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CLINICAL REPORT

Maxillary exostoses as contributing etiology to lip hypermobility and associated excessive gingival display: A clinical report

Cléverson O. Silva, DDS, MSc, PhD,[a] Robert C. da Silva, DDS, MSc, PhD,[b] and Dimitris N. Tatakis, DDS, PhD[c,d]

ABSTRACT

Several etiologies may contribute to the development of excessive gingival display (EGD). However, little, if any, consideration has been given to the potentially significant role of prominent buccal maxillary exostoses (BMEs) in EGD etiology. Therefore, the aim of this report was to highlight the contribution of BMEs to EGD. Two patients complaining of EGD were evaluated, and BMEs were found associated with a hypermobile upper lip, vertical maxillary excess, and altered passive eruption. Both patients received esthetic crown lengthening (ECL) as the first surgical intervention. The BMEs were removed by osteoplasty performed during ECL. The resulting smile and EGD changes were evaluated 3 to 6 months postoperatively. An extraordinary amount of gingival display reduction was found in both patients (8 mm and 6 mm), a highly atypical outcome for ECL alone. BME removal on its own represented 75% and 67% of the EGD decrease, respectively. The exostoses removal-associated EGD decreases corresponded to observed reductions in lip mobility during smile. Sizeable BMEs can contribute significantly to the etiology of EGD, in part through an effect on lip mobility during smile. Proper management of such BMEs through osteoplasty provides meaningful EGD reduction, resulting in improvements of smile esthetics and patient satisfaction. (J Prosthet Dent 2025;133:637-643)

Smile esthetics are dictated by the harmony and symmetry of teeth, surrounding gingiva, and lips.[1–3] Many people have a high smile, that is, a smile where a contiguous band of gingiva is displayed.[4,5] However, excessive gingival display (EGD), when > 3 mm of gingiva is exposed while smiling, is less common and has also been referred to as a gummy smile.[6,7] EGD is a trait that is generally considered unattractive[8] and may affect the patient's self-perception, self-esteem, and confidence; therefore, EGD may negatively impact the patient's social and psychological well-being and quality of life.[9–11]

Several etiologic factors may contribute to the development of EGD, and their understanding is key to proper diagnosis and treatment planning.[2,11,12] EGD etiologies can be categorized as follows: primarily of soft tissue (gingiva and lips) origin: these include altered passive eruption (APE), gingival enlargement, short and/or hyperactive upper lip; primarily of hard tissue origin: these include dentoalveolar extrusion and/or vertical maxillary excess; and of both soft and hard tissue origin, for example, certain APE subclasses.[12,13] Furthermore, it is not uncommon for patients to present with EGD that is attributable to multiple concurrent etiologies.[11,14,15]

Thick buccal bone, often reaching close to the cementoenamel junction (CEJ),[16] has typically been associated with APE.[17,18] APE has also been associated with a thick periodontal phenotype,[18] as well as with having thicker buccal bone.[16,19] Sites with buccal maxillary exostoses or bone lipping are sites where buccal alveolar bone thickness is significantly greater than normal, with thickness often exceeding 2 mm, especially in premolar and molar sites.[20] Such exostoses may be associated with APE and may also affect lip positioning during smile, that is, they may also contribute to lip hypermobility. In this manner, exostoses may contribute to EGD etiology. However, the potential of sizeable maxillary exostoses (increased buccal bone volume) to appreciably contribute to EGD etiology has received limited attention.[21]

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[a]Professor and Postdoctoral Program Director, Postgraduate Program in Integrated Dentistry, State University of Maringá (UEM), Maringá, PR, Brazil.
[b]Professor and Scientific Director, ImplantePerio Institute, São Paulo, SP, Brazil.
[c]Professor and Postdoctoral Program Director, Division of Periodontology, College of Dentistry, The Ohio State University (OSU), Columbus, OH.
[d]Department of Oral and Maxillofacial Surgery, Oral Medicine and Periodontology, College of Dentistry, University of Jordan, Amman, Jordan.

The objective of this clinical report was to demonstrate the contribution of maxillary exostoses removal, through osteoplasty, to EGD reduction and smile improvement. The hypothesis guiding this work was that maxillary exostoses have a sizable and quantifiable effect on lip mobility during smile and that removal of these exostoses provides significant gingival display reduction.

CLINICAL REPORT

Patient 1

A 23-year-old woman presented to a private periodontal practice with a chief complaint regarding the esthetics of her smile. The patient was unhappy with the amount of gingiva exposed when smiling and with the apparent excessive bone volume in the maxillary anterior area. She had declined the option of orthognathic surgery, which had been presented to her following a previous consultation. Her medical history revealed good systemic health and no medication intake.

During clinical evaluation, it was verified that, at rest, the entire incisor crown and 1 mm of marginal gingiva could be visualized (Fig. 1A, B) and the upper lip measured 21 mm at rest. Moreover, when she smiled, the following measurements were obtained: 11 mm of upper lip rising, 10 mm of upper lip length, and 11 mm of gingival display (Fig. 1C, D). The clinical crown length of the central incisor was 9 mm, with the cementoenamel junction (CEJ) positioned 2 mm subgingivally. The patient presented with skeletal class II and vertical maxillary excess, with the inferior third of the face being longer then the superior and middle thirds. Additionally, exostoses were present in the maxillary anterior area, mainly over the central incisor teeth (Fig. 1C, D). These exostoses, which were confirmed by cone beam computed tomography (CBCT) imaging (Fig. 1E), led to a more anterior position of the upper lip at rest (Fig. 1B) and an apical

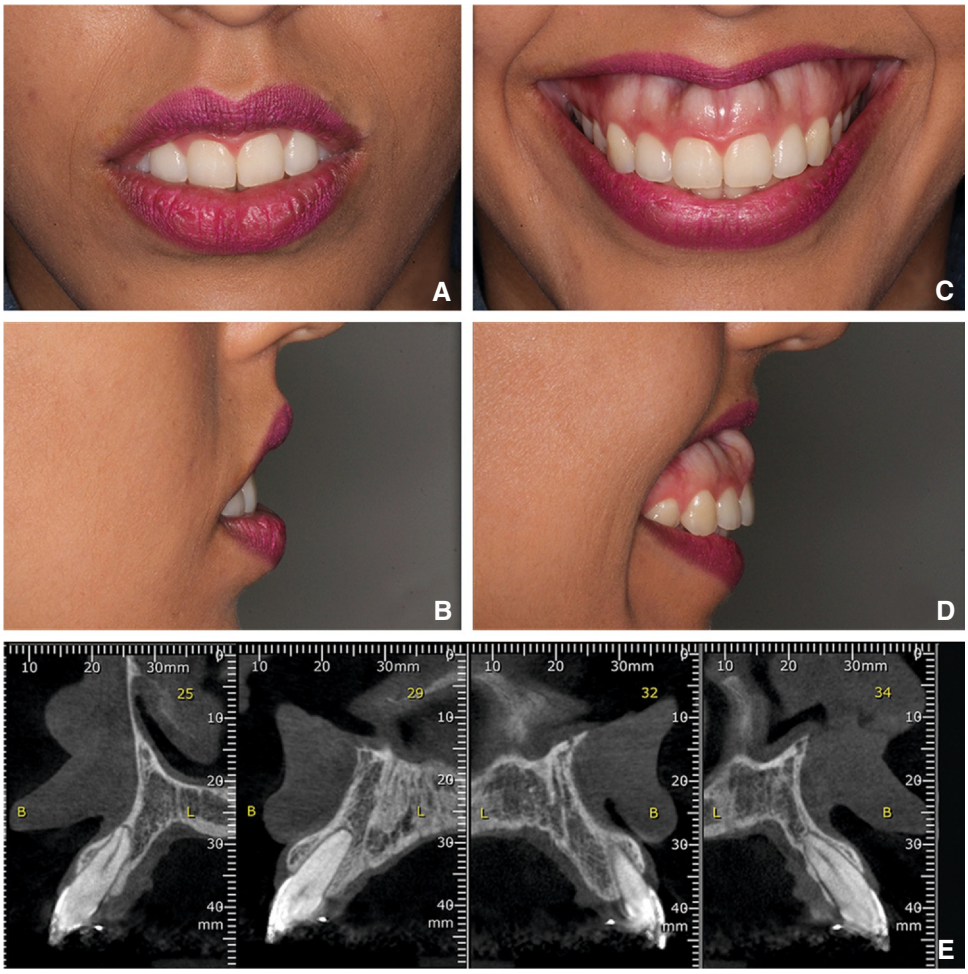

Figure 1. Patient 1. A, Initial frontal view at rest. B, Initial profile view at rest. C, Frontal smile view showing excessive gingival display and presence of buccal maxillary exostoses. D, Profile smile view. E, Detail of cone beam computed tomography image of maxillary anterior teeth (from left to right, respectively) demonstrating prominent maxillary exostoses.

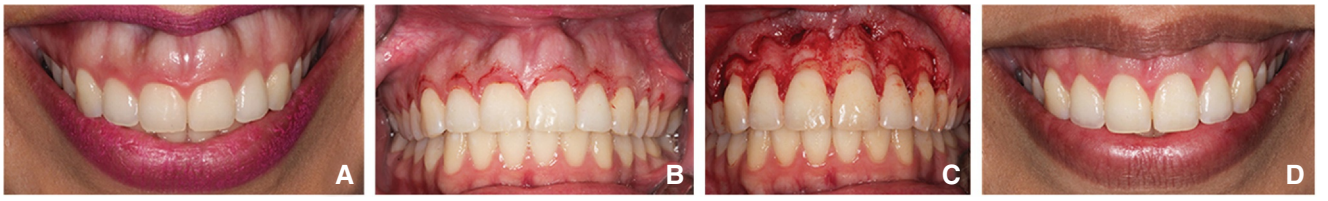

Figure 2. Patient 1. A, Preoperative condition. B, Outlined internal bevel incision. C, Elevated mucoperiosteal flap and completed ostectomy and extensive osteoplasty to reduce exostoses. D, Outcome of esthetic crown lengthening procedure at 6 months postoperatively.

position of the upper lip during smile (Fig. 1D). During smile, the upper lip appeared to "roll" under the exostoses (Fig. 1D). These findings led to a diagnosis of normal upper lip length, EGD due to APE (type 1B),[13] hypermobile upper lip (HUL), vertical maxillary excess, and buccal maxillary exostoses. Consequently, an esthetic crown lengthening (ECL)[22] with extensive osteoplasty was the first approach for her treatment, with subsequent lip repositioning surgery planned if required.[14,23]

Antisepsis was performed with povidone iodine (10% solution) extraorally and with antimicrobial rinse (chlorhexidine 0.12% for 1 minute) intraorally. Anesthesia was achieved with local infiltration of lidocaine 2% with 1:100,000 epinephrine (Alphacaina, Adrenalina 1:100.000; DFL Ind E Com). The surgical procedure was initiated with an internal bevel incision (Fig. 2A, B) by following the CEJ anatomy and preserving the interdental papillae, followed by the removal of the outlined marginal gingiva. A mucoperiosteal flap was then elevated and rotary (#2173Esp and #3018 burs) and hand (#2 Fedi, #36/37 Rhodes chisels) instruments were used for ostectomy and extensive osteoplasty, mainly in the exostoses areas, until a 3-mm CEJ-Alveolar bone crest (ABC) distance was achieved (Fig. 2C). Care was taken to leave approximately 1 mm of bone thickness covering the roots. Finally, the flap was repositioned and stabilized with vertical mattress sutures (polyglactin 910).

The patient was prescribed analgesic (acetaminophen 750 mg, qid) and anti-inflammatory (ibuprofen 600 mg, qid) medications for 3 days. She was instructed to use the antimicrobial rinse twice daily for 2 weeks and refrain from mechanical plaque control in the operated area for 1 week, to apply ice packs for the first 2 days, to consume only soft foods during the first week, and to avoid any other mechanical trauma to the area.

Follow-up visits were made at 2 weeks (suture removal) and at 1, 3, and 6 months. She healed uneventfully with no postoperative complaints. After this period, she demonstrated a more esthetic smile, with harmonious gingival contours and tooth dimensions (11 mm length), along with an 8-mm reduction in gingival display during smile (3 mm of gingival display at 6 months; Fig. 2D). She expressed her satisfaction with the overall outcome. This outcome represented an extraordinary and atypical result after ECL alone, where gingival width was reduced by 2 mm (Fig. 2B). The observed changes suggest that despite the performance of ECL for APE, only 25% (2 of 8 mm) of the change in gingival display was associated with the increased crown length, while 75% was because of change in lip mobility. This remarkable outcome was attributed to the extensive osteoplasty performed, which reduced the buccal bone prominence and allowed for better upper lip drape and a significant decrease in lip rising during smile (compare Fig. 2A with Fig. 2D). It appears that the decreased lip rising and the elimination of the lip roll under the exostoses also resulted in increased vermilion vertical length (height) during smile (Figs. 2A, 2D, 3A, 3B).

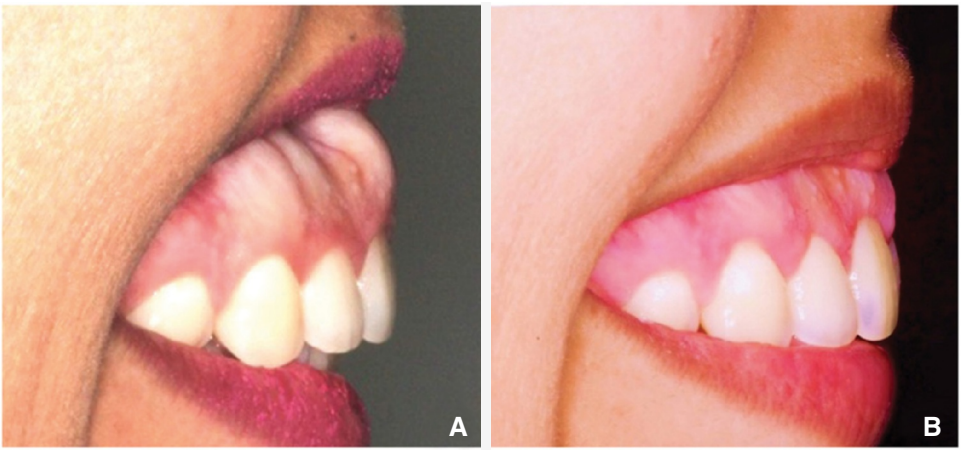

Figure 3. Profile of patient 1 smiling. A, Preoperatively. B, 6 months postoperatively.

Figure 4. Patient 2. A, Initial presentation of patient smiling. B, Retracted preoperative view of maxilla. C, Mucoperiosteal flap fully elevated, making apparent significant exostoses present throughout maxillary dentition. D, Completion of ostectomy and extensive osteoplasty to reduce exostoses. E, Flap sutured (end of crown lengthening procedure). F, Patient smiling at 3 months postoperatively.

Patient 2

A 27-year-old woman presented to a private periodontal practice complaining about the esthetics of her smile. She was dissatisfied with the excessive gingival display and with the voluminous appearance of the tissues that could be seen while smiling. She was systemically healthy and not taking any medication.

During clinical evaluation, it was verified that 9 mm and 13 mm of gingiva was displayed during her smile in the anterior and posterior areas, respectively, with healthy gingiva and normal upper lip length (25 mm at rest and 13 mm during smile) (Fig. 4A). Tooth evaluation revealed short and square clinical crowns in the canines and posterior areas, with extensive bony exostoses, mainly in the posterior region (Fig. 4A, B). Moreover, 12 mm of lip rise was observed during smiling, and vertical maxillary excess was also present. The final diagnosis was normal upper lip length, EGD due to a combination of APE (type 1B),[13] HUL, vertical maxillary excess and buccal maxillary exostoses. The treatment plan included ECL initially, mainly in the posterior areas, with concomitant ostectomy and osteoplasty.

The treatment was performed similarly to patient 1 (Fig. 4C-E), except for the suture material used (5.0 nylon soft blue; Techsuture). She followed the same postoperative protocol as in patient 1. Postoperative healing was uneventful, and she had no complaints. After 3 months, she presented with more harmonious tooth proportions (11 mm length), a smile showing tissue volume reduction, and a decrease in the amount of gingival display (6 mm anterior and 7 mm posterior areas) with reduced lip rising (4 mm less) and greater lip vermillion exposure (Fig. 4F). In this patient, 67% of the 6-mm reduction in the posterior tooth gingival display was attributable to the reduction in lip mobility during smile. However, she was still unsatisfied with the overall gingival display and was then treated with modified lip repositioning surgery[23] with blunt muscle dissection. Briefly, 2 strips of alveolar mucosa of 12 mm in apicocoronal width were removed (Fig. 5A, B), one of each side of the frenulum, which was preserved (Fig. 5C). After this, a deep periosteal fenestration, blunt muscle dissection (Fig. 5D), and suspensory sutures through the attached gingiva (Fig. 5E) were performed.[24] Finally, the apical mucosal wound margin was sutured to the attached gingiva (Fig. 5F). Postoperative healing was uneventful, with no patient complaints, and sutures were removed at 4 weeks. After 1 year, she presented a harmonious smile with 2 mm and 4 mm of gingival display at the anterior and posterior areas, respectively (Fig. 6).

The most relevant clinical measurements and outcomes of both patients following ECL and exostoses removal are summarized in Table 1.

DISCUSSION

The present report aimed to highlight the potential contribution of maxillary exostoses to EGD etiology. The

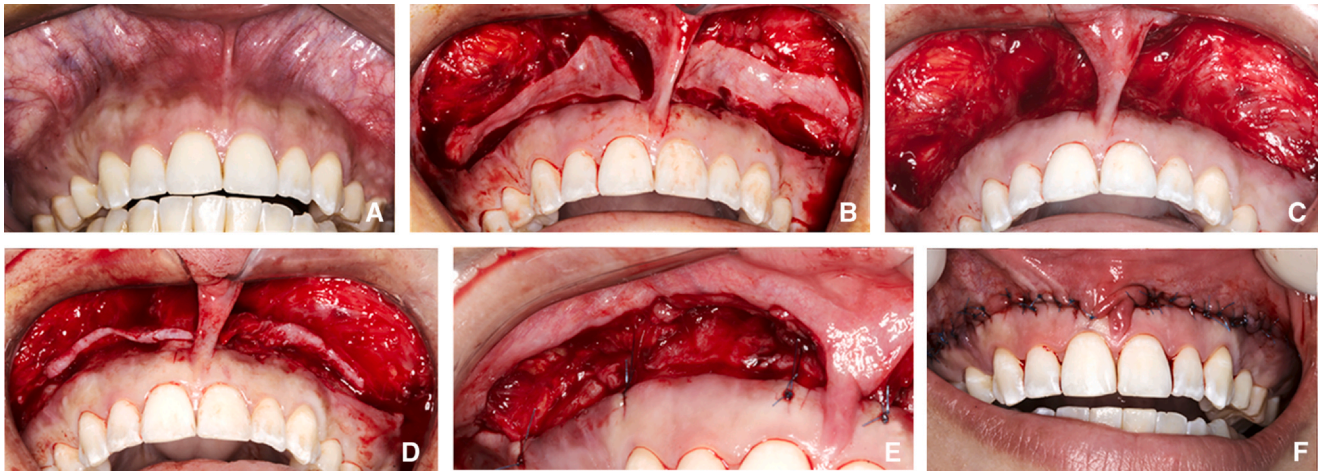

Figure 5. Patient 2. Steps of lip repositioning surgery. A, Intraoral image prior to lip repositioning surgery. B, Outlined mucosal strips. C, Mucosal strips removed, leaving maxillary frenum intact. D, Deep periosteal fenestration and blunt muscle dissection. E, Suspensory sutures anchored to attached gingiva. F, Closure of mucosal wound margin.

Figure 6. Patient 2. A, Smiling at initial presentation. B, 3 months after completion of esthetic crown lengthening surgery. C, 1 year after completion of lip repositioning surgery. Contributions of each surgical procedure to reduction in gingival display and associated improvements in esthetics of patient's smile visualized.

achieved treatment outcomes indicated that the removal or reduction of excessive buccal alveolar bone volume has a major impact on reducing EGD, at least in part by reducing upper lip mobility during smile. Many factors can contribute to EGD development and have been used to classify EGD and guide treatment decisions. Classically, Silberbeg et al[12] considered both soft and hard tissue origins as possible etiologies; these have also been more recently reviewed by other investigators.[25–27] However, the authors are unaware of a proposed classification or diagnostic algorithm that considered maxillary alveolar bone exostoses as a contributing etiologic factor. This report documents 2 patients where exostoses were important factors contributing to upper lip displacement during smile and thus to the resulting EGD.

Buccal bone thickness has been shown to be greater in patients with APE,[17–19] and the use of osteoplasty or ostectomy to reduce the thickness of alveolar bone during an ECL procedure to treat APE has been previously reported.[21,22,28,29] However, the underlying

Table 1. Quantification of relevant clinical outcomes following ECL and exostoses removal

Patient Parameter	Patient 1			Patient 2		
	Pre-tx	Post-tx	Change	Pre-tx	Post-tx	Change
Gingival display (mm)	11	3	8	13	7	6
Lip length at smile (mm)	10	16	6	13	17	4
Lip mobility/rising (mm)	11	5	6	12	8	4
Clinical crown length (mm)	9	11	2	9	11	2
Gingival display reduction (%)		72.7			46.1	
Lip mobility reduction (%)		54.5			33.3	
Display reduction attributed to crown elongation (% [mm])		25 [2]			33.3 [2]	
Display reduction attributed to lip mobility reduction (% [mm])		75 [6]			66.7 [4]	

ECL, esthetic crown lengthening; Post-tx, posttreatment (exostosis removal during crown lengthening) values; Pre-tx, pretreatment values.
All parameters recorded on right central incisor.

rationale has been the need to properly position the postoperative gingival margin at the right location (relative to the CEJ) and to minimize the risk of recurrence[28] and/or to simply reduce any surface contour irregularities.[29] This rationale is consistent with the evidence that, in the majority of patients with APE, the crest is in close proximity to the CEJ[17] and the proper dimensions of the supracrestal soft tissues need to be surgically established.

Different surgical treatment options are available for the treatment of EGD associated with APE or HUL.[30,31] The treatment focus on these 2 etiologic conditions stems from the fact that APE and HUL are the 2 most prevalent soft tissue etiologies of EGD, as documented in recent studies.[11,15,32] However, the potential contribution of sizeable maxillary buccal exostoses to EGD etiology has not been adequately addressed in the literature. Ribeiro et al,[21] in a report on 3 patients, observed that following an extended osteoplasty as part of the correction of EGD in patients diagnosed with APE, the gingival display was reduced by approximately 47%, of which about 20% was related to the change in lip drape while 27% related to the increased crown exposure; in other words, the postoperative reduction in lip mobility contributed almost 43% to the change in gingival display. In the present report, where the exostoses were much more voluminous than the ones described by Ribeiro et al,[21] the change in lip mobility accounted for 67% to 75% of the gingival display reduction. These clinical outcomes suggest that the greater the size of the maxillary exostoses, the more they can contribute to the presenting HUL. They also suggest that the magnitude of the osseous reduction in a buccolingual direction is in direct proportion to the decrease in lip mobility, and thus to the reduction in gingival display. The anatomic differences between patient 1 (exostoses present mostly in the anterior sextant) and patient 2 (more voluminous exostoses but located mostly in posterior sextants), along with the differences in outcomes (patient 1: ~55% reduction in lip mobility; patient 2: 33% reduction in lip mobility), suggest that location of the exostoses is an additional relevant factor, besides the exostoses' dimensions, in altering lip mobility and, accordingly, gingival display during smile. Collectively, the results of the present patients indicated that when HUL is diagnosed, proper consideration should be given to the possible presence and influence of buccal maxillary exostoses. This is important because it affects the proposed treatment sequence; what this means is that voluminous maxillary exostoses should be treated first, as part of an esthetic crown lengthening procedure, to reduce lip mobility and gingival display before any attempt to perform lip repositioning surgery. The 2 patients presented here offer a clear illustration of this concept: when the maxillary exostoses removal reduces gingival display to a satisfactory level, the patient does not need to undergo lip repositioning surgery (patient 1); in contrast, despite the significant improvement in gingival display after exostoses reduction (patient 2), the lack of patient satisfaction and the remaining HUL provide the proper indication for a second stage lip repositioning surgery.

Epidemiological considerations may explain why the presence of maxillary exostoses has not featured more prominently in the etiology of EGD or HUL. The prevalence of maxillary buccal alveolar exostoses has been reported to vary between 17%[33] and 34.6%[20] of examined persons or jaws, depending on the population, with the majority (60% to 67%)[20,33] presenting in men. In addition, maxillary exostoses are much more common in older age groups (>60% found in persons ≥40 years old)[33] and in molar teeth.[20] The marked divergence between the epidemiological characteristics of maxillary buccal exostoses (that is, present primarily in older men) and the typical demographics of patients seeking treatment for EGD (overwhelmingly young women)[11,15] may explain why the potential direct contribution of maxillary exostoses to EGD etiology has not received greater recognition until now.

When maxillary exostoses are present, the availability of a preoperative CBCT scan helps to determine the buccal bone thickness present and to properly guide the bone reduction that should be performed. Based on this information, during the performed ECL and concomitant osteoplasty, the effort was to leave approximately 1 mm of buccal bone thickness over the tooth roots. This choice was based on the fact that in periodontally healthy persons a buccal bone thickness of approximately 1 mm has been confirmed by several investigators[34–37] and on the fact that thicknesses greater than 1 mm are rare.[35,37]

Within the limitations of this report, the presence of sizeable maxillary exostoses can contribute to the etiology of excessive gingival display, in part through an effect on lip mobility during smile. Proper management of such maxillary exostoses through osteoplasty can provide meaningful gingival display reduction, resulting in improvements in smile esthetics and patient satisfaction.

SUMMARY

The present report aimed to illustrate the potential contribution of significant maxillary exostoses to increased upper lip mobility and the resulting excessive gingival display. Two patients presenting with sizeable maxillary exostoses were treated with osteoplasty to reduce the buccal prominence of the alveolar process; this treatment resulted in significant reduction of the upper lip hypermobility and of the original excessive

gingival display. The relative contribution of the performed osteoplasty process to excessive gingival display reduction was quantified.

PATIENT CONSENT

Informed consent was obtained prior to treatment from both individuals included in the report, and consent for publication was also obtained from both individuals.

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Corresponding author:
Dr Dimitris N. Tatakis
Division of Periodontology
College of Dentistry
The Ohio State University
305 West 12th Avenue
Columbus, OH 43210
Email: tatakis.1@osu.edu

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CRediT authorship contribution statement
Cléverson O. Silva conceived the study, performed the surgeries and contributed to drafting of manuscript, and editing and revising manuscript. **Robert C. da Silva** conceived the study, contributed to drafting, editing and revising manuscript. **Dimitris N. Tatakis** conceived the study, contributed to preparation of figures, and editing and revising manuscript. All authors approved the final version of the manuscript.

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