International Journal of Advanced Engineering Research and Science (IJAERS)
Peer-Reviewed Journal
ISSN: 2349-6495(P) | 2456-1908(O)
Vol-8, Issue-11; Nov, 2021
Journal Home Page Available: https://ijaers.com/
Article DOI: https://dx.doi.org/10.22161/ijaers.811.43

Gingivectomy for smile aesthetics

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Received: 21 Sept 2021,

Received in revised form: 09 Nov 2021,

Accepted: 18 Nov 2021,

Available online: 30 Nov 2021

Keywords*— *Aesthetics, Gingivectomy, Smile.

***Abstract*—** *Gingival appearance plays an important role in smile aesthetics and may influence the individual's relationship in society. In search of a standard of beauty stereotyped by the media, the demand for patients is growing in dental offices. Currently, professionals in the field suggest the anatomization of the smile through surgical techniques used accordingly, with each etiology and diagnosis. Gingivectomy presents itself as an ally for this anatomization, making the removal of hyperplastic gingival tissue, as well as providing a physiological contour of this gingiva. The present study aims to carry out an integrative review of the scientific evidence related to gingivectomy for smile aesthetics. The methodology used was an integrative review, with a qualitative approach, whose data collection was carried out in August and September 2021, developed in six stages. In the first stage of the study, 316 articles were found, which referred to gingivectomy for smile aesthetics. After reading the titles of selected articles, 112 articles were selected. After reading the abstracts, only 59 studies were selected to be included in the critical and full reading. Finally, 14 studies met the inclusion criteria. Studies have shown that new technologies in the field of dental aesthetics have made gingivectomy a simple solution for gum repair. The benefits are many, especially to improve the prognosis of patients with periodontal disease or tooth decay. It is a dental treatment to make the gummy smile disappear with 100% effectiveness.*

I. INTRODUCTION

The main common objective of the various types of dental specialties is based on the restoration of health and the aesthetic and masticatory function of a patient. Today, however, people often seek dental treatment for aesthetic reasons, forcing professionals to find ways to achieve more harmonious and symmetrical smiles, in order to ensure satisfactory rehabilitation (KATO et al., 2019; TURCATO; PERUFFO, 2019 ; REDDY et al., 2019).

The factors normally involved in the aesthetic consideration of a smile are related to the lips, position, size, shape and color of the teeth, as well as the proximity between the gingival tissue and the teeth. Other factors associated with esthetics are related to health, tooth discoloration, proper gingival morphology and contours, all considered essential for an attractive smile. Among the various disorders that can compromise the aesthetics of the smile are gingival excess or exacerbated gingival exposure, a condition known as gingival smile (ÖNKÜ et al., 2017; SEKER; AKDEMIR, 2020).

Gummy smile is recognized by the American Academy of Periodontology (AAP) as a deformity and mucogingival condition that affects the area around the teeth. Allen in 1998 stated that gingival exposure less than 2-3 mm can be considered attractive, with overexposure (> 3 mm) being generally considered unattractive and known as gummy smile, which is generally considered an aesthetic problem. However, the perception of excessive gingival exposure is

also subject to cultural and ethnic preferences. In some European countries, gingival exposure of up to 4 mm or more is acceptable, while exposure greater than 2-3 mm is considered ugly in the USA (BATISTA; PINTO, 2020; PEREIRA FILHO et al., 2020).

The main etiological factors related to gummy smile involve gingival (altered passive eruption), skeletal (excess vertical maxillary), and muscular (upper lip hyperfunction) characteristics. Altered passive eruption occurs when the periodontal complex does not migrate apically towards the cementoenamel junction, covering part of the clinical crown, resulting in short teeth. This coverage can present esthetic complications, especially in patients with a high smile line. The prevalence of gummy smile is 10% in the population aged between 20 and 30 years, being more common in women than in men (HORTKOFF et al., 2017; TURCATO; PERUFFO, 2019).

Some consequences of this alteration are the short clinical crown and excess gingival tissue. For the diagnosis and planning of altered passive eruption, some authors suggest the association of radiographic analysis, transgingival probe measurement and, more recently, the use of cone beam computed tomography. The therapeutic procedure will depend on the etiology and severity of the case, which may indicate the removal of excess and remodeling of the gingival tissues. The gingivectomy procedure is indicated when there is a need for remodeling only the gingival tissues, when the elements are partially open with the crown. When the bone level is adjacent to the cementoenamel junction or even covering it, gingivectomy is performed together with the osteotomy. In these cases, surgical techniques to lengthen the clinical crown can effectively resolve aesthetic problems (KATO et al., 2019; TURCATO; PERUFFO, 2019; REDDY et al., 2019).

The aim of this study was, therefore, to carry out an integrative review of the scientific evidence related to gingivectomy for smile esthetics.

II. LITERATURE REVIEW

2.1 ETIOLOGY

According to the literature, gingival smile can be defined as a state in which the smile line moves apically beyond the anteroposterior teeth, causing excessive exposure of the maxillary gingiva during the smile. The main etiology of gingival growth is bacterial plaque and tartar, indicative of poor oral hygiene. Other general factors include the use of certain medications known for their hyperplastic effects. These drugs include cyclosporine A used as an immunosuppressive agent in transplant patients to prevent tissue rejection and phenytoin prescribed for people with epilepsy (BATISTA; PINTO, 2020; PEREIRA FILHO et al., 2020).

Hormonal imbalances, such as pregnancy and puberty, as well as certain hematological conditions, such as leukemia, may be responsible for the genesis or worsening of gingival enlargement. Etiologies can vary widely and various elements can interact while smiling. These elements involve the labial, dental and gingival components of the smile and the dynamic relationships between them; not only lip length, but also activity, clinical crown size, dentoalveolar extrusion and excessive vertical maxillary height are the main causes (HORTKOFF et al., 2017; TURCATO; PERUFFO, 2019).

Healthy gingiva is represented by specific clinical features such as pale pink color, dull and dotted surface, firm and resilient consistency, volume dependent shape and gingival contour with a thin margin and ending against the tooth like a knife blade. When submitted to periodontal probe, its depth can vary from 1-3 mm and should not present bleeding in this exam (BATISTA; PINTO, 2020).

Hyperplasia resulting from failure of oral hygiene is one of the most common complications related to gingival enlargement, since the accumulation of biofilm from food debris causes the proliferation of inflammatory cells and pathogenic bacteria, causing the gingiva to present edema, reddish coloration, loose and with chances of spontaneous bleeding (ARAÚJO; BARROS, 2018; PEREIRA FILHO et al., 2021).

There are risk factors that can predispose to gingival hyperplasia, such as the use of orthodontic appliances or medications, but their development is directly linked to poor hygiene, creating space for the installation of dental biofilm, which is the etiological agent of the vast majority of periodontal problems (BRITO et al., 2016).

The implantation of dental appliances facilitates gingival inflammation and has a great influence on the oral microbiota, but these conditions can be reversed in people who have adequate oral hygiene (NUNES et al., 2020; SOUZA et al., 2021).

The presence of periodontal pockets is detected through the probing depth. For this, the level of clinical attachment of each patient is measured to analyze the periodontal biological space, which includes gingival sulcus (0.69 mm), junctional epithelium (0.97 mm), that is, taking into account that in the state natural presents 2 to 3 mm of healthy structure that extends from the alveolar bone crest to the gingival margin (HORTKOFF et al., 2017; TURCATO; PERUFFO, 2019).

2.2 INDICATIONS

According to several authors, the gummy smile prevails with a percentage of 10% in the age group from 20 to 30 years old and occurs much more in women than in men. Excessive gingival exposure decreases with age. As a consequence, it can offer an aesthetic aspect of a "young appearance" (BRITO et al., 2016; ORTKOFF et al., 2017; TURCATO; PERUFFO, 2019).

2.3 PREPARATION

The diagnosis of gummy smile must be accurate and based on a detailed and careful analysis of the factors and the degree of their participation in the occurrence of gummy smile. In contrast to a pleasant smile, a gummy smile is characterized by excessive gingival exposure associated with a high smile line that can be linked to several causes. These causes include abnormal tooth eruption proven by a short clinical tooth crown, short length or hyperactivity of the upper lip muscles, or excessive vertical maxillary growth (KATO et al., 2019; TURCATO; PERUFFO, 2019; REDDY et al., 2019).

The "smile line" is a parameter very commonly used to analyze and categorize a patient's smile. According to several studies on smile perception by orthodontists and laypersons, it is a valid tool to assess the aesthetic appearance of a smile and to quantify the amount of gingival exposure of a smile (BATISTA; PINTO, 2020; PEREIRA FILHO et al., 2020).

The data needed for a proper diagnosis include medical and dental histories, extraoral and intraoral clinical examinations, study models and photographs. Cephalometric analysis provides comprehensive information about craniofacial structures. However, the evaluation of the gummy smile is mainly clinical. Thus, this analysis serves to confirm possible alveolar-skeletal etiologies (SEKER; AKDEMIR, 2020).

2.4 GINGIVECTOMY

Many patients go to dental offices in search of a beautiful and harmonious smile to increase their self-esteem. Currently, there is a great search for oral aesthetics, where the smile harmony is determined not only by the shape, position and color of the teeth, but also by the gingival tissue, which can be corrected with surgical techniques such as gingivectomy (HORTKOFF et al., 2017 ; TURCATO; PERUFFO, 2019).

Gingivectomy is an easy-to-perform technique and generally well accepted by patients, who, according to the correct indications, can obtain satisfactory results in terms of esthetics and dentogingival harmony. The procedure consists of removing the gingival deformities resulting in a better gingival contour, which can be performed by removing the inserted, papillary and marginal gingiva when there is no periodontal disease. However, it can be indicated for clinical enlargement of the crown or remodeling of thick margins, removal of hyperplasia caused by a variety of factors, or even removal of supra-osseous periodontal pockets (BATISTA; PINTO, 2020; KUMAR et al., 2015; LIONE et al., 2019; SEKER; AKDEMIR, 2020).

After gingival hyperplasia is observed, surgery is usually indicated for treatment, the ideal is always to be associated with basic periodontal therapy, and after scaling and root planning, the adequacy of the oral environment, with elimination of all outbreaks of infection, aiming at awaken the patient through oral hygiene guidelines, care and concern with oral health, this being the most important phase of treatment to obtain a healthy gingival condition (KUMAR et al., 2015; LIONE et al., 2019).

In general, surgical removal of 1 to 2 millimeters of gingival tissue resolves most cases of gummy smile, but when the gingiva in height is very significant, a more complex surgery must be performed (BATISTA; PINTO, 2020; PEREIRA FILHO et al. al., 2020).

During the surgical technique, it is possible to perform the incision with the conventional or electrosurgical scalpel (electrosurgical scalpel), although the former is the most used and most preferably among professionals, both achieving the same satisfactory aesthetic results, being a choice obtained during the treatment plan and in patient-professional harmony, for each specific case (BRITO et al., 2016; ÖNKÜ et al., 2017; SEKER; AKDEMIR, 2020).

After preparing the surgical field and oral antisepsis, local infiltration anesthesia is performed and bleeding points are marked, both buccally and lingually. To determine the bleeding points and, therefore, the gingival portion to be removed, the depth of the probe is marked with a millimeter probe with the aid of an explorer (BATISTA; PINTO, 2020).

Thus, the union of these points is performed with Kirkland gingival, the literature also describes the use of a 15c blade connected to a scalpel handle and also the use of an electric scalpel to perform this step, and for the interproximal areas it is the gingiva of Orban, and sometimes a McCall 13/14 curette can be used to remove gum tissue, dental calculi, or dental biofilm. After removing the gingival collar, gingivoplasty is performed with Kirkland gingivectomy and cuticle pliers at the surgical site, in order to improve esthetics, favoring tissue repair and restoring the functional shape of the gingiva, which is covered with surgical cement for protection and favoring tissue repair (KATO et al., 2019; TURCATO; PERUFFO, 2019; REDDY et al., 2019).

There are also high-frequency lasers, such as the carbon dioxide laser, which can be used transoperatively to remove the gingival collar, as they have long wavelengths, are better absorbed by tissues with large extensions of water, evaporating more easily and providing the removal of the gingiva without causing deep burns, replacing the use of conventional scalpels (ÖNKÜ et al., 2017; SOUZA et al., 2021).

The carbon dioxide laser stimulates blood clotting in small vessels, allowing it to act in a controlled area, being indicated for very vascular areas and in patients where infection control is essential, as the laser has the ability to transform an area contaminated or infected in a sterile wound, also inhibiting the formation of abnormal cells, through the lining of the lymphatic vessels, in addition to little contraction, scar formation, usually does not require surgical cementation or suture and the pain remains for a few seconds after surgery, generating little postoperative discomfort allowing the patient to return to normal activities (KUMAR et al., 2015; LIONE et al., 2019; NUNES et al., 2020).

The first step in establishing a correct diagnosis is to properly classify the gingival level, taking into account variables such as sex, age and periodontal health. The defined causes for gingival growth can be characterized by numerous factors (orthodontic reasons, maxillary growth, drug-induced, pathologies) and aggravated according to factors such as age, sex, hygiene and systemic condition of the affected patient (NUNES et al., 2020; SOUZA et al., 2021).

The side effect of conventional gingivectomy procedures is excessive bleeding during surgery. This bleeding limits the surgeon's convenience and decreases the surgical success rate. However, the conventional technique can be easily performed and a precise incision with well-defined margins can be administered with minimal damage to the lateral tissue (HORTKOFF et al., 2017; KATO et al., 2019; REDDY et al., 2019).

Electrosurgery provides excellent hemostasis during surgery, but thermal damage to surrounding tissue is one of the drawbacks. Recently, laser is used for gingivectomy due to its reduced number of patients, discomfort and better hemostasis, less postoperative pain, better patient acceptance and reduced recurrence rate. Comparison of the diode laser with conventional surgery showed that patients treated with the laser required less infiltration anaesthesia, had reduced bleeding during and after surgery, showed rapid postoperative hemostasis and improved postoperative comfort (ÖNKÜ et al., 2017; SEKER; AKDEMIR, 2020).

Healing after the gingivectomy procedure is an important factor influencing treatment success. It is known that platelets affect wound healing by integrating complex cascades among their mediators, which include several cytokines, transforming growth factors, platelet growth factors and vascular endothelial growth factors. Also, release of activated platelets and many substances that promote tissue repair. Consequently, the ability of platelets to form fibrin clots has been clinically used to promote healing. The influence of various techniques on healing is also important when choosing the gingivectomy method (KUMAR et al., 2015; LIONE et al., 2019).

III. METHODOLOGY

Integrative review, with a qualitative approach, whose data collection was carried out in August and September 2021, developed in six stages. In the first two stages, the justification, question and objective of the research were outlined. In the third stage, the Scielo, Pubmed and Lilacs databases were defined as research sources.

In the fourth stage, the inclusion criteria were: articles focused on gingivectomy for smile aesthetics, registered from January 2015 to July 2021, containing the words "gingivectomy", "aesthetics" and "smile", or in the title, abstract or keywords. In the fifth stage, a critical evaluation was carried out through a data collection script with the following information: author, year, objective, methodology and main results. In the sixth and final stage, the results were obtained, using content analysis for theoretical evaluation.

IV. RESULTS AND DISCUSSION

In the first stage of the study, 316 articles were found, which referred to gingivectomy for smile aesthetics. After reading the titles of selected articles, 112 articles were selected. After reading the abstracts, only 59 studies were selected to be included in the critical and full reading. Finally, 14 studies met the inclusion criteria, as shown in Figure 1.

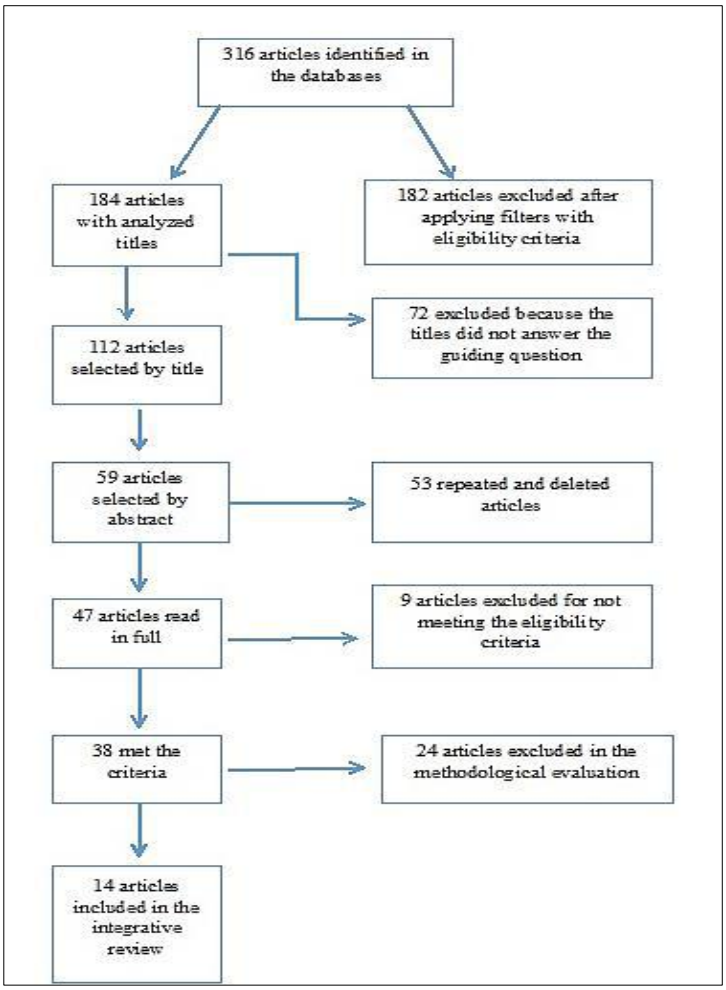

Fig. 1: Selection of studies for review.

This review comprises 14 articles published from January 2015 to July 2021. Of the selected sample, three were literature reviews, two prospective randomized studies, and nine clinical cases, as shown in Table 1.

Table.1: References used in this review.

Authors	**Year**	**Methodology**	**Objective**	**Main results**
Araújo e Barros	2018	Literature review	Establish the etiology, diagnosis and treatment, through periodontal plastic surgery, to correct gummy smile.	It is possible to restore the patient's self-esteem through periodontal surgery, however, it is necessary for the dentist to know that, sometimes, interdisciplinarity is necessary to resolve the case.
Batista e Pinto	2020	Literature review	Relate the etiology, diagnosis and technique for correcting gummy smile using gingivectomy and gingivoplasty procedures.	It is possible to restore the patient's self-esteem through periodontal surgery, being effective gingivoplasty and gingivectomy techniques to correct gummy smile, and the correct

				diagnosis and selection of the surgical technique are of fundamental importance for the success of the treatment.
Brito et al.	2016	Clinical case	To report a clinical case of a patient who exhibited excessive gingiva when smiling, having upper lip hyperfunction as the etiology.	Through clinical and photographic analysis, it was found that the association of techniques resulted in a smile harmonic and more aesthetically pleasing, with a decrease in gingival exposure during the smile from 8mm to 2mm.
Hortkoff e Copia	2019	Clinical case	To demonstrate the clinical case of a patient who presented after a gingivectomy and gingivoplasty surgery gingival necrosis in the tooth area 21.	The case led to the search for a solution for necrosis where the treatment was conservative without exposing the patient to a gingival esthetic defect and implied the development of a clinical protocol, highlighting measures to be taken in case of post-gingivectomy complications.
Kato et al.	2019	Clinical case	Clarify the process of replacing junctional epithelium (EJ) with oral gingival epithelium (EGO) cells using a green fluorescent protein (GFP) positive dental germ transplantation method.	GFP-positive EJ was partially replaced by EGO cells and completely replaced on day 200 after transplantation, whereas there was no difference in integrin β4 (Itgb4) and laminin 5 (Lama5) expression between EJ before and after replacement by EGO cells.
Kumar et al.	2015	Prospective randomized study	Assess whether laser has any advantage over electrocautery in performing gingivectomy procedures.	Both techniques, with adequate adhesion to safeguards, can be used to remove gingival growth with equal efficiency and wound healing ability. There is no advantage of diode laser over electrocautery in performing gingivectomy.
Lione et al.	2021	Clinical case	To compare the use of diode laser with conventional surgery, evaluating the effectiveness of gingivectomy as an adjunct to non-surgical periodontal treatment in the management of gingival enlargement	Adjuvant use of scalpel gingivectomy and laser gingivectomy was more effective in controlling gingival inflammation than non-surgical periodontal treatment alone at 1, 3, and 6 months. In the control group, greater improvement in periodontal parameters was seen within 3 months, depending on a

			during orthodontic treatment.	self-care approach to managing gingival enlargement.
Nunes et al.	2020	Clinical case	To report a clinical case of correction of gummy smile associated with the eruption passive altered through gingivectomy in internal bevel and osteotomy with reverse planning and aided by a surgical guide developed to facilitate the technique, where the OHIP and VAS questionnaire was done to assess the improvement in quality of life and pain in the post- operative.	Knowing that aesthetics is closely linked to The individual's quality of life is essential to employ predictable planning, using techniques such as diagnostic wax-up and surgical guidance, which provide a more reliable procedure.
Önkü et al.	2017	Clinical case	Compare the use of 940 nm diode laser with conventional surgery in the treatment of soft tissue in gingivectomy procedures in terms of patient satisfaction.	This study shows that the diode laser has a great advantage over conventional surgery in gingivectomy procedures.
Pereira Filho et al.	2020	Clinical case	To discuss the results of the clinical crown augmentation procedure for aesthetic purposes, presenting two clinical cases of patients with gingival hyperplasia and altered passive dental eruption.	To perform the gingivectomy, several factors must be analyzed prior to the procedure, including aesthetic factors, biotype periodontal, the cause of the alteration and the need or not for osteotomy.
Reddy et al.	2019	Prospective randomized study	Compare the effectiveness of LLLT, Gengigel and Hiora SG gel post-gingivectomy.	Gengigel performed better than Hiora SG gel, both clinically and histologically, being close to the laser group. However, many more studies with a larger sample size need to be done to assert the benefits of LLLT and Gengigel, as noted in this study.
Seker e Akdemir	2020	Clinical case	Evaluate the effect of non-thermal atmospheric pressure plasma (NTAPP) on gingival wound healing.	NTAPP increases epithelialization and stimulates wound healing after gingivectomy and gingivoplasty. However, further clinical studies with larger sample sizes are needed to

				determine the exact benefits of NTAPP for the healing of gingival wounds.
Souza et al.	2021	Clinical case	To report a case of gingival asymmetry correction using the gingivectomy technique with minimal osteotomy traumatic.	When correctly indicated and performed, the technique of gingivectomy with osteotomy only via the sulcular route, using a periodontal chisel, without flap elevation, is effective in correcting asymmetries in the anterior teeth.
Turcatto e Peruffo	2019	Literature review	Discuss the use of periodontal plastic surgery, by gingivectomy and gingivoplasty techniques, for harmonizing the gummy smile, also addressing aspects of etiology, diagnosis and proper treatment for such situations	Gingivectomy and gingivoplasty are minimally invasive surgical techniques for correction of the gummy smile, easy to perform, presenting immediate and predictable results, but which depend on the professional's theoretical and practical knowledge to achieve an aesthetic and functional result.

Most professionals share the opinion that a beautiful smile is harmonic is influenced by the dentogingival relationship, in this sense, they start from the ideathat the upper lip must be located at the same level as the tissue margingingival of the dental elements called maxillary central incisors.There may also be a small part of the gum on display, as you understandthis denotes a younger appearance (SOUZA et al., 2021).

It is important to assess the patient's esthetic expectations and show the possible therapeutic solutions that fit the patient. Studies have revealed that botulinum toxin is considered one of the minimally invasive, quick and accessible modalities that can replace extensive surgical procedures for correction of severe gummy smile (ARAÚJO; BARROS, 2018; REDDY et al., 2019). In the essay by Brito et al. (2016), the association of treatments in this clinical case – surgery periodontal plastic surgery and application of botulinum toxin type A – achieved a very satisfactory result, as it instituted esthetic correction through less gingival exposure in the patient's smile and speech. The option for isolated treatments could not culminate in the excellence of the achieved result.

Gingival enlargement is a condition that commonly develops during orthodontic treatment. Orthodontic appliances are irritation and plaque retention factors that impede oral hygiene and control of gingival inflammation. Studies of gingival hypertrophy in young people undergoing orthodontic treatment with fixed appliances are described and treated by gingivectomy. This surgical procedure generated morphological conditions of the gingiva allowing better control of the plaque and the ongoing orthodontic treatment. Periodic controls in children and adolescents are necessary for a healthy periodontium during orthodontic therapy. Collaboration between orthodontists and periodontists is one of the most important keys to treatment success (PEREIRA FILHO et al., 2020; TURCATTO; PERUFFO, 2019).

Secker and Akidemi (2020) point out in their studies that enlargement of the clinical tooth crown, correction of interproximal craters, removal of high and thick margins, in addition to elimination of gingival growth due to hormonal factors, use can be considered as indications for gingivectomy. of drugs or due to the accumulation of dental biofilm. However, for Önkü et al. (2017), when there is an intention to remove supraosseous periodontal pockets, there is an indication for gingivectomy, but, in this case, gingivoplasty is contraindicated for this purpose.

Several studies have shown that LLLT has a beneficial effect on pain reduction. The results of the study by Kumar et al. (2015) showed that the mean pain score in the test group was comparatively lower on the 3rd postoperative day, on the 7th postoperative day and at the end of 1 month than the control group. These results explain the positive effect of LLLT on the patient's pain response after scalpel

gingivectomy. Patients in the test group that has LLLT experienced significantly less postoperative pain compared to the control group. Based on the results of Reddy et al. (2019), it can be concluded that LLLT using 940 nm diode laser at an energy density of 4 J/cm 2 as an adjunct to the scalpel gingivectomy procedure can be used to reduce postoperative pain and discomfort and assist in better wound healing. However, Kumar et al. (2015) emphasize that it is necessary to establish effective laser application protocols, allowing this new therapy to be used in periodontology and bringing more comfort to patients. Further studies should be conducted along with several other surgical procedures to assess the effect of adjunctive use of LLLT on wound healing and patient response.

V. CONCLUSION

Studies have shown that new technologies in the field of dental esthetics have made gingivectomy a simple solution for gum repair. The benefits are many, especially to improve the prognosis of patients with periodontal disease or tooth decay. It is a dental treatment to make the gummy smile disappear with 100% effectiveness.

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