

Correlation of Gingival Phenotype and Schneiderian Membrane Thickness: A Cross-Sectional Study

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Abstract

Background and Purpose: Gingival phenotype (GP) can be measured in patient's clinical evaluations to predict the Schneiderian membrane thickness (SMT). **Materials and Methods:** In this analytic observational cross-sectional study, cone-beam computed tomography (CBCT) images of 310 patients requiring implant surgery in the first or second molar area of maxilla were selected. The GP was determined by inserting a periodontal probe into gingival sulcus. If the outline of the underlying periodontal probe could be seen through the gingival, it was categorized as thin; if not, it was recorded as thick. The examiner measured SMT by calculating the average thickness of the Schneiderian membrane in three sequent cuts of CBCT images. All analyses were performed using SPSS Version 24 software. To analyze the data, independent samples test, Pearson correlation, and linear regression were performed. The level of significance was set at $P = 0.05$. **Results:** Age had no statistically significant relation with SMT and GP ($P = 0.666$ and $P = 0.842$, respectively). The difference of SMT among males and females was not statistically significant ($P = 0.196$). In terms of GP, males and females were statistically significantly different such that females had thin GP more frequently compared to males ($P = 0.003$). SMT was statistically significantly thinner in patients with thin GP compared to those with thick GP ($P \leq 0.001$). **Conclusion:** It may be suggested that GP is an important clinical predictor for SMT, particularly if CBCT evaluations or histological examinations are not possible.

Keywords: Cone-beam computed tomography, gingival phenotype, implant surgery, Schneiderin membrane perforation, Schneiderin membrane thickness

INTRODUCTION

Dental implants are one of the most acceptable treatments for occlusion and mastication rehabilitation.^[1,2] Low bone density, a large pneumatized maxillary sinus, and atrophic maxillary alveolar bone pose a compromised challenge toward the success of implant placement in posterior maxillary ridge.^[3-5] To overcome the above limitation and to regenerate adequate bone, sinus lift procedure has been introduced through which the Schneiderian membrane (SM) is elevated gently, and bone substitutes are deposited.^[1,6] This procedure is considered to be safe due to low complication rate.^[2] However, its most common complication is SM perforation (SMP) which leads to acute or chronic sinusitis, bacterial invasion, swelling, bleeding, and wound dehiscence and also affects the success and survival rate of dental implants.^[2,5,7] The occurrence of this complication varies from 19.5% to 58.3%.^[8] It is, therefore, important to estimate its occurrence possibility before the

operation and provide additional consideration if needed.^[3,9] SM thickness (SMT) can be determined through biopsy and three-dimensional radiography; however, the application of these methods in dental offices may be difficult for requiring special equipment.^[8] Therefore, attempts to find an anatomic factor that predicts SMT are essential.^[10] Aimetti *et al.* obtained mucosa biopsy of maxillary sinus endoscopically and reported a direct relation between SMT and gingival phenotype (GP).^[11] GP is characterized as the scalloped and thin gingiva or the

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flat and thick gingiva and is determined using histological examination and transgingival probing.^[9,10] Histopathologic examination is an accurate but unrealistic measure in clinical studies for requiring biopsy, being invasive, time-consuming, and interrupting the healing process.^[6,12]

GPs may assist the clinician in addressing the features of the SM. Therefore, the aim of this study was to evaluate the relationship between SMT and GP, respectively, measured by radiography and probing to suggest a reliable and practical predictor of SMT and to prevent from SMP through sinus lift surgery.

MATERIALS AND METHODS

This study was an analytic observational cross-sectional study with the aim of evaluating the relation between the GP and SMT of patients referring to dental faculty of Guilan University of Medical Sciences. Three hundred and ten patients were chosen based on the following inclusion and exclusion criteria.

Patients undergoing implant surgery in the first or second molar region of maxilla or both, with probing depth of 3 mm or less, firm gingiva and without traumatic occlusion, history of periapical infection, and gingival recession, were included in the study.

Patients with following criteria were excluded from the study: untreated periodontal disease, previous periodontal surgery and previous sinus surgery, history of previous orthodontic treatment, consumption of drugs with gingival enlargement side effect, pregnancy, tobacco smoking, overerupted mandibular molars, and severe bone loss in the maxillary molar region.

All patients were informed of the study and signed a consent form. Prescription of cone-beam computed tomography (CBCT) radiography is essential as part of the dental implant surgery process, and patients did not receive additional radiation for this study. CBCT was obtained by NewTom VG/Verona/Italy, voxel 0.2–0.24 mm, and field of view 10 × 10. Radiographic imaging was performed by an oral and maxillofacial radiologist. Buccolingual cross-sectional images (with the orientation of perpendicular to axial plan) with 1 mm thickness and 2 mm apart from each other were reconstructed. SMT was measured in three sequential cuts, in the first and second molar region, and the mean of SMT in these three cuts was recorded. All measurements were taken in millimeters using the ruler contained in the NNT Viewer software (NNT 2.21; Image Works, Verona, Italy).

An expert examiner determined GP clinically before the dental implant surgery. The GP was assessed by inserting a calibrated standard periodontal probe (UNC-15 Hu-Friedy) into the gingival sulcus at the midfacial aspect of both central maxillary incisors (Kan 2003).^[13] If the outline of the underlying periodontal probe could be seen through the gingival, it was categorized as thin; if not, it was recorded as thick. Intraexaminer reliability was assessed in twenty patients.

GP and SMT were measured at the baseline and remeasured after 1 week. The intraclass correlation for SMT and GP ranged from 0.96 to 1.00 which was defined as excellent reproducibility, according to Gwet (2008).

All the statistical analyses were performed using IBM® SPSS® Statistics Version 24 software (IBM, Armonk and North Castle, NY, USA). Frequency and percentage were used to describe the qualitative data, and mean and standard deviation were used to describe the quantitative data. To analyze the statistical data, independent samples test, Pearson's correlation, and linear regression were used. The level of significance was set at $P=0.05$.

RESULTS

This study was carried out to evaluate the relation of SMT with age, gender, and GP.

The average age of patients was 52.59 ± 7.61 . The youngest patient was 36 and the oldest was 67. Age had no statistically significant relation with SMT and GP ($P=0.666$ and $P=0.842$, respectively). The mean age of patients with thin GP was 52.73 ± 7.76 and with thick GP was 52.46 ± 7.53 .

Nearly 51.5% (67) of patients were female and 48.5% (63) were male. The average of SMT in male patients was 1.68 ± 4.3 mm, and in female patients was 1.59 ± 3.41 mm. However, the difference of SMT among males and females was not statistically significant ($P=0.196$). In terms of GP, males and females were statistically significantly different such that females had thin GP more frequently compared to males ($P=0.003$) [Table 1].

According to the statistical analysis, 48.5% (63) of patients had thin GP and 51.5% (67) had thick GP. The mean of SMT was 1.47 ± 3.13 mm in patients with thin GP and was 1.79 ± 3.88 mm in patients with thick GP. SMT and GP were positively associated such that SMT was statistically significantly thinner in patients with thin GP compared to those with thick GP ($P \leq 0.001$).

DISCUSSION

It is important to attempt to find an anatomic factor that predicts SMT preoperatively to prevent from SMP. This study was designed to evaluate the relation between SMT and GP in patients requiring dental implant in the posterior region of maxilla.

SMT varies in different studies as a result of variations in geographic population and inclusion criteria such as having

Table 1: Distribution of gingival phenotype based on gender

Gender	Gingival phenotype	
	Thin	Thick
Female, % (n)	61.2 (41)	38.8 (26)
Male, % (n)	34.9 (22)	65.1 (41)
Total, % (n)	48.5 (63)	51.5 (67)

periodontal disease or not and racial and ethnical differences. In the current study, SMT was 1.47 ± 3.13 mm in patients with thin GP and was 1.79 ± 3.88 mm in patients with thick GP, while Aimetti *et al.* reported 0.45–0.85 mm and 0.95–1.40 mm, respectively.^[11] Pommer *et al.* reported 0.02–0.35 mm and Kalyvas *et al.* stated 0.4–2.8 mm as the mean of SMT.^[1,2] In Janner *et al.* and Wen *et al.* studies, SMTs >2 mm were more frequent in patients.^[3,14] As opposed, in Shanbhag *et al.*'s study, the most frequently SMT found was thickness of <2 mm.^[15] Insua *et al.* state that periodontal diseases, apical periodontitis, and tooth extraction thicken the SMT.^[16] By contrast, Janner *et al.* consider endodontic, periodontal, and periapical condition to have no significant influence on SMT.^[3] Furthermore, there are controversies over the effect of smoking and allergy on SMT due to their dependence on individuals' usage and sensitivity.^[2,5,8,16]

Some studies come in accordance with current findings that age has no influence on SMT and sinus abnormalities,^[2,17] which are in contrast with findings of Lathiya *et al.*, Goller-Bulut *et al.*, Çam *et al.*, and Vallo *et al.*^[5,18-20] The aforementioned differences attribute to the age of patients attempting the studies. The mean age of patients in studies in line with the current study is 50–60, while in the rest of researches is 30–40 years old.

Khorramdel *et al.* found no significant relation between gender and GP and SMT, while other studies and the current study stated that male patients tend to have thicker SMT.^[2,3,8,11,19] Manjunath *et al.* stated that GP changes as female patients' age, but this trend was not found in the male patient.^[21]

The results claim the relationship between GP and SMT to be significant. Patients with thick GP have thicker SMT, and patients with thin GP have thinner SMTs which correspond with the following studies.^[9,11,22]

Aimetti *et al.* evaluated GP and SMT, respectively, by probing and excising a biopsy of sinus mucosa.^[11] Studies state that differences in the location of the biopsy and amount of inflammatory infiltrate can lower the accuracy of this method and require specific equipment.^[16] In another study, Yilmaz *et al.* recorded GP and SMT using CBCT.^[9] Assessment of GP in radiographic images is not accurate due to the superimposition of anatomic features and difficult visualizing.^[8] Similar to the current study, Chaturvedi *et al.* assessed GP using probe transparency and measured SMT in CBCTs of patients. They concluded that the GP can provide information about SMT preoperatively.^[22] Similarly, the results of the current study show that probing, as the simplest method of determining GP, can be easily used before sinus lift surgery to predict the SMT and prevent SMP. The limitation of Chaturvedi *et al.*'s study was that they did not assess the relation of SMT and gender.^[22] While, in the current study, the relation was assessed so that SMT tends to be thicker in male patients. Limitations of the current study were small sample size and performing the study in the Iranian population. The SMT and GP may vary in different races and ethnicity. Further

studies are required to study the relation of SMT and GP in larger sample size and in different study population.

CONCLUSION

From the findings of this study, it can be concluded that SMT was thinner in patients with thin GP and was thicker in patients with thick GP. Within the limitations of the current study, it may be suggested that GP is an important clinical predictor for SMT, particularly if CBCT evaluations or histological examinations are not possible.

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Conflicts of interest

There are no conflicts of interest.

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