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Surgical Techniques to Improve the Smile

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1. Introduction

A smile has always been an important key in our social life, not to mention if it is an attractive one. The type, degree, tone, at static or a dynamic figure concerns facial beauty as well as the internal mood, or what might be called “the internal smile.” The society in the current century is turning towards social media, gadgets, electronics and advertisements mainly based on pictures. Those corporates seeking to recruit applicants for job positions assess the persons photograph in addition to their CV because a photo can tell a lot about an applicant. Hence, there is a growing trend towards enhancement of facial esthetics.

Among the medical professions, many specialties are dealing with smiles; however, the approach to management can vary considerably due to improper diagnosis and lack of knowledge toward the variable treatment options. Specialists such as restorative dentist, prosthodontist, orthodontist, periodontist, maxillofacial surgeon, plastic surgeon, and dermatologist are working around the “smile complex”; however, no clear inter-specialty communication exists to provide the best intervention for patients. This might be a reason for variable management to smile imperfections via different specialties.

In this chapter, the “unattractive smile”, is being discussed from different angles and in a totally different manner. The objective is to collect the expertise of variable cosmetic specialties in a single chapter to help practitioners in future decision-making processes in “smile management.” Hence, the concepts are presented along with multiple challenging cases with different interventions. Interventions such as restorative veneers in the maxillary anterior teeth can be the answer to all patients’ troubles if used in the right cases; while crown lengthening as a sole procedure or in combination with veneers can be the ultimate solution for others [1].

Maxillary surgical procedures such as LeFort 1 may be the only solution in others. Laser therapy for lip irregularities can provide more convenient results in case of fine wrinkles, while Botox and fillers may provide better outcomes for some gummy smiles. The case can be a little

bit more challenging if the patient is known to have a repaired cleft lip, previous lip trauma, or secondary facial deformity [2].

Other situations where patients visit clinics with a clear demand of what can make them feel happier, such as piercing or cheek dimples can be linked to the patient's own personal satisfaction. On other occasions, clients may be confused, and complain of resenting their profile pictures without clear understanding of their problem needing correction. It is well known, that in the current era of cosmetic revolution and subspecialty care and techniques, continuous evaluation and research regarding the principles of "smile management" are evolving. Therefore, practitioners should keep in mind that proper training in the field, careful case selection, and inter-specialty communication can provide the best results with the least possible complications.

2. Definition of smile

A smile is expressed as a form of one's feature reflecting pleasure and happiness usually shown by upturning the corners of the mouth [1]. It can be presented in a static state mostly during taking pictures, or can be as part of a dynamic state during articulation. However, the personal self-evaluation can be more complicated due to the era of advanced social networking. Hence, it is not surprising that critics of smiles and perfectionism are increasing [2].

3. Components of the smile

Medical practitioners may describe the smile as a status of the orofacial complex where muscles of the facial expression are harmonized. Muscles such as the frontalis, orbicularis oculi, orbicularis oris, zygomaticus major, risorius, platysma and depressor anguli oris are working in harmony to provide various facial expressions [3]. A common mistake is considering the oral complex as the only item composing the smile, though midfacial muscles such as the zygomaticus major and minor originate from the midface and hence affect the general character and smile. The muscles around the orbital complex are critical to facial expression as a reflection of youth and beauty when lacking heavy wrinkles [4]. Hence, the components of a smile can be evaluated according to different factors namely:

- a. Anatomical components
- b. Smile lip line
- c. Dental smile lines
- d. Facial character

Anatomical components: The smile is composed of the upper lip, the maxillary bone, the maxillary teeth, and the gingival tissue envelope [5, 6].

The upper lip represents the area from the point subnasal to the upper lip stomion which varies between 18-22mm (Figure 1) [5]. The width of the lip is composed of mucosa, orbicularis muscle, fat, and skin, which varies between individuals in height and thickness. However, the extension of muscles into the surrounding structures such as the nose can affect the nasal shape when smiling. A lot of patients have their nasal tips turned downward when they smile, or have the alae of the nose extremely widen or flare, which can be unsightly [7].

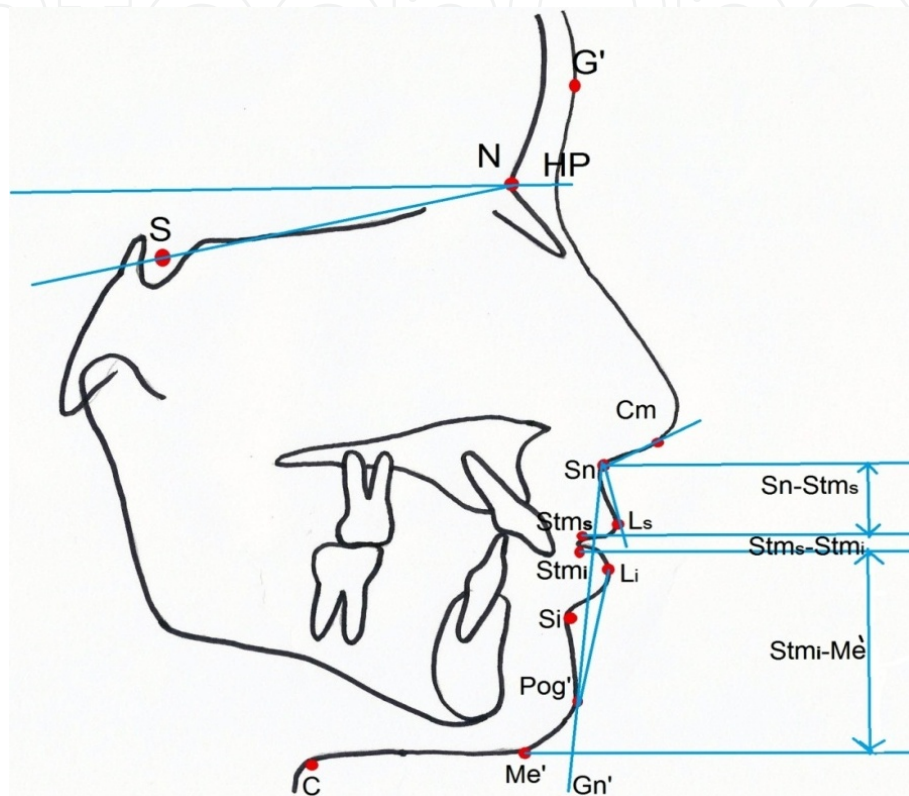


Figure 1. Lateral cephalometric analysis showing the lip form and position. Nasolabial angle (Cm-Sn-Ls), mentolabial sulcus depth (Si to Li-Pog'), maxillary incisor exposure (Stms-1). Upper lip protrusion (Ls to Sn-Pog'), lower lip protrusion (Li to Sn-Pog'), vertical lip-chin ratio (Sn-Stms/Stmi-Me'), interlabial gap (Stms- Stmi). [5]

The maxillary bone and teeth constitute the second and third parts. The maxilla extends from the subnasal down to the alveolar component housing the teeth. The width of the smile is correlated with the width of the maxilla, as transverse deficiency will lead to narrow V-shaped maxillary arch and a wide buccal corridor which is not pleasant, and vice versa. While in the vertical dimension, maxillary excessive growth will lead to over expression of gum and teeth during smiling or a gummy smile; while extreme maxillary bone vertical deficiency will lead to absence of teeth and gingival show at static or dynamic orofacial states reflecting an unpleasant aging character. Evaluation of the maxillomandibular complex is accomplished via clinical and radiographic modalities clarified later in this chapter [5].

The gingival architecture is the fourth factor. Gingival recession exposing more tooth structure and roots is as unpleasant as gingival overgrowth -leading to short clinical crowns. As the crown shape, including height, width, curvature, and alignment have an important role [3],

once the dental smile arc line is upturned posteriorly it will reflect better cosmetic results compared to a flat or downturned arc line. [6] Hence, a defect in a single component or inappropriate harmony between each can provide patients with unpleasant smiles. Therefore it is very critical to diagnose the major contributor to the disharmony and formulate the best management plan accordingly.

Smile lip line: This is divided into high, moderate or low horizontal smile lines according to the magnitude of upper lip coverage of the maxillary anterior teeth when static and smiling. [6] A high lip line refers to a smile showing the maxillary anterior teeth and part of the gingival tissue, while a low lip line shows 0-2mm of the anterior teeth. A high smile line is considered to be a challenging factor when rehabilitating the anterior maxilla. As any defect in the crown or gingival tissue can be disclosed; unlike patients with moderate or low smile lines (Figure 2).

Dental smile line (smile arc): This pertains to maxillary teeth from the incisor going along to the 1st molar and describes the best cosmetic relation as evaluated by an expert restorative dentist.[4,6] A smooth transition of dental lines, alignment, shape, and color can provide pleasant smiles. The dental smile line is an imaginary line drawn from the incisal edges of the maxillary anterior teeth and following the upper lip inferior border curvature. It can be flat, upturned, or downturned. These lines do have more fine details that a specialist restorative dentist can analyze. [3, 4, 6] The fine dental line details are beyond the scope of the chapter.

4. Case

A young female patient referred complaining that she does not like her smile. On examination the patient was presented an option of orthodontic treatment to adjust the spaces and dental relation before any final restorative esthetic procedures. However, the patient did not prefer any orthodontic intervention. Hence, the cosmetic restorative team evaluated the patient for possible prosthetic rehabilitation of the smile and anterior teeth via dental veneers. Proper examination, impression and lab simulation using wax up models was performed and showed a favorable outcome. Therefore, the team elected to proceed with the treatment. Although the team advised the patient to receive restorative therapy of the premolar teeth, the patient refused, as she was mainly interested in betterment of the anterior tooth show (Figure 2).

Facial character: The overall shape, color, and harmony of the face and maxillomandibular relationship should be evaluated clinically as well as radiologically. Clinical pictures of the frontal and profile views from different angles are necessary for documentation. Static evaluation as well as dynamic evaluation of the facial expression is important and any facial asymmetry should not go unforeseen. [2, 7, 8]

Beside the clinical examination of the head and neck region, radiographic evaluation is important to investigate the maxillomandibular complex, temporomandibular joint, and dentition using panoramic radiography and cephalometrics. [5, 7, 8]



Figure 2. (Left) a moderate smile lip line, with unfavorable dento-gingival relationship and dental esthetics. (Right) Postoperative results after treatment with restorative veneers (Courtesy of Professor Motaz Ghulman, King Abdulaziz University).

4.1. Principles of managing an unpleasant smile

Unpleasant smiles can be due to clear defect in one or more of the major smile components, lack of harmony of the smile pillars, or loss of self-satisfaction, which can be due either to a specific demand the patient is requesting (such as cheek dimples) or pure personal psychological dissatisfaction. The most important principle in managing such patients is to diagnose the etiology to see if it is actually an organic anatomical issue or is it an issue of self-concept. The answer is usually explored via careful teamwork consultation that will help guide the patient to the proper treatment channels.

4.1.1. The use of botox and fillers for smiles: [9, 10]

Botox (Botulinum toxin) is a neurotoxin that is derived from the bacterium *Clostridium Botulinum* that has several serologically distinct subtypes, A, B, C, D, E, and G. It acts by blocking acetylcholine release at the neuromuscular junction, and hence preventing muscular contraction leading to smoothening of the hyperkinetic unpleasant looking facial rhytids or skin lines. The most common one is Botulinum A, Botox. [9, 10]

Botox has many applications in medical fields such as:

1. Treating facial rhytids: forehead, periorbital, and paranasal area
2. Treating neck vertical platysmal bands
3. Myofacial pain of the head and neck
4. Migraines
5. Muscle palsy
6. Muscle hypertrophy, commonly masseter and temporalis muscle hypertrophy.

For smiles with hyperactive muscular complex of the upper lip, Botox can be carefully deposited in the main hyperactive areas to reduce the action and hence to allow better draping of the upper lip complex on the maxillary teeth. [11]

The advantages are: easier application, less invasive, quick procedure, reasonable price, reasonably fast onset, and duration of about 6 months.

Disadvantages are: the action may start with fine dropping of the upper lip that patients may perceive as unpleasant, it takes from days to weeks to stabilize, asymmetric smile, uncomfortable injections, requiring re-injection after 6 months to stabilize results. [9, 11]

4.1.2. Case presentation

A 29-year-old woman complained that she was unsatisfied with her smile and that she had to use her hand to cover her mouth while laughing. On examination it was noticed that she had a hyperactive upper lip muscles, orbicularis oris and elevator labii alaeque nasi. She agreed to start management with a simple non-invasive method such as Botox therapy of the hyperactive areas (Figure 3, 4).



Figure 3. A 29-year-old woman with a gummy smile.

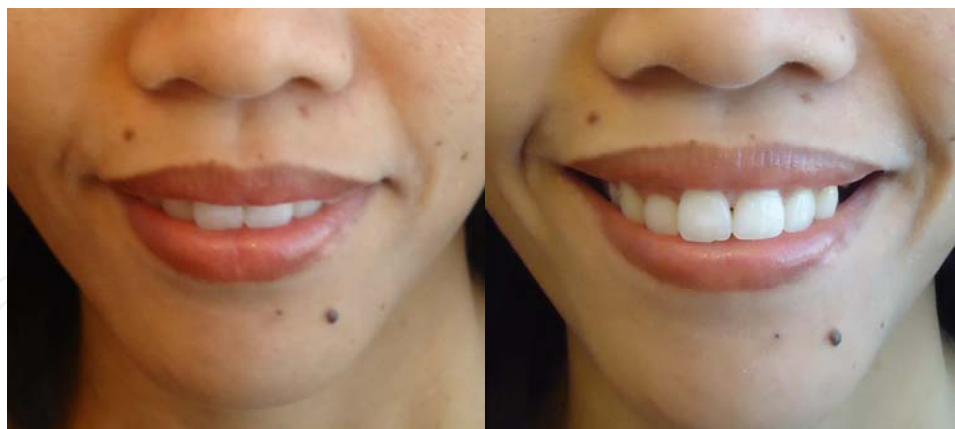


Figure 4. The patient after treatment with selective Botox therapy at the hyperactive muscular areas. The pictures showing two pleasant smile poses, as compared to the preoperative smile in Figure 3.

4.2. Lefort 1 maxillary surgery

A LeFort 1 maxillary procedure is a surgical intervention where the maxillary bone is osteotomized in the semi-horizontal plane to disengage it from the cephalic end and allow moving the disengaged part into a more favorable position as dictated in relation to the opposing jaw and thus, improving the general facial harmony. The movement can be accomplished in three

dimensions as needed. A maxillofacial surgeon trained in the field of orthognathics and facial reconstruction usually performs the procedure [5, 12]. Preoperative evaluation and consultation with an orthodontist trained in the field is necessary to estimate the defect and treatment planning including a thorough preoperative work up. This usually includes the following: Facial clinical photographs, intraoral photographs, panoramic radiograph, lateral cephalometric radiograph, anteroposterior cephalometric radiograph, impressions to develop study casts, mounting casts and a face bow transfer to aid in the cast mounting (Figure 5) [5,12]. Once this is accomplished, a proper data analysis is required for each aspect to develop a preoperative documented record, a diagnosis, and a provisional plan.



Figure 5. Lateral cephalometric radiograph with superimposing face bow transfer is a method to insure proper dentoskeletal relation before sending the face bow and impressions to the laboratory.

One of the most common indications is in gummy smile cases due to maxillary vertical excess. The procedure can be more challenging in cases with a short upper lip that contributes to the unpleasant smile complex. The procedure is mainly directed toward reducing the maxillary excess by moving the maxilla in the superior direction, and hence, it improves the smile.

The advantages of such a procedure are that it provides a major improvement in the shape of the face and smile.

The disadvantages are that it is done under general anesthesia, requires hospitalization, requires prolonged recovery time that can be up to a month (hence usually done during a prolonged vacation), postoperative expectations include swelling, pain, midface paresthesia, difficulty eating, minor changes in nasal shape, and general discomfort. [12, 13]

4.2.1. Case presentation

A 27-year-old patient with an unpleasant smile and difficulty eating. Clinical and radiographic evaluation revealed vertical maxillary excess and mandible deviation. The patient under-

went multi-team comprehensive consultation and found it best to be treated via orthognathic surgery. LeFort 1 maxillary osteotomy was done to position the maxilla in upward position and correct the rotation, while the mandible underwent bilateral sagittal split osteotomy to optimize symmetry and occlusion. The patient still requires final orthodontic treatment (Figure 6).



Figure 6. Maxillary vertical excess that required orthognathic surgery intervention to correct the deformity seen on the left. The right picture shows the postoperative favorable results.

4.3. Upper lip enhancement procedures

Facial aging is a continuous process that can be accelerated by smoking, sun exposure, or personal genetic predisposition. The loss of elastic fibers and replacement with collagen fibers leads to reduction in skin elasticity and sagging of the skin complex. Hence, cosmetic procedures such as facial fillers, lipofillers, chemical peeling, surgical lifting procedures, and laser treatment can optimize the general results. [10-14]

Other surgical procedures are not as common such as upper lip elongation or shortening that can treat cases of short upper lip that require some elongation to redrape the maxillary teeth. The upper lip is measured from the subnasal point to upper lip stomion, and has an average of 18-22mm length. [8]

A subnasal upper lip-lift is a procedure used to shorten a long upper lip and to evert it outward. This will allow more maxillary teeth show, upper lip outward eversion, and hence, a more pleasant youthful smile. It can be designed in a W-lift direction to provide better enhancement of the cupid bow area. The W arms can be designed in asymmetric fashion to manage upper lip asymmetric deformities. [2]

The lips can be in inverted, everted, hypoplastic, or with fine mucosal irregularities [13]. Such lip irregularities can be managed using laser therapy to eliminate superficial folds, or even cut and plan the rotation movements needed (Figure 7). [13, 14]

4.3.1. Case presentation

A 23-year-old female referred complaining of unesthetic upper lip and unpleasant smile. The patient had had multiple cleft lip and palate repair procedures in the past. The patient was presented an option of asymmetric upper lip lift and fat transfer to the upper lip. The procedure took place under general anesthesia and the results were immediately noticed (Figure 7, 8).



Figure 7. The patient at the preoperative stage (left); the upper lip is thin, inverted and flat. The plan surgically was to lift up the upper lip, evert it outward, and augment it using fat transfer. The picture on the right shows the preoperative W-lift marking. [2]



Figure 8. One-week postoperatively showing the upper lip volume, lip lift, and outward eversion of the patient in Figure 7.

Upper lip volume enhancement can be accomplished using autogenous grafts such as fascia, muscle, and periosteum especially if more volume is needed in compromised sites such as repaired cleft lip with notching or whistle deformity (Figure 9). Synthetic fillers are a common option now days to achieve lip volume enhancement or final border definition [7-9, 13].

4.3.2. Case presentation

A 34-year-old male patient referred complaining of extramucosal fold of his upper lip that shows more during smiling. The patient was presented an option of Erbium-Yag laser therapy to remove the mucosal folds under local anesthesia (Figure 9).



Figure 9. The left picture presents a smile of a 34-year-old male patient complaining of extramucosal fold of his upper lip that shows more during smiling. The patient was presented an option of Erbium-Yag laser therapy to remove the mucosal folds under local anesthesia. The picture on the right showing the result immediately after laser therapy, indicating the dry field and a potential of favorable secondary intentional healing.

4.3.3. Case presentation

A 23-year-old female presented with severe whistle deformity and notching of the upper lip secondary to repaired cleft lip 6 years ago. She was presented an option of upper lip revision; however, she was not keen to do so. Hence, she was presented the option of periosteum-muscular graft augmentation harvest from the lower lip / chin mass and transfer to the upper lip (Figure 10).



Figure 10. Reconstruction of an upper lip with severe notch deformity on the left picture using autologous muscular graft. The photograph on the right is three months postoperative. Final fine-tuning of lip boundaries can be achieved using synthetic fillers.

4.4. Crown lengthening

Crown lengthening is defined as a procedure used to increase the height of the clinical crowns by removing part of the gingival tissue with or without the crestal alveolar bone [14]. The procedure is usually designed according to the demand of the clinical crown height or the planned prosthetic crown or veneer. The tissue ablation is performed using blades, lasers, or less favorably, electrocautery, which has the tendency to damage the soft tissue cuff when compared to laser-based precise cutting capabilities. However, Laser treatment will require a set up to be ready, such as machine position, extensions, wires plastic covers, goggle's for the team and patient, surgical sites protections, and proper infection control protocol (Figure 11). [14]

The dental gingival relation describes the maxillary teeth height, width, shape, and alignment status in relation to the gingival envelope. This can never be satisfying unless it was reflected in a beautiful smile [1, 2]. Therefore, a specialized restorative dentist should evaluate the case to verify the needed consultation and intervention, which can vary from simple odontoplasty, placing veneers, crowns, orthodontic treatment, or even extraction, alveolar bone reconstruction and implant-based rehabilitation (Figure 12).[15-17] Hence, teamwork is always the key to reach the best dento-gingival relation to provide a satisfying smile. This can be clarified through two examples, the first one illustrating the role of the oral and maxillofacial surgeon to evaluate a poor alveolar bone supporting the gingival tissue that requires alveolar reconstruction in horizontal and/ or vertical dimensions before prosthetic rehabilitation. [17] The second example illustrates the role to manage patients with short lip and vertical maxillary excess that will never be managed properly if crown-lengthening procedure was only performed. Such a case will require a LeFort 1 surgical procedure to reposition the maxilla superiorly first. [5, 12]

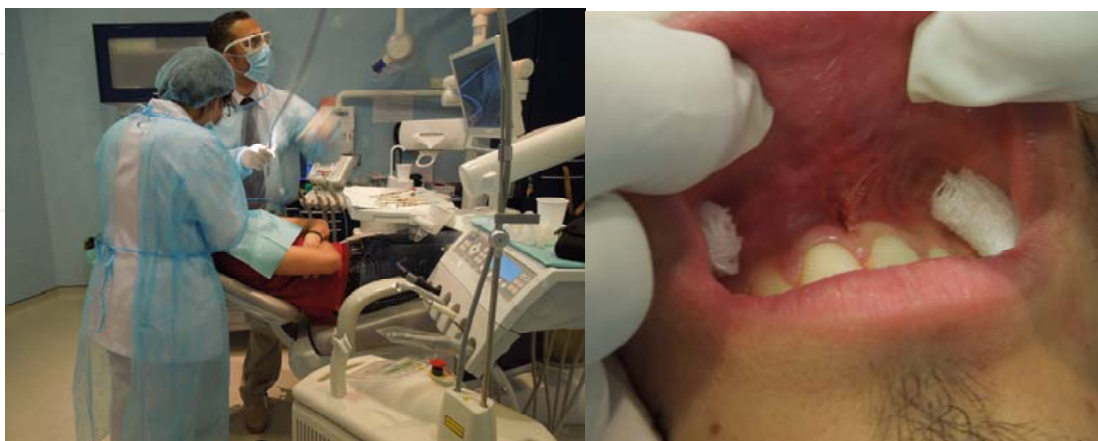


Figure 11. Showing the laser setup in the dental office as well as surgical site preparation for laser assisted labial frenoplasty.

The indication for crown lengthening is: cases of satisfying harmony of the upper lip height and maxillary bone relation, healthy dentition and periodontium but with poor dentogingival relation such as gingival overgrowth or poor architecture. It is used as well to optimize the restorability of the coronal portion of teeth. [14, 15]

The advantages: done under office local anesthesia, can be done using a laser for less bleeding and better postoperative recovery.

The disadvantages: Asymmetry, might require re-treatment to remove more gingival tissue or/ and bone, gingival recession, discomfort that lasts for few days. [14, 15]

4.4.1. Case presentation

A young male patient referred complaining of unesthetic anterior maxillary teeth. On clinical and radiographic evaluation, the patient had a poor dentogingival relation of the anterior maxillary teeth, poor crown shape, color and texture. The patient was presented to the team which advised a multi-step intervention starting from proper planning to restore the eight anterior teeth after a crown lengthening procedure using laser therapy (Figure 12).



Figure 12. The picture on the left showing poor dentogingival relation of the anterior maxillary teeth. The right figure is showing the poor alveolar crestal bone relation to the first maxillary right crowned incisor, which looks short and misshapen. Those poor relations lead to esthetically non-balanced anterior maxillary teeth.

4.5. Internal smile procedures (patient's personal satisfaction)

Some patients can be unsatisfied with their smiles regardless of the type of treatment planned. Unless the operator figures out the exact factor contributing to the problem treatment will not really work. To provide examples, patients might be looking for cheek, lip, or chin piercing as the major key factors to their internal satisfaction while others, regardless of the procedures performed on their teeth, a single cheek dimple may be the change that the patient desires. And once that left cheek dimple procedure is performed, self-satisfaction is reflected positively on the actual smile (Figure 13). [18]



Figure 13. The patient had the desire to get a dimple on the left cheek that made her satisfied with her smile. The post-operative picture on the right side indicates a more pleasant smile.

Another situation, is where patients can have acceptable jaw skeletal relations, however, microgenia (small chin bone) or macrogenia (large chin bone) reduces their self-satisfaction of their smiles (Figure 14). Such chin deformities can be treated with genioplasty, chin augmentation or chin reduction procedures [2, 5, 7, 9, and 13].



Figure 14. Although the patient presented with what looks like a retruded lower jaw (left), his occlusion is in an acceptable relation, that clarifies that the defect is mainly at the chin level, microgenia (right).

5. Conclusion

In conclusion, this chapter presents the major components of a “smile” from the anatomical aspect as well as the evaluation methodology. A multi team approach can provide the best evaluation and management plan. Hence, the term “Smile Team” is appropriate to be embraced in the medical and dental professions.

The trick is always the proper diagnosis, treatment plan, and best implementation of one or more of the treatment modalities.

6. Recommendations

It is recommended that dental students, medical students, general practitioners, and residents dealing with the facial complex consider applying training rotations at the involved specialty departments in order to get a clear exposure to the capabilities of each specialty. Such will help expanding their skills in treatment planning and seeking interspecialty care. As well, it should be noted that dealing with smiles is considered to be a very challenging task at every step of treatment, hence, managing teeth in the anterior maxillary zone with veneers, placing dental implants, or lips enhancement procedures should always be approached with caution and perhaps under the supervision of specialized providers.

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