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Original Article

Correlation Between Gingival Biotype and Post-Surgical Scarring Following Minor Oral Surgical Procedures

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ABSTRACT

Background The relevance of post operative aesthetic assimilation into the oral cavity is an important aspect of clinically significant maxillary soft tissue intra-oral surgical procedures. However, a link between gingival phenotype andresidual mucosals scarring has not been sufficiently elucidated. Objective To assess correlation between baseline gingival phenotype and 12 weeks esthetic wound closure among subjects receiving flap-reflection oral surgeries. Methods a prospective analytical observational study was conducted among 78 eligible health individuals age range 18-45 years who had undergone minor oral surgical procedures on anterior or premolar region of the maxillary jaws in Islamabad-Rawalpindi region, between June and November 2025. Preoperative probe translucency was used to assess and group participants to categories of thick (n=43) or thin (n=35) gingival phenotype. Standardize pre-operative photograph evaluation at 12 weeks was performed separately for linearly aligned, contour match, color match and the overall cosmetic result. Independent samples t test was conducted to determine difference in continuous outcomes whereas chis-quare was performed for categorical outcomes. Results Overall aesthetic result was higher (8.42±0.91 vs 6.14 ±1.25; difference=2.28; 95% CI 1.79-2.77, p<0.001, Hedges' g=2.10) for individuals with thick gingival phenotype compared to the thin phenotype group. Presence of esthetic impairment was found in 4 (9.3%) participant who had thick phenotype and in 21 (60%) participant with thin phenotype (RR=6.45, 95% CI 2.44-17.04; p<0.001). Conclusion presence of thin gingival phenotype is correlated with impaired 12 week oral wound healing, however establishing a causality could not be assessed due to observational study design. Keywords Gingival phenotype, Oral surgical procedures, Wound healing, Cicatrix, Gingiva, Esthetics.

INTRODUCTION

The techniques usually associated with minor oral surgical procedures generally include creating mucosal incisions, flap reflection, manipulation and repositioning of tissue, and closure with sutures. While conventional assessments of surgical success primarily focus on resolution of etiology, infection control, conservation of

anatomical components, and reconstruction of function, subsequent to minor procedures there is particular consideration given to the cosmetic appearance of soft tissues for procedures of the anterior maxilla or other esthetically important areas. Oral mucosal wound repair differs physiologically from skin repair and is typically regarded as characterized by accelerated re-epithelialization, minimal inflammation, effective remodelling of extracellular matrix, and minimal fibrosis (1).

Nonetheless, evidence gathered from clinical research continues to indicate the occurrence of apparent postoperative scars resulting from full thickness oral incision, and that scar maturation continues well beyond initial epithelial closure (2).

Evidence from research projects from the laboratory to translation has similarly suggested the role of resident oral fibroblasts, the interplay between oral immune cell responses and the oral environment lead to characteristic regeneration of oral wounds (3), and comparative analyses of oral compared to skin wounds highlight that the former exhibit differences in inflammatory signals, epithelial and matrix remodeling processes that would favour scarring (4).

Although the oral wound environment is frequently conducive to effective repair, not all oral wounds in patients or in different areas will be consistent and uniform. Differences in factors such as the physical properties of the site tissue, dimensions of the wound, tissue mobililty, geometry of incision, mechanical forces, vascular supply, microdial exposure and systemic factors the individual patient's state of health can dictate how a minor procedure heals. These factors are important at a gingival site whereThere can be a significant disparity between individuals and within the mouth, as indicated by the modern nomenclature "gingival phenotype to encompass both quantitative characteristics of soft tissue thickness and width of the keratinised mucosa within the Gingival and periodtal phenotype to include relationships between Gingival anatomy and the anatomy of underlying bone. One study examining a sample of healthy, but as a population, was found to exhibit widely varying Gingival phenotypes by region (5).

The measurement of gingival thickness is therefore clinically important when examining potential correlations between baseline tissue characteristics and subsequent response to treatment. In addition to clinical measurements of baseline characteristics such as initial tissue thickness have been described, many including transgingival probing, examination of the transparency of a periodontal probe, ultrasonography, cone beam computed tomography (CBCT), and various digital/radiological measurement methods. A systematic review comparing methods of assessing gingival thickness demonstrated that the diagnostic accuracy and reproducibility will partially be determined by the assessment method and location within the oral cavity (6). Methodological consistency is also lacking concerning which landmark gingival thickness is measured. One systematic review of maxillary anterior measurements identifies various measurement landmarks and highlights the need for quantitative quantitative measurement assessment (7). While clinical and radiological comparisons in the maxillary anterior suggest some correlation between many of the indirect and direct measurement techniques and validate the use of phenotype classification in assessing soft tissue thickness with appropriate recognition of their inherent methodological limitations (8).
The transparency of the periodontal probe measurement continues to be an appealing clinical study model due to its speed and relatively atraumatic and inexspensive nature as well as its amenability to categorical assessment. Contemporary diagnosis accuracy studies nevertheless demonstrate a clear lack of 1 to 1 correspondence between a dichotomous thin versus thick measurement and the value derived from quantitative gingival thickness. While it has been suggested that both color-coded and conventional steel probes can be informative in describing phenotype, it also has been demonstrated in studies that they possess non-perfect accuracy comparing them to transgingival measures (9) and later studies suggest differences between cone beam computed tomography, direct, and color-coded probingdepending on measurement site and classification type (10). Vertical location on the tooth also affects a phenotype classification, as gingival thickness will vary depending upon the apicocoronal level where tissue is measured (11). Transparency of periodontal probe therefore provides clinically useful results although they should only be considered a categorical phenotype classifier not as a true quantitative value.

The clinical importance of gingival and peri-implant soft-tissue phenotype has been evaluated most extensively in periodontal plastic surgery and implant dentistry. A systematic review and meta-analysis comparing thin and thick peri-implant tissues reported associations between increased soft-tissue thickness and several favorable esthetic

or structural outcomes, including less recession and improved papillary characteristics, although the certainty of evidence was limited by methodological heterogeneity and residual confounding (12). Similarly, meta-analytic evidence suggests that thinner peri-implant mucosa may be associated with greater short-term marginal bone loss, although longer-term differences are less certain (13). Long-term mucogingival evidence indicates that gingival-margin stability following root-coverage or gingival-augmentation therapy is associated with post-treatment keratinized tissue width and gingival thickness, supporting the concept that the three-dimensional characteristics of the soft tissue contribute to tissue stability (14). Soft-tissue augmentation studies around implants also demonstrate that increasing tissue thickness can modify recession and some professional esthetic outcomes, although effects vary among techniques and outcomes (15).

However, the link between baseline phenotype and the esthetic surgical result is not absolute. A current systematic evidence about single gingival defects in recession shows that esthetic results as reported by the clinician and the patient is dictated by surgical procedure, root coverage, choice of graft and manipulation of soft tissues (16). While there is a contrasting systematic review on initial gingival phenotype and its effect on root coverage, it showed inconsistent results indicating that initial gingival biotype classification per se does not predict root coverage results (17). These imply that phenotype may influence, but not substitute other determinants of healing such as procedural and anatomical considerations.

Evidence directly studying gingival phenotype on wound closure and formation of obvious scars is relatively limited. A prospective study from the year 2025 led by Theodorou et al. Performed standard gingival wounds on patients with thin and thick gingiva and noted no significant between group differences in early healing score, epithelialisation and wound closure during the first 2 weeks postoperation, though more immediate postoperative pain was present in the thin gingiva group (18).

However early wound closure differs to the final cosmetic remodel.

Studies in which oral wounds have been prospectively photographed have indicated that scar remodeling continues after closure and that the final appearance and conspicuousness of oral scars continues to remodel and change for several weeks depending on the anatomical region (2). Moreover studies using clinical scoring systems of the Mucosal Scarring Index following gingival surgical Procedures has shown that the appearance of postoperative scars can be measured over time and will also respond to localized wound environment.

Therefore, a clinical question on the association of baseline gingival phenotype with the macroscopic appearance of mucosal healing in standard flap-reflection minor oral surgical interventions persisted. Proving a clinical association of this kind could enhance preoperative risk evaluation without suggesting it acts as a sole determinant of surgical outcomes. The current study designed to examine whether a relation exists between thin versus thick baseline gingival phenotype with 12 wk cosmetic healing outcomes of healthy subjects who had undergone maxillary anterior or premolar minor oral flaps procedures as standard. Components of cosmetic score and number of incidences of clinically determined aesthetic deficiency were analyzed on thin compared to thick gingival phenotypes in both groups of participants.

MATERIALS AND METHODS

ObjectiveTo determine the effect of combined pre and post-operative de-brief on the outcome of local analgesia in minor oral surgery. Study designProspective analytical observational study. SettingThe study was carried out in the institutional dental hospital setting in Islamabad–Rawalpindi, Pakistan.

Recruited participants and performed oral surgery procedures from June 2005 – November 2005, and a post operative assessment of outcomes were carried out at 12 weeks.

ParticipantsA sample of 78 normal healthy adult patients undergoing minor oral surgical procedures involving flap elevation within either the anterior or premolar region of maxilla was included. Target sample size was calculated based upon the limits of clinical practicality and as reported in similar single centre morphometric studies of soft tissue wound healing. Ethical approval institutional was received prior to start of the study and prior to the participation written Informed Consent was taken.

Eligible participants were adults aged 18–45 years requiring a minor oral surgical procedure involving a visible flap design in the anterior or premolar maxillary sextants. Individuals with active periodontal disease, uncontrolled diabetes mellitus, a history of keloid or hypertrophic scarring, current tobacco smoking, or systemic corticosteroid use were excluded to reduce the influence of important systemic and local factors capable of modifying wound repair. The analysis ultimately included 43 participants with a thick gingival phenotype and 35 with a thin phenotype.

Gingival phenotype was assessed preoperatively at the intended surgical site using the periodontal probe-transparency method. A periodontal probe was inserted into the gingival sulcus; visibility of the probe through the marginal gingival tissue was categorized as a thin phenotype, whereas absence of visible probe transparency was categorized as a thick phenotype. Contemporary evidence supports probe transparency as a clinically feasible categorical assessment technique while also demonstrating that its diagnostic accuracy varies according to the reference thickness threshold, gingival landmark, and measurement approach (9–11). The resulting thin-versus-thick classification was treated as the primary exposure variable.

In all of the procedures, only one surgeon was allowed to perform all of the surgical steps as a way of minimizing the variability of operator factors. In each instance, the surgeons used a standardized approach for incising the gingival sulcus and then dissecting the flap, after which simple interrupted closure using interrupted 4-0 nonresorbable monofilament suture material was carried out to aid in closing the wound margins. Standardization of the operator, the incision and placement procedure, and the suture materials used helped to diminish unwanted and avoidable surgical variability among participating surgeons.

The main end point was cosmetic postoperative healing after 12 weeks. Uniform clinical digital photographs were taken with consistent lighting, graded individually by two blinded assessors. Two calibrated observers used a modified 0–10 linear visual scale (VA-based cosmetic scale), addressing linear alignment, contour irregularity and the colour blend to background normal mucosal mucosa for the healed incision.

A linear score was devised indicating excellent healing.

Overall cosmetic scoring the two group-level outcomes were graded on a similar linear 0-10 scale.

For categorical examination esthetic compromise was operationally defined as an overall cosmetic score <7.0, together with the presence of obvious tissue surface abnormality or linear deviation as assessed clinically at week 12. For participants that failed this measure, esthetic optimum was defined. These two classes could then be compared in terms of the proportion of clinical evidence of sub-optimal wound healing between the thick and thin phenotype groups.

Continuous data were presented as means and standard deviations. Categorical data were presented as frequencies and percentages. Normality of distribution for continuous outcomes was examined with the Shapiro-Wilk test.

Baseline age was compared between phenotype groups using an independent-samples t-test, and compare sex and surgical-site distributions by a Pearson's chi-square test.

Postoperative cosmetic outcomes were compared between groups (thick and thin phenotype) by independent samples t-tests. We computed the mean difference between groups along with a 95% confidence interval (CI) and a standardized effect size metric (Hedges' g) based on the provided group summary data. The distribution of the categorization of optimalesthetic healing compared toesthetic compromise was assessed by Pearson's chi-square test. The relative risk and absolute difference foresthetic compromise between the thin and thick phenotype groups was estimated, along with a 95% CI.

Statistical comparisons were two-tailed, with $P < 0.05$ defined as statistically significant.

RESULTS

All 78 enrolled subjects participated in the 12-week postoperatively and resulted in 100% retention without reported loss to follow-up. 43 (55.1%) subjects presented thick gingival phenotype and 35 (44.9%) showed thin phenotype. The average overall age was 29.4 ± 6.8 years old.

42 (53.8%) females, and 36 (46.2%) were males.

48 (61.5%) surgery performed in anterior maxilla and 30 (38.5%) in the premolar maxilla. Similar demographic, characteristics, and surgical- site were identified between two phenotype groups. 48.8% of subjects were male in thick-group versus 42.9% in thin-group (p =0.598). Average age of patients in the thick and thin-phenotype groups was 30.1±7.1 and 28.5 ±6.3years old, respectively (p =0.295).

Regarding the location of the surgical-site anterior maxilla group was in 58.1% in thick phenotype group versus 65.7% for thin phenotype, vice-versa for the premolar area (p=0.494).

Table 1. Baseline Demographic and Clinical Characteristics by Gingival Phenotype (N=78)

Characteristic	Overall (N=78)	Thick Phenotype (n=43)	Thin Phenotype (n=35)	p-value
Age, years, mean ± SD	29.4 ± 6.8	30.1 ± 7.1	28.5 ± 6.3	0.295
Male, n (%)	36 (46.2)	21 (48.8)	15 (42.9)	0.598
Female, n (%)	42 (53.8)	22 (51.2)	20 (57.1)	—
Anterior maxillary site, n (%)	48 (61.5)	25 (58.1)	23 (65.7)	0.494
Premolar maxillary site, n (%)	30 (38.5)	18 (41.9)	12 (34.3)	—

Values represent mean SD or n (%) Age differences was assessed using an independent samples t test and categorical variable differences using the Pearson's chi square test. For dichotomous categorical variables, P value reflects comparison of all responses to compare overall distribution.
All assessed components of cosmetic-healing scores were significantly greater in individuals with thick gingival phenotype in terms of cosmetic-healing scores by 12 weeks. Mean linear-alignment scores were higher in the thick and thin groups (M=8.65 +/- SD.84 and M=6.42 +/- SD.31 respectively), which corresponds to a mean difference between groups of 2.23 (95%CI: 1.74-2.72) p<0.001. Standardized between group effect was large (Hedge's g=2.05). Mean contour scores were greater in the thick compared to thin group (M=8.21 +/- SD.04) which reflects the mean difference between groups for contour score of 2.30 (95%CI: 1.73-2.87) p<0.001 with Hedge's g=1.81. Color-matching was greater among thick compared to thin group (M=8.40 +/- SD .93), which was significantly greater than the thin group (M=6.09 +/- SD.17), the mean difference between groups was 2.31 (95%CI: 1.84-2.78) p<0.001 with Hedge's g=2.19. The overall cosmetic score was significantly greater in the thick-phenotype group (M=8.42 +/- SD .91) than the thin-phenotype group (M=6.14 +/- SD 1.25). The mean difference between groups was 2.28 (95%CI: 1.79-2.77) p<0.001 with Hedges' g=2.10 (Table2).

Table 2. Post-Surgical Cosmetic Healing Scores at 12 Weeks by Gingival Phenotype

Cosmetic-Healing Measure, 0–10	Thick Phenotype (n=43), Mean ± SD	Thin Phenotype (n=35), Mean ± SD	Mean Difference (95% CI)	Hedges' g	p-value
Linear alignment	8.65 ± 0.84	6.42 ± 1.31	2.23 (1.74–2.72)	2.05	<0.001
Contour score	8.21 ± 1.04	5.91 ± 1.48	2.30 (1.73–2.87)	1.81	<0.001
Color matching	8.40 ± 0.93	6.09 ± 1.17	2.31 (1.84–2.78)	2.19	<0.001
Overall cosmetic score	8.42 ± 0.91	6.14 ± 1.25	2.28 (1.79–2.77)	2.10	<0.001

Scores indicate better esthetic result and lower incisional scarring during postoperative phase. Mean differences are shown as thick phenotype – thin phenotype. Hedges g: standardized between-group mean difference.

Category analysis reflected the difference in the rate of esthetic compromise.

The number of patients fulfilling esthetic criteria in the group with the thin phenotype was 21 (out of 35; 60.0%) at 12 weeks in comparison to 4 participants (out of 43; 9.3%) with the thick phenotype. In the reverse calculation, cases with ideal esthetic result and with the thin and thick phenotype were 14 (out of 35; 40.0%) and 39 (out of 43; 90.7%) respectively (Table 3). ((1) = 22.77, p < 0.001).

Table 3. Clinical Esthetic Healing Outcomes at 12 Weeks by Gingival Phenotype

Clinical Healing Outcome	Thick Phenotype (n=43), n (%)	Thin Phenotype (n=35), n (%)	Risk Ratio, Thin vs Thick (95% CI)	Risk Difference, Percentage Points (95% CI)
Optimal esthetic healing	39 (90.7)	14 (40.0)	—	—
Esthetic compromise	4 (9.3)	21 (60.0)	6.45 (2.44–17.04)	50.7 (32.3–69.1)

Pearson $\chi^2(1)=22.77$, p<0.001 for the overall 2×2 distribution. Risk estimates use the thick phenotype as the reference group.

Taken together, the continuous and categorical analyses demonstrated a consistent pattern. The thick-phenotype group had higher linear-alignment, contour, color-matching, and overall cosmetic scores, while clinically defined esthetic compromise was substantially more frequent among participants classified as having a thin gingival phenotype.

DISCUSSION

This study provides evidence of a significant relationship between the baseline gingival phenotype and cosmetic healing 12 weeks post-flap reflection and minor oral surgery. Participants with a thick phenotype demonstrated higher scores for linear alignment, contour, color matching and thus overall cosmetic healing when compared with participants exhibiting a thin phenotype. The difference in overall cosmetic score was 2.28 points on the 0–10 scale (with an overall effect size of a large degree). The rate of aesthetic compromise was present in 60.0% and 9.3% of the thin versus thick phenotypes respectively (RR 6.45). This corroboration between categorical and continuous outcomes offers validity to the internal consistency of the identified relationship, however; it must be stated that these were unadjusted observational comparisons; a causal relationship cannot be established. These observations do not conflict with those already made, stating that the dimension of gingival soft tissue is clinically significant in specific periodontal contexts, and possibly along with dental implant placement. Bienz et al. Reported on evidence stating the significance of thick peri-implant soft tissues at least with regards to reduced recession, numerous positive papillary characteristics, and numerous good esthetic qualities. Unfortunately the quality of the available data was assessed as low in the systematic review due to significant measurement inconsistency between studies, inclusion of non-randomized study designs and unaccounted for confounding (12). Tang et al. Also showed a correlation between thickness of peri-implant mucosa and lower rates of marginal bone loss in shorter term follow-ups, with a less definite conclusion in regard to long-term differences (13). Clearly soft tissue dimensions appear significant, although effect size, nature and definitions of results vary between different indications and durations.

A second aspect which lends to comparisons comes from studies looking at mucogingival factors in the long term. Afterroot-coverage andgingival-augmentation surgery, Gingival-margin stability was correlated to amounts ofKTIand Gingival Thickness present 3 months post surgery at the time of maturity of the graft (14). Furthermore, meta-analytic studies evaluatingperi-implantsoft-tissue augmentation have also shown that surgeries capable ofincreasing GFTcan reduce recession and Selected Professional Esthetic Outcomes to varying degrees in certain contexts (15). Whereas these data neither prove that a thick, natural phenotype prevents surgical scarring of soft tissue, they support the generalized biological and clinical notion that volume and thickness can impact how soft tissue responds to operative interference, and later, how much dimension is lost.

More complex still may be the association between phenotype and cosmetic outcome. Contemporary, systematic data examining Gingival Recession Surgery suggest that esthetic outcome is correlated with flap designs, root coverage achieved, grafting method, changes in soft-tissue dimensions, but that no one anatomical factor singularly impacts such outcome (16). Herrera-Serma et al have studied gingival biotype as independent variablein root coverage operations, and their systematic review found no definitive indication that baseline thin versus thick categorizations predicts the esthetic result (17). The difference between this observation and the present is in its support against the simple characterization of phenotype as having universal predictive impact. It supports more the explanation of the present results as an association in the context of flap reflection minor oral surgery, but not as broad evidence that thin phenotype universally dictates poor periodontal outcomes.

Further clinical evidence supporting a similar degree of early, simple epithelial healing in both thin and thick gingival tissue can be found in an upcoming prospective evaluation of gingival excisional wounds. In that study, Theodorou et al. Prospectively evaluated a standardized gingival excisional wound in a matching of thin and thick gingiva recipient areas (n=26 per group).

No significant differences were seen in healing score, epithelial closure, or wound-area closure for the first 14 days postoperatively (18).

Those findings, while at first glance may appear to differ from our present study, reflect a different phase of wound healing; epithelial coverage vs. Our later, cosmetic endpoint. It is entirely possible that early epithelial closure does

not differ between the two groups, but later contour stability, color, shape, alignment, or scar appearance do not be equal. As mentioned earlier, subsequent remodelling can, and has been shown to continue for several weeks.

Demonstrated with use of an index of oral scar visibility, that the length and score of oral mucosal incisions could continue to evolve from time of initial wound closure through several weeks of healing. These authors found the visibility of oral scars could vary and was, in part influenced by location and method of wound treatment(2). Likewise it has been found that oral cicatrisation of gingival grafts can be assessed with a cicatricial index and can be predictably altered by wound preparation techniques (19).

It follows, therefore, to differentiate uncomplicated early healing from the later qualitative aspects of tissue remodelling in these patients, if their final aesthetic results are to be analysed.

However, several biological systems are hypothesized as likely contributors to the differences between gingival phenotypes and tissues, though none were measured directly in this study: Tissue healing within the oral mucosa is driven by synergistic cooperation between epithelial cells, fibroblasts, immune, vascular, matrix, saliva, and resident biota (1). In vitro evidence has identified distinct subsets of oral fibroblasts, able to instigate rapid resolution of acute inflammation and regenerative outcomes (3). Studies comparing gingival and cutaneous keratinocytes have shown differences in response among the tissues during wound repair (20).

Recently, translational research has revealed a role for the GAST6/AXL axis in attenuation of inflammation-related mechanosignaling and generation of regenerative oral repair, while suppressing the development of fibrotic tissues (21).

Comprehensive reviews of oral mucosal healing detail differences from the skin including those related to inflammatory kinetics, regulation of the cytokine profile, extracellular matrix turnover and the response of epithelia (4, 22).

These data support a biologically relevant context to explain variations among individuals for the reasons stated, but do not provide a direct indication that there is any deficiency in thin gingival phenotype relative to either of these mechanisms. Gingival phenotype is a macrostructural descriptor of tissue rather than a true measurement of cellular structure, collateral blood flow, fibroblast activity, inflammation control or the tissue's load bearing. Potentially, thicker tissues have a greater capacity for accommodating flap manipulation, placement of suture materials, temporary puffiness that is temporarily more easily absorbed and contained, modeling of the margins and even some dimensional contraction. Thinner tissues might show a greater proportional difference after only minimal absolute volume loss. However, both are strictly hypothetical.

The method used to classify phenotype is therefore important when interpreting the results. The present study used probe transparency, a clinically convenient technique widely employed in periodontal research. Systematic evidence confirms that methods used to assess gingival thickness differ in accuracy and repeatability and that measurement location materially affects the resulting values (6,7). Clinical investigations comparing probe transparency with transgingival probing or imaging-based measurements have produced variable levels of agreement (8–10). Bolat and Lutfioglu further demonstrated that phenotype classification can change according to the vertical level at which gingival thickness is measured (11). Consequently, the present thin-versus-thick categories should be interpreted as clinical phenotype classifications rather than precise quantitative estimates of gingival thickness.

Such dichotomization could lead to non-differential phenotype misclassification and may have attenuated or changed the observed relationship. Future research would be benefited from quantifying gingival thickness with standardized measurement points; further site-level evaluations; or the utilization of synergistic digital and imaging technologies that permit exploring the thickness and its effect on cosmetic outcome as a continuous exposure rather than classifying genetically and mechanically diverse tissues into only two discrete categories. Clinical Relevance of the Findings It should be kept in mind that clinical relevance should be commensurate with the study design.

Regardless, the findings reinforce the concept of gingival phenotype within a greater framework of preoperative soft-tissue assessment, especially for esthetic zones.

Findings do not claim that thin phenotype necessarily calls for specific technique or that altering the phenotype automatically avoids postoperative facial facial scars. Interventional periodontal studies have clearly established that gingival thickness is modifiable by numerous means. For instance, Santamaria et al. Describe significant changes in phenotype after coronally advanced flap combined with a connective tissue graft or leukocyte and platelet rich fibrin material (23), while a systematic review and meta-analyis suggested an increase in gingival thickness after injection of leukocyte and platelet rich fibrin (or a similar preparation), especially if also Combined with microneedling, may result in clinically meaningful gingival thickening in thin phenotype Patients but with low- to moderate evidence levels (24).

The above mention interventions facilitate phenotype alteration in order to possibly avoid post operative mucosa scar.

Similarly, contemporary implant literature demonstrates that soft-tissue augmentation can substantially increase mucosal thickness, while its effects on professionally rated esthetics and patient satisfaction are more variable (25). This distinction is clinically important because a measurable increase in tissue thickness should not automatically be interpreted as equivalent to improved cosmetic perception. Systematic evidence from recession surgery likewise demonstrates that clinician-rated esthetic outcomes and patient-reported esthetic satisfaction are related but not interchangeable constructs (26). Future work on postoperative mucosal scarring should therefore combine objective clinician-rated scar or esthetic scores with patient-reported satisfaction and perceived visibility of the surgical site.

Key strengths of the present study include the sequential design where baseline phenotype was assessed prior to surgical outcomes, reliance upon a single surgeon and a consistent standardized intrasulcular incision protocol, the use of a uniform suture material, a single standardized photograph assessment, and the employ of two independent blinded evaluators of the outcome. This restricted designto non-systemic disorders in otherwise healthy adult individuals and the exclusion of active periodontitis, uncontrolled diabetes, active smoking, systemic corticosteroid treatment, and a history of pathological scar formation eliminated key sources of heterogeneity. And complete 12 week follow up in the overall 78 enrolled subjects reduced the potential for selection bias due to dropout from analysis.

There are several important limitations however. The current trial, conducted within a single institution, restricted the designto a narrow patient cohort 18 to 45 years of age in the anterior and premolar regions of themaxilla, hence limited external generalizability. Secondly, both primary comparisons were unadjusted, and while age, gender and distribution of basic surgical site seemed comparable between groups, residual confounding effects could and would not be ruled out relating to differences in surgical procedure(s), dimensions of incision, flap design, flap and tissue tension, local anatomy, difficulty in closing wound,post-operative morbidities, or other factors we could not have controlled for. The way that postoperative patients are treated may affect healed tissue appearance:evidence from systematic review indicates that different postoperative regimens could contribute to the heterogeneity of the reported healing appearance after flap surgery (27), and the supporting evidence base remained heterogeneous. Gingival phenotype cannotbe interpretedas independent predictor on the basis of the information from thecurrentstudyin absence of information relating to specific procedures or other postoperative therapy that could influence outcome.

Thirdly the modified 0–10 point cosmetics scale utilizedin the present study needs extensive validation concerning its construct,interrater agreement, responsiveness and clinical meaning. The threshold was defined to mean esthetic comprise,i.e., less than7 and evidence of surface-or line related changes on tissue-level. That this defined measure enabled us to derive a clinically applicable categoric endpoint is well documented, but we need an additional objective validation study of this threshold. Fourth, the probe used in the assessment of appearance may have influenced categorizations by measuring superficial changes rather than providing estimates of thethicknessof tissue. Therefore, a Dose-response effect between tissue thickness and its appearance may not have been analyzed. Fifth, the 12 week duration should be understoodas amiddle stageof tissue remodeling , Rather than full maturation ofscarring.A recently conducted prospectedivivid showed that the scarring of intraoral wounds may take over a year for remodeling (2), so further research with long followup should be conducted in order to test if there is any relationship between the phenotype score and the cosmetic appearance of resultant scar over time.

Clinician esthetic grades were assessed but not the patient reported esthetic outcome, Quality of life in the immediate postoperative period, scar awareness, or repeat the procedure. It's important to make this distinction, because there is not always good correlation between professional index and patient rating (16,25,26) and subsequent studies should include objective assessment of tissues, tested indices of scarring as well as subjective outcome parameters in order to establish if the statistically significant are also statistically perceptible.

Subsequent research should be done using multicenter perspective designs, with sufficient samples, standard operative case reporting, objective assessment of the gingival thickness using objective methods, tested instruments for scoring of the scar, with reliable assessors, and enough data of every single patient to be able to perform multivariate analysis. Serial measurements should be done during healing phase to find out how soon would the epithelium become visible and if there were any differences between the groups at the very moment of epithelial wound closure and when later on the scar starts forming and in what time, phenotypical differences start showing up. Also the value of phenotype as continuous tissue variable as well as potential interaction effects between tissue thickness and surgical procedures, alongside with patient-reported esthetic evaluation should be observed. Last, to make specific suggestions about incisions, flap procedures, grafting techniques, sutures or tissue augments intended to be used to prevent scar formation, randomiized trials are necessary.

CONCLUSION

The 12-week cosmetic healing after minor flap reflection was considered in relation toBaseline gingival phenotype. Subjects designated as thin phenotype showed lower linear-alignment, contour, color-matching and aesthetic scores along with a significantly higher incidence of Clinically defined aesthetic deficiency compared to thick phenotype subjects, supporting use of the thin profile as part of esthetically relevant presurgical soft-tissue evaluation in esthetically demanding situations. The observational study design, unadjusted assessment, dichotomization of phenotype and uncontrolled single-center setting and follow-up limited ability for causal inference nor support any conclusion that phenotype specific approaches to surgery or tissue augmentation are superior.

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