcomes, and examining these differences could help tailor treatment plans for both male and female patients more effectively.

In this study GSD utilized as an additional metric to compare thin and thick PB after ECL surgery, given that the marginal gingiva tends to creep coronally during the healing time in order to create a new sulcus. This creeping might extend for up to one year post-surgery, potentially resulting in the loss of the gained CCH post-surgically.⁽¹⁶⁾ At BL, the GSD was 2.47 ± 0.36 mm for G1 and 2.4 ± 0.36 mm for G2, with no significant difference among the groups ($p \leq 0.05$). Although GSD was intended to be zero immediately post-surgery, it increased during the first three months post-surgery but remained significantly less than BL for both groups. This increase could be attributed to the coronal migration of epithelial tissue, whether junctional, sulcular, or marginal, as part of the re-establishment of the new sulcus. These findings align with the conclusions of *Zucchelli et al.*, and *Silva et al.*, who reported a statistically significant decrease in GSD by the end of their respective follow-up periods.^(29,30) GSD showed a reduction during the second three-month period and subsequently increased by the conclusion of the study for both groups. Notably, G1 exhibited a statistically significant increase in GSD at 12M compared to 3M, whereas G2 demonstrated an increase at 12M relative to 3M, though this change was not statistically significant. This disparity might be attributed to the different characteristics of gingival tissue, as thick tissues possess a greater capacity for differentiation and regeneration compared to thin tissues.⁽³¹⁾ This is in agreement with *Carneiro et al.*, who showed significant decrease in the GSD at 3M compared to BL and then increase in the GSD at the end of the study without statistical difference compared to BL. However, *Carneiro et al.*, did not differentiate between thick and thin PB.⁽²¹⁾

The findings of the current prospective trial showed a progressive soft-tissue rebound over 6M and 12M post-surgery for both groups. Evaluating

soft-tissue rebound and vertical bone levels at 6M and 12M post-surgery is standard practice to ensure accurate assessment of surgical outcomes. This timeline allows for the healing and stabilization of periodontal tissues, providing a reliable measure of the procedure's effectiveness.⁽¹⁴⁾

However, the rebound was significantly higher in thick PB group than thin PB (3.51 ± 0.19), (3.19 ± 0.28) respectively at 12M. Tissue rebound was found to be dependent mainly on PB, the distance between the GM and ABC and suturing position of flap margin in relation to the ABC. *Domínguez et al.*, and others suggested a 3 mm distance at the surgery time supports post-surgical stability of the MG, facilitates satisfactory tissue rebound, and ensures the desired CCH is achieved. In the current trial, a 3mm distance between CEJ and ABC was set as the target to be achieved for all participants post-osteotomy to enable post-surgical stability of the marginal gingiva. Consequently, our results were mainly due to different PB. These results according to *Arora et al.* who found more tissue rebound after 6M in thick biotypes than thin biotypes.^(8,18,32) Additionally, a systematic review and meta-analysis highlighted that thicker and flatter phenotypes demonstrated greater tissue rebound than thin, scalloped phenotypes.⁽³³⁾ These findings underscore the importance of pre-surgical assessment of gingival biotype to tailor the procedure to individual patient characteristics, thereby optimizing long-term outcomes. The determination of the ABC-MG distance was done via vertical bone sounding at minimum 6M or 12M post-surgery. Bone sounding considered highly accurate simple, reliable and non-costly tool.⁽²⁶⁾ This is in contrast with *Carneiro et al.*, who used tomography pre-operative and 12M post-surgery to evaluate the rebound which expose the patients to unneeded radiation dose and financial cost.⁽²¹⁾

In addition to the factors previously mentioned affecting the clinical outcomes of ECL surgery, tooth size and shape might be another factor affecting the gain in CCH. In this study both groups showed a significant increase in CCH at 0M and 3M without

significant difference between groups. However, the gain in the CCL in G2 was greater significantly than G1 at 6M and 12M. This could be due to the crown size and shape associated with thin PB is more triangular and covered with thin gingiva and thin buccal plate of bone compared with thick PB which is square and covered by thick fibrous gingiva and thick plate of bone.⁽³⁴⁾

These results clarify that the stability of the gained final clinical crown proportions were firstly dependent on the biotype and secondly on the osseous surgery creating at least 3mm biological width. However, González-Martín *et al.*, attributed the final increase in the length of clinical crown after ECL surgery was predominantly due to the osseous surgery rather to the secondary gingival re-contouring regardless to the phenotype.⁽⁶⁾ A systematic review by Vlachodimou *et al.*, found a positive correlation between gingival thickness and the width of keratinized gingiva, suggesting that patients with thicker gingival phenotypes tend to have a more pronounced width of keratinized tissue.⁽³⁵⁾ A thin PB with narrow WKT or absence of keratinized mucosa are considered risk factors for the development of gingival recession around natural teeth or dental implant. The presence of about 2 mm WKT and about 1 mm of attached gingiva are considered significant for appropriate periodontal health.⁽³⁶⁾ As long as there is direct relation between PB and WKT and healthy periodontium, it should be mentioned in this study the effect of the ECL surgery on the WKT among different gingival biotypes especially if the patient was planned for prosthetic rehabilitation. Currently, WKT was reduced significantly from 7.94 ± 0.74 mm at BL to 5.50 ± 0.63 mm at 6M among G1 and from 7.21 ± 0.52 mm to 5.18 ± 0.57 mm among G2. Nevertheless, WKT remained stable over the study period within G2 but showed some insignificant gain within G1. This could be regarded to the case selection that excluded narrow WKM < 4 mm, not extending the flap elevation beyond MGJ

and meticulous surgical procedures. According to Cortellini & Bissada WKT in thin PB is narrower zone ranging from 2.75 to 5.44 mm than thick PB ranging from 5.09 to 6.65 mm.⁽³⁷⁾ Pontoriero and La Rocca *et al.*, showed remarkable soft tissue regain in subjects with thick phenotypes compared to thin phenotypes after crown lengthening procedures.^(16, 38) However, Domínguez *et al.*, found significant decrease in WKT immediately after surgery and stability 6M post-surgery but within only one group comparing individual teeth regardless the PB and over only 6M.⁽³²⁾

CONCLUSION

The biotype of the periodontium and respect of 3 mm ostectomy impact the stability of MG at 3M, 6M, and 12M following ECL surgery in individuals with both thin and thick PB. Notably, a significant degree of TR and regaining of GSD and CCH was observed in participants with thick PB at the 12M follow-up, underscoring the dynamic healing capabilities inherent to this biotype. This response can be attributed to the increased resilience and regenerative potential of thick PB, which exhibited pronounced epithelial migration and coronal creeping of the gingival margin over time. The study's novel approach in distinguishing the different healing responses between thin and thick biotypes provides valuable insight into more tailored clinical strategies. The results highlight the critical need for a comprehensive evaluation of PB prior to surgical intervention to ultimately enhancing patient outcomes and fostering advances in periodontal and prosthetic rehabilitation.

RECOMMENDATIONS

Enhance awareness regarding the clinical relevance of periodontal biotype among general practitioners and how it influences the clinical outcome of the cosmetic crown lengthening surgery. Knowing that the distance between CEJ and ABC

should not exceed 3mm in thin biotype individuals to avoid post-surgical recession and should not be less than 3mm in thick biotype individuals to avoid the post-surgical relapse with repositioning of the flap at the CEJ in both situations.

Strengths and Limitations

Compared to previous studies, one year follow up is considered satisfactory regarding the healing process. Comparison of ECL surgery between thin and thick PB was not addressed before in the literature. Since this study only included female participants, the results may not fully account for how male patients would respond to similar esthetic crown lengthening procedures. Further research including male participants is needed to determine whether the findings are applicable to both genders. All clinical measurements were done manually. Use of digitalized method for measurements could give more precise result.

Funding

No funding was received.

CRedit authorship contribution statement:

Eman Abdulhady & Mohamed Al bahrawy: Revise & edit, supervise, resources, project management, investigation and concept development. Omar Soliman: Methodology writing, original draft and data analysis.

Conflict of interest

No declaration of conflicts of interest.

Data availability

Materials and data are readily available upon requisition

ACKNOWLEDGEMENT

The authors would like to express their sincere gratitude to Dr Ahmed Yusuf -Teaching assistant of Oral medicine, Periodontology and Oral Diagnosis, Faculty of Dentistry, Horus University-Egypt for

his invaluable assistance in capturing the clinical photographs used in this study. His expertise and dedication greatly contributed to the quality and precision of the visual documentation, enhancing the overall impact of the work.

Table of abbreviation

ABC	Alveolar Bone Crest
APE	Altered Passive Eruption
BL	Baseline
CCH	Clinical Crown Height
CEJ	Cemento-Enamel Junction
ECL	Esthetic Crown Lengthening
GD	Gingival Display
GSD	Gingival Sulcus Depth
MGJ	Muco-Gingival Junction
MG	Marginal Gingiva
PB	Periodontal Biotype
PCI	Plaque- Control Instructions
TR	Tissue Rebound
WKT	Width of Keratinized Tissue

REFERENCE

1. Hung YJ, Lin IP, Wang SH, Lai EH. A stepwise approach to the correction of excessive gingival display: an integrative review of the literature. *Australasian Orthodontic Journal*. 2020 Nov 1;36(2):184-94.
2. Rao AG, Koganti VP, Prabhakar AK, Soni S. Modified lip repositioning: A surgical approach to treat the gummy smile. *J Indian Soc Periodontol*. 2015;19(3):356-9.
3. Pavone AF, Ghassemian M, Verardi S. Gummy Smile and Short Tooth Syndrome--Part 1: Etiopathogenesis, Classification, and Diagnostic Guidelines. *Compend Contin Educ Dent*. 2016;37(2):102-7; quiz 8-10.
4. Schmidt JC, Sahrman P, Weiger R, Schmidlin PR, Walter C. Biologic width dimensions--a systematic review. *J Clin Periodontol*. 2013;40(5):493-504.
5. Pilloni A, Marini L, Zeza B, Ferlosio A, Aghazada R. Histologic Analysis of Clinically Healthy Human Gingiva in Patients with Altered Passive Eruption. *Dent J (Basel)*. 2021;9(3).
6. González-Martín O, Carbajo G, Rodrigo M, Montero E, Sanz M. One- versus two-stage crown lengthening surgical

- procedure for aesthetic restorative purposes: A randomized controlled trial. *J Clin Periodontol*. 2020;47(12):1511-21.
7. Mele M, Felice P, Sharma P, Mazzotti C, Bellone P, Zucchelli G. Esthetic treatment of altered passive eruption. *Periodontol 2000*. 2018;77(1):65-83.
 8. Deas DE, Mackey SA, Sagun RS, Jr., Hancock RH, Gruwell SF, Campbell CM. Crown lengthening in the maxillary anterior region: a 6-month prospective clinical study. *Int J Periodontics Restorative Dent*. 2014;34(3):365-73.
 9. Kan JY, Rungcharassaeng K, Umezu K, Kois JC. Dimensions of peri-implant mucosa: an evaluation of maxillary anterior single implants in humans. *J Periodontol*. 2003;74(4):557-62.
 10. Herrero F, Scott JB, Maropis PS, Yukna RA. Clinical comparison of desired versus actual amount of surgical crown lengthening. *J Periodontol*. 1995;66(7):568-71.
 11. Pennel BM, King KO, Wilderman MN, Barron JM. Repair of the alveolar process following osseous surgery. *J Periodontol*. 1967;38(5):426-31.
 12. Lee EA. Esthetic crown lengthening: contemporary guidelines for achieving ideal gingival architecture and stability. *Current Oral Health Reports*. 2017;4:105-11.
 13. Lanning SK, Waldrop TC, Gunsolley JC, Maynard JG. Surgical crown lengthening: evaluation of the biological width. *J Periodontol*. 2003;74(4):468-74.
 14. Deas DE, Moritz AJ, McDonnell HT, Powell CA, Mealey BL. Osseous surgery for crown lengthening: a 6-month clinical study. *J Periodontol*. 2004;75(9):1288-94.
 15. Valderhaug J, Birkeland JM. Periodontal conditions in patients 5 years following insertion of fixed prostheses. Pocket depth and loss of attachment. *J Oral Rehabil*. 1976;3(3):237-43.
 16. Pontoriero R, Carnevale G. Surgical crown lengthening: a 12-month clinical wound healing study. *J Periodontol*. 2001;72(7):841-8.
 17. Shobha KS, Mahantesha, Seshan H, Mani R, Kranti K. Clinical evaluation of the biological width following surgical crown-lengthening procedure: A prospective study. *J Indian Soc Periodontol*. 2010;14(3):160-7.
 18. Arora R, Narula SC, Sharma RK, Tewari S. Evaluation of supracrestal gingival tissue after surgical crown lengthening: a 6-month clinical study. *J Periodontol*. 2013;84(7):934-40.
 19. Gandevia B, Tovell A. DECLARATION OF HELSINKI. *Med J Aust*. 1964;2:320-1.
 20. Nart J, Carrió N, Valles C, Solís-Moreno C, Nart M, Reñé R, et al. Prevalence of altered passive eruption in orthodontically treated and untreated patients. *J Periodontol*. 2014;85(11):e348-53.
 21. Carneiro VMA, Gomes AMS, Marinho MU, de Melo GS, Kasabji F, An TL, et al. Dental and periodontal dimensions stability after esthetic clinical crown lengthening surgery: a 12-month clinical study. *Clin Oral Investig*. 2024;28(1):76.
 22. Couso-Queiruga E, Tattan M, Ahmad U, Barwacz C, Gonzalez-Martin O, Avila-Ortiz G. Assessment of gingival thickness using digital file superimposition versus direct clinical measurements. *Clin Oral Investig*. 2021;25(4):2353-2361.
 23. O'Leary SA, Doyle BJ, McGloughlin TM. Comparison of methods used to measure the thickness of soft tissues and their influence on the evaluation of tensile stress. *J Biomech*. 2013;46(11):1955-60.
 24. Agarwal V, Mehrotra N, Vijay V. Gingival biotype assessment: variations in gingival thickness with regard to age, gender, and arch location. *Indian Journal of Dental Sciences*. 2017;9(1):12-5.
 25. Kan JY, Morimoto T, Rungcharassaeng K, Roe P, Smith DH. Gingival biotype assessment in the esthetic zone: visual versus direct measurement. *Int J Periodontics Restorative Dent*. 2010;30(3):237-43.
 26. Christiaens V, De Bruyn H, Thevissen E, Koole S, Dierens M, Cosyn J. Assessment of periodontal bone level revisited: a controlled study on the diagnostic accuracy of clinical evaluation methods and intra-oral radiography. *Clin Oral Investig*. 2018;22(1):425-31.
 27. Jing WD, Xu L, Xu X, Hou JX, Li XT. Association between Periodontal Biotype and Clinical Parameters: A Cross-sectional Study in Patients with Skeletal Class III Malocclusion. *Chin J Dent Res*. 2019;22(1):9-19.
 28. Zorić EK, Žagar M, Zlatarić DK. Influence of Gender on the Patient's Assessment of Restorations on the Upper Anterior Teeth. *Acta Stomatol Croat*. 2014 Mar;48(1):33-41.
 29. Zucchelli G, Mazzotti C, Monaco C. A Standardized Approach for the Early Restorative Phase After Esthetic Crown-Lengthening Surgery. *Int J Periodontics Restorative Dent*. 2015;35(5):601-11.

30. Silva CO, Soumaille JM, Marson FC, Progiante PS, Tatakis DN. Aesthetic crown lengthening: periodontal and patient-centred outcomes. *J Clin Periodontol*. 2015;42(12):1126-34.
31. Herrera-Serna BY, López-Soto OP, Chacón T, Montoya-Gómez AM, Agudelo-Flórez D, Zuluaga-López OH. Relationship between the gingival biotype and the results of root covering surgical procedures: A systematic review. *J Clin Exp Dent*. 2022;14(9):e762-e8.
32. Domínguez E, Pascual-La Rocca A, Valles C, Carrió N, Montagut L, Alemany AS, et al. Stability of the gingival margin after an aesthetic crown lengthening procedure in the anterior region by means of a replaced flap and buccal osseous surgery: a prospective study. *Clin Oral Investig*. 2020;24(10):3633-40.
33. Smith SC, Goh R, Ma S, Nogueira GR, Atieh M, Tawse-Smith A. Periodontal tissue changes after crown lengthening surgery: A systematic review and meta-analysis. *Saudi Dent J*. 2023 May;35(4):294-304.
34. Caton JG, Armitage G, Berglundh T, Chapple ILC, Jepsen S, Kornman KS, et al. A new classification scheme for periodontal and peri-implant diseases and conditions - Introduction and key changes from the 1999 classification. *J Periodontol*. 2018;89 Suppl 1:S1-s8.
35. Vlachodimou E, Fragkioudakis I, Vouros I. Is There an Association between the Gingival Phenotype and the Width of Keratinized Gingiva? A Systematic Review. *Dent J (Basel)*. 2021 Mar 23;9(3):34.
36. Kim DM, Neiva R. Periodontal soft tissue non-root coverage procedures: a systematic review from the AAP regeneration workshop. *J Periodontol*. 2015; 86(S2): S56-S72
37. Cortellini P, Bissada NF. Mucogingival conditions in the natural dentition: Narrative review, case definitions, and diagnostic considerations. *J Clin Periodontol*. 2018; 45 Suppl 20:S190-s8.
38. La Rocca AP, Alemany AS, Levi P, Jr., Juan MV, Molina JN, Weisgold AS. Anterior maxillary and mandibular biotype: relationship between gingival thickness and width with respect to underlying bone thickness. *Implant Dent*. 2012;21(6):507-15.