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SUBJECTIVE EVALUATION OF THE OBTAINED AESTHETICS AFTER LASER-ASSISTED CROWN LENGTHENING IN THE FRONTAL MAXILLARY AREA

СУБЈЕКТИВНА ЕВАЛУАЦИЈА НА ДОБИЕНАТА ЕСТЕТИКА ПО ЛАСЕРСКИ АСИСТИРАНО ПРОДОЛЖУВАЊЕ НА КЛИНИЧКАТА КОРОНКА ВО ФРОНТАЛНАТА МАКСИЛАРНА ОБЛАСТ

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Abstract

Introduction: Crown lengthening in the frontal aesthetic areas involves the removal of misaligned gingival tissue and the restoration of its margins to meet aesthetic standards. The use of lasers can significantly simplify this procedure. Giving the growing demand for aesthetically pleasing smiles and the benefits offered by laser technology, this study aimed to assess the aesthetic impact of laser-assisted crown lengthening in the upper frontal region. **Material and method:** The study involved 35 participants. To fulfill the study's AIM, a comprehensive questionnaire was developed to collect subjective evaluations of the aesthetic results from patients who received prosthetic restorations. Additionally, a portion of the questionnaire was completed by the dentists who performed the procedures to evaluate the aesthetic outcomes. **Results:** Over ninety percent of participants indicated that the restorations led to an improved aesthetic effect. A significant number of patients reported a notable enhancement in aesthetics, while an equal proportion of clinical practitioners assessed the improvements as either significant or moderate. **Conclusion.** The findings of this study suggest that the use of lasers in clinical crown lengthening procedures results in a substantial enhancement of aesthetics, as perceived by both patients and dentists. **Keywords:** aesthetics, aesthetic effect, crown lengthening, laser-assisted crown lengthening.

Апстракт

Вовед. Процесот на продолжување на клиничката коронка во фронталните естетски зони вклучува отстранување на неправилно поставеното гингивално ткиво и враќање на неговите маргини во согласност со естетските стандарди. Употребата на ласери значително го олеснува овој процес. Со зголемената желба на пациентите за естетски привлечни насмевки и предностите што ги нуди ласерската технологија, оваа студија имаше за цел да ја процени естетската вредност на ласерски асистираното продолжување на клиничката коронка во горната фронтална регија. **Материјали и методи.** Студијата вклучи 35 испитаници. За да се исполни целта на истражувањето, беше изготвен детален прашалник со кој се собираа субјективни евалуации за естетските резултати од пациентите што добија протетски реставрации. Дополнително, дел од прашалникот беше пополнет од стоматолозите што ги изведуваа интервенциите за да ја проценат естетската вредност на добиените резултати. **Резултати.** Повеќе од деведесет проценти од испитаниците изјавија дека реставрациите довеле до подобрен естетски ефект. Значителен број од нив пријавиле забележливо подобрување на естетиката, додека идентичен процент на стоматолози го оцениле подобрувањето како значително или умерено. **Заклучок.** Резултатите од оваа студија укажуваат дека употребата на ласери при продолжување на клиничката коронка резултира со значително подобрување на естетиката, како што е перцепирано и од пациентите и од стоматолозите. **Клучни зборови:** естетика, естетски ефект, продолжување на клиничка коронка, ласерски асистирано продолжување на клиничка коронка.

Introduction

Clinical crown lengthening in aesthetic zones typically requires the removal of misaligned gingival tissue and the reshaping of the gingival margins to align with aesthetic expectations. However, in certain cases where it is essential to excise the alveolar bone ridge near the cementoenamel junction, as merely removing the gingival tissue may not adequately preserve the desired length over time. Some studies suggest that minimally invasive techniques

for crown lengthening, those that avoid flap elevation and incorporate osteotomy, are as effective as those that utilize mucoperiosteal flap lifting, while also presenting fewer complications[1].

A comprehensive understanding of gingival form, position, and contour are essential to understanding gingival architecture. The gingival margin is crucial in determining the shaping the gingiva as observed from the anterior view of the tooth. Several factors influence this architecture , with the primary consideration being that the gingival margins of the central incisors should be aligned at the same level, forming an arch that follows the contours of the enamel-cementum junction. Moreover, the gingival margins of the canines should match the level of the central incisors. It is also important that the gingival margins of the lateral incisors are approximately 1.0 to 1.5 mm shorter than those of the canines and central incisors. This configuration results in a variation in the heights of the gingival margins, which contributes to its overall shape. The contour of the gingiva is defined as the portion of the gingival architecture that runs parallel to the tooth surface. If the gingival shape is altered without proper contouring, it may result in a relapse of the condition[2].

Osteotomy is often required to achieve an optimal aesthetic outcome during crown lengthening procedures. In addition to traditional rotary instruments, this procedure can also be done by using piezoelectric ultrasonic devices or laser technology. The piezoelectric device is particularly advantageous as it can excide bone tissue while preserving the integrity of the root surface, making it a potentially ideal choice for crown lengthening without necessitating osteotomy.

As laser technology becomes more prevalent, its application in these procedures is expected to become essential. Laser assisted interventions offer numerous advantages for patients, including a reduction in postoperative complications, a shortened recovery period, minimized trauma during the procedure, and often the possibility of performing the interventions without anesthetics. Furthermore, lasers enhance the visibility of the surgical field by decreasing bleeding, which is crucial for efficient intervention. The establishment of sterile conditions during and after the surgery, the likelihood of complications and infections is significantly reduced[3].

The primary indications for undertaking clinical crown lengthening include the presence of short clinical crowns, the necessity for additional tooth structure to support mechanical restorative interventions, and biological factors aimed at preserving the biological width and preventing subsequent attachment loss around the restored tooth. In addition to providing sufficient dental structure for effective and biologically appropriate restorations, crown lengthening is also performed for aesthetic enhancement[4].

To achieve optimal aesthetic results, it is recommended to conduct procedures in a gradual manner, particularly when utilizing laser technology. Typically, the most favorable results are obtained by initially treating one half of the dental arch, thereby establishing ideal gingival contours-such as contour height and smooth transitions of angles-before proceeding to the opposite side. This approach not only allows for the completion of the entire procedure within a single visit but also eliminates the necessity of re-treating previously laser-treated tissue that may have dried out due to vaporization. The objective of various crown lengthening procedures can include:

- Revealing adequate, robust, and healthy tooth structure in instances of deep fractures located in the subgingival area or the presence of carious lesions in that same region.
- Enhancing the stability, retention, and longevity of different types of restorations.
- Ensuring the correct positioning of the marginal edges of restorations while preserving the biological width.
- Achieving improved aesthetics for patients with irregular gingival margins and excessive gingival overgrowth[5].

It is essential to recognize that this procedure is not only feasible but also delivers satisfactory results in terms of both functionality and aesthetics when performed according to the designated therapeutic plan. The increasing number of patient inquiries regarding clinical crown lengthening, along with the significant advantages that lasers provide for this type of procedure, has motivated to pursue their combined application.

Our objective was to evaluate the achieved aesthetic effects by patients undergoing laser-assisted clinical crown lengthening of the frontal teeth, as well as their appropriate restorative care.

The aesthetic evaluation of a smile is significantly influenced affected by the vertical positioning and angulation of the upper anterior teeth. This influence, however, can be perceived differently by various groups, including the general population, dental students, practitioners of dental medicine, and specialists in other areas of dentistry. The ultimate goal of dental treatment encompasses not only the restoration of normal anatomical and morphological characteristics and functions of the teeth but also the enhancement of aesthetic appeal for patients. Beauty, as a concept, resists quantification due to its dependence on a variety of factors and its variability across different cultures, nationalities, and religious traditions.

The aesthetic harmony between the teeth, lips, and gingival tissue may be disrupted by gingiva that is healthy yet inadequately positioned. As such, the aesthetics of the gin-

giva are heavily influenced by the contour progression, known as the gingival zenith, from the central incisor to the canine, which should ideally follow a parabolic curve[6].

In conventional aesthetic crown lengthening procedures, the gingiva is surgically reshaped with a scalpel, while bone is removed using a rotary instrument by creating full-thickness mucoperiosteal flap. This method is often intensive, requires suturing, and is often perceived as intimidating, particularly for patients with dental anxietyA laser is an apparatus that generates concentrated light aimed at a specific point over considerable distances. The primary distinction between laser light and conventional light lies in the properties of laser light, which is characterized as monochromatic, coherent, and parallel. In contrast, ordinary white light comprises multiple colors, with waves that are neither synchronized nor parallel, resulting in refraction of its rays[8]. These three fundamental attributes enable the application of lasers in the fields of medicine and dentistry. The advantages of utilizing lasers are extensive, with the most notable being precision and enhanced therapeutic outcomes compared to traditional dental procedures. However, a comprehensive understanding of this therapeutic instrument is essential to mitigate potential side effects and to maximize the intended benefits. The 2940 nm wavelength of this laser corresponds to the peak absorption in water molecules, which is significantly greater-fifteen times higher than that of the carbon dioxide laser and 20,000 times higher than the Nd:YAG laser[9]. Additionally, the laser light produced is optimally absorbed by hydroxyapatite. Consequently, it can be inferred that this laser type is effective not only in the removal of dentin and enamel with minimal and mild side effects, such as thermal damage to the dental pulp, but also in treating soft tissues within the oral cavity, making it suitable for clinical crown extensions[10]. Based on its effective absorption in both water and hydroxyapatite, numerous studies have demonstrated the efficacy of this laser in ablating hard and soft tissues during interventions, as well as its bactericidal properties, which contribute to reduced or absent pain sensations during clinical applications, thereby highlighting the numerous benefits associated with this laser technology. Research into its various potential applications continues, reflecting an increasing interest among dental professionals worldwide.

Aim

Considering the increasing demand for aesthetically pleasing smiles among patients, coupled with the significant benefits of utilizing laser technology for dental crown extensions, this study aims to evaluate the aesthetic effects of prosthetic rehabilitation. This assessment is based on perspectives of both the patients who received laser-assisted crown extensions in the upper anterior region and the clinicians involved in the treatment process.

Material and methods

The research sample consisted of 35 respondents, including 13 males (37.14%) and 22 females (62.86%). The average age of participants was 31 years. The study was carried out across four private dental practices, employing a total of 10 dentists, located in Skopje (two practices), Bitola, and Gevgelija, within the Republic of North Macedonia. Among the dentists involved, three were specialists: two in orthodontics and one in periodontology. The research was conducted from August to November 2022.

Each participant received an indication for tooth crown lengthening and provided verbal consent to partake in the study. To achieve the aim of this study, a comprehensive questionnaire was utilized to identify the motivations for these interventions, the types of prosthetic restorations applied, and the patients' subjective evaluations of the aesthetic outcomes. Additionally, part of the questionnaire was completed by the dentists who performed the procedures, focusing on the used lasers and their assessments of the aesthetic results of the prosthetic restorations.

Statistical analysis was performed utilizing the software Statistics 7.1 (SPS 7.1), which is specifically designed for statistical processing. In the context of descriptive statistics, the following analytical methods were applied:

1. For numerical data series, the standard deviation (±Stand.dev.) and the 95.00% confidence interval (±95.00% CI) were established, alongside the determination of the minimum and maximum values of the parameters analyzed;
2. For non-numerical data series, the percentages representing the structure were calculated.

Results

The total number of participants in this study is 35, each of whom underwent laser-assisted clinical crown lengthening. The data analyzed from the entire sample indicated that the average age of the participants is 31.142 ± 6.049 years, with the youngest patient being 20 years old and the oldest at 44 years. Following the data analysis, it is evident that the examined group is predominantly composed of females (62.86%) compared to males (37.14%).

Patients identified aesthetic reasons as the most prevalent motivation for this intervention, representing 77.14% of cases, followed by prosthetic needs at 11.43% and orthodontic considerations at 8.58%. The least frequent reasons were associated with various periodontal diseases, which accounted for 2.85% (Table 1.).

Table 1. Reasons for performing laser-assisted crown lengthening

Reasons	No	%
Aesthetic	27	77.14 %
Orthodontic	3	8.58 %
Prosthetic	4	11.43 %
Periodontal	1	2.85 %

Table 2. Lasers used for laser-assisted crown lengthening

Laser type	No	%
Diode	16	45.71 %
Er:YAG	19	54.29 %
CO_2	0	0 %

Table 3. Type of restoration

Type of restoration	No	%
Metal-ceramic	3	8.57%
Metal-free	10	28.57%
Porcelain veneers	7	20%
Composite veneers	15	42.86%

In everyday dental practice, a variety of laser devices with different wavelengths are available, each affecting tissues in unique ways. The E r :YAG laser was the most commonly used for laser-assisted clinical crown extension, utilized in 54.29% of cases, while diode lasers accounted for the remaining 45.71%. No other types of lasers were reported among the participants in this study (Table 2.).

Upon analyzing the data, it was observed that a significant majority of the participants, specifically in 57.14%, prosthetic devices were done, whereas 42.86% had received composite restorations, including composite veneers (Table 3.). Regarding the types of prosthetics, metal-free crowns were the most prevalent, being utilized by 28.57% of the subjects, which accounts for 50% of those with prosthetic restorations. Porcelain laminates were reported in 20% of the subjects, representing 35% of individuals with prosthetic restorations, while metal-ceramic products were found in 8.57% of the subjects, equating to 15% of those with prosthetic restorations.

More than 90% of the respondents in the survey indicated that the restorations implemented after the intervention contributed to a better aesthetic result. In contrast, 5.72% of the participants felt that the restorations did not result in any noticeable change in aesthetic quality. Additionally, one individual, making up 2.86% of the subjects, mentioned that the aesthetic restoration applied to the tooth subjected to the intervention led to a worsening of its aesthetics (Table 4.).

Table 4. Influence of restorations on the aesthetic effect

Influence	No of subjects	%
Improved aesthetic effect	32	91.42 %
Worsened aesthetic effect	1	2.86 %
No influence on aesthetics	2	5.72 %

Table 5. Staging of aesthetic effect by the respondents

Staging	No	%
considerably improved aesthetics	18	56.25 %
moderately improved esthetics	12	37.5 %
satisfactory improved aesthetics	2	6.25 %

Table 6. Staging of the aesthetic effect by clinicians

Grading	No	%
significantly improved aesthetics	14	43.75 %
moderately improved aesthetics	14	43.75 %
satisfactorily improved aesthetics	4	12.5 %

For those respondents who subjectively felt that their aesthetic appearance had improved due to the restorations applied to their teeth following the laser-assisted crown lengthening procedure in the anterior maxillary region, an additional question was posed regarding the level of aesthetic improvement. The majority, representing 56.25%, indicated a significant enhancement in aesthetics. A smaller proportion, at 37.50%, reported a moderate improve-

ment, while only 6.25% stated that their improvement in aesthetics was minimal or satisfactory (Table 5.).

The evaluation of the aesthetic outcomes achieved by the patients was conducted by the clinicians, relying on their subjective assessments. Consequently, an identical proportion of clinical doctors reported observing a significant improvement in aesthetics as well as a moderate enhancement, with both categories representing 43.75% of the total. In contrast, twice as many doctors, in comparison to the patients' self-assessments, indicated that the aesthetic improvement was merely satisfactory, accounting for 12.50% of the overall number of clinicians.

Discussion

This study investigates the types of prosthetic devices used for the teeth involved in this intervention. A key aspect of this research is the evaluation of the aesthetic effects achieved through the laser procedure in combination with prosthetic restoration.

While the existing literature provides comprehensive information on the aesthetic outcomes associated with clinical crown lengthening and highlights the various benefits of utilizing lasers in these procedures, there is insufficient information regarding the aesthetic impact of combining these two elements, specifically in the context of laser-assisted clinical crown lengthening of teeth.

Comparing the findings of this study with other similar research endeavors presents significant challenges. This complexity arises mainly from the limited number of participants in most published studies, coupled with the diverse variations in research methodologies and criteria employed across different investigations. Furthermore, the subjective influences of both patients and physicians contribute to this difficulty. Additionally, there is a notable scarcity of published data on this topic within the national context.

The aesthetic technique for extending the clinical crown of teeth may be carried out using either traditional surgical methods with a scalpel or laser technology. The advantages of employing lasers for such procedures are notable, including their accuracy, the ability to sterilize the treatment area, a bloodless surgical and recovery process, the absence of sutures, diminished pain and swelling, and a more favorable prognosis for the results. Furthermore, laser procedures are significantly more efficient than conventional surgical methods.

The impairment of biologic width is correlated with long-standing chronic gingival inflammation, often resulting in spontaneous tissue regrowth within approximately three months[11]. Enhanced soft tissue regrowth is particularly evident in groups that received laser gingivectomy and electrocautery gingivectomy. According to Antenucci's findings, the application of laser techniques in soft tissue management optimizes the health and healing processes of oral tissues in a manner that is minimally invasive[12].

The assessment of aesthetic results in restorations is inherently subjective, which undermines the reliability of this study, especially given the lack of objective measures. However, since aesthetic values are personal and significantly influenced by patient needs, the study retains its importance if patients themselves recognize a positive outcome. In conclusion, dental lasers are established as a safe, rapid, and effective treatment modality that delivers outstanding results for gummy smiles. As marketing strategies improve, these treatments are gaining greater acceptance among patients[13].

Numerous research efforts have explored the various aesthetic factors influencing patients who desire enhancements in their smile aesthetics. Despite significant advancements in this area, there remains a considerable focus on studies involving female participants, who tend to exhibit a greater concern for aesthetic outcomes. It is essential to consider patients' perspectives to mitigate the risk of dissatisfaction with orthodontic interventions[14,15].

Conclusion

Based on the analysis of the collected data, several conclusions can be drawn regarding the aesthetic evaluation of the achieved following the laser-assisted extension of the clinical crown. It is noteworthy that over ninety percent of the examined sample indicated that the restorations applied after the intervention contributed to a significant improvement in their aesthetic results. Moreover, a substantial portion of the respondents assessed their aesthetic enhancement as considerable.

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