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Laser assisted crown lengthening - a multidisciplinary approach: A review

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Abstract

Crown lengthening is a resective procedure achieved by partial removal of supporting periodontal tissues to increase exposure of coronal tooth structure. It is an essential adjunctive procedure for restorative dentists for the treatment of grossly decayed or badly mutilated teeth. Crown lengthening can be best accomplished by lasers which have advantages of precision, better wound healing, less discomfort and esthetics. Cases indicated for crown lengthening in the esthetic zone requires special considerations to achieve desirable results. Implementation of proper diagnostic criteria, surgical and restorative protocols and use of lasers maximizes the predictability and success of this procedure. This article reviews the functional and esthetic demands of laser assisted crown lengthening.

Keywords: Crown lengthening, Lasers, Esthetics, Lasers vs Surgery

Introduction

Clinical crown lengthening procedure is a valuable adjunctive in almost all the specialities of dentistry.[1] This term was first coined by D.W Cohen in 1962.[2] Crown lengthening procedures are often performed to provide access for treatment of subgingival caries, fractures or defective restoration[3]. The conventional crown lengthening involves various complicated procedures which include incisions, bleeding, hemostasis, surgical packs which makes it more time consuming and less accepted[4]. The invention of lasers in dentistry with state of the art instrumentation such as a soft tissue laser may assist the clinician in maximizing predictability in the treatment zone with recreation of maximum biological width for periodontium and other supporting structures. This article discuss laser assisted crown lengthening where functional and esthetic demands are achieved.

History of lasers

LASER is an acronym for 'Light Amplification By The Stimulated Emission of Radiation'. W.R Bennet and D.R. Heriott have elaborated the first laser with helium-neon in 1961. C.K.N produced the first laser with co² in 1964. Stern and Sognnaes in 1964 identified the possible uses of ruby laser n dentistry[5]. Pick, pioneer in the area of clinical periodontal and oral surgery, in

1985 along with his colleagues reported on laser gingivectomy[6].

Indications for crown lengthening[7]:

- Gummy smile
- Esthetics
- Accessing subgingival caries
- For restorative needs
- Correction of gingival contour
- Relocation of restorative margins in relation to biological width
- For increasing clinical crown height due to wear or fracture
- Microdontia
- Functional crown lengthening:

To access subgingival caries, to increase the clinical crown height reduced by tooth wear or fracture extending subgingivally
Correcting the position of the restorative margin when there has been invasion of the biologic width

- Esthetic crown lengthening:

Correction of short clinical crowns due to wear or altered passive eruption
Creating gingival symmetry in the smile line
Correcting irregular/ uneven gingival margins
Correcting for hyperplastic tissue overgrowth

Contraindications[8]:

- Esthetic variations
- Furcation involvement is high
- Restorative space insufficiency
- Root fractures
- Variations of crown to root ratio
- Periodontal compromise
- Tooth arch relationship

Laser principles

Crown lengthening procedures exhibit a higher degree of precision which can be achieved through lasers. The technique varies from device to wavelength. The absorption of laser light energy in the tissue is directly related to the wavelength of light expressed in nanometers[9]. The greater the absorption of laser energy in the target tissue, the more ablation of the tissue. With the soft tissue of the oral cavity being approximately 70% water it is the primary chromophore (absorption of light) that is of interest for this procedure. The selection of laser depends on its effects on surrounding and adjacent tissues on the surrounding area. Incidental contact with non-target area should be avoided. The energy interaction of laser with the tissue also has a significant impact. The temporal mode of a laser refers to the timing that energy is emitted by the device which can be continuously emitted in a pulsed interval. Pulsing assists in keeping the remaining tissue from overheating. Power, often expressed in watts (W) is another main factor to regulate the amount of laser energy that interacts with the tissue. A healthy predictable outcome should be the primary objective of crown lengthening procedure which can be obtained through appropriate combination of power and proper wavelength.

Laser techniques

The bloodless nature of laser therapy enhances the clinician's visualization of tissue contours and properties during surgical treatment. This greatly reduces the patient's as well as clinician's anxiety. There are two basic techniques that can be used in a soft tissue crown lengthening procedure and the amount of tissue to be removed usually determines which technique is more appropriate[10].

When a large amount of tissue is to be removed, an excisional technique is used in which the laser is used in a manner similar to a scalpel. If small amount of tissue is to be removed an ablation technique is often preferred. With this technique the laser energy is delivered in a back and forth motion to ablate (vapourize) the tissue in small increments with each stroke. The

movement of laser handpiece is very similar in concept in using a pencil eraser to remove writing from a piece of paper. The process is continued until the appropriate tissue is removed and the desired treatment objective has been accomplished. The laser is used to make an incision and bulk volume of tissue is removed. The clinician often starts this procedure with the laser energy directed perpendicular to the long axis of the tooth, moving the hand piece back and forth until there is approximate thickness of tooth surface is removed. The laser tip is then placed in the pocket and the remaining tissue is removed with the laser energy directed away from the tooth surface. The excisional technique is almost always followed up with small amount of ablative technique to give the remaining tissue the desired contours. In excisional technique sometimes histopathological examinations are carried out and clinical findings are recorded.

Table 1: Classification of esthetic crown lengthening by ernesto[12].

Classification	Characteristics	Advantages	Disadvantages
Type I	Sufficient soft tissue allows gingival exposure of the alveolar crest or violation of the biologic width.	May be performed by the restorative dentist. Provisional restorations of the desired length may be placed immediately.	
TYPE II	Sufficient soft tissue allows gingival excision without exposure of the alveolar crest but in violation of the biologic width.	Will tolerate a temporary violation of the biologic width. Allows staging of the gingivectomy and osseous contouring procedures. Provisional restorations of the desired length may be placed immediately.	Requires osseous contouring. May require a surgical referral.
TYPE III	Gingival excision to the desired clinical crown length will expose the alveolar crest.	Staging of the procedures and alternative treatment sequence may minimize display of exposed subgingival structures. Provisional restorations of desired length may be placed at second-stage gingivectomy	Requires osseous contouring. May require a surgical referral. Limited flexibility.
TYPE IV	Gingival excision will result in inadequate band of attached gingiva		Limited surgical options. No flexibility. A staged approach is not advantageous. May require a surgical referral.

Regardless what technique is used, clinical diligence and prevention measures need to be taken to ensure that the dentition and remaining soft tissue is not inadvertently damaged in the process so that the desired outcome can be achieved[11].

Concept of biological width[13]

Biological width is always considered as a clinical guidance during periodontal restorative inter relationship cases. The concept of biological width assumes the existence of constant vertical proportion of healthy supra-alveolar soft tissues with a mean dimension of 2.0mm measured from the bottom the gingival sulcus to the alveolar crest[14]. The concept of biological width was first originated by research conducted by Gargiulo, Wentz, and Orban. It is the thedistance between the apical end of the gingival sulcus and the crest of the alveolar bone[15](Figure-1).

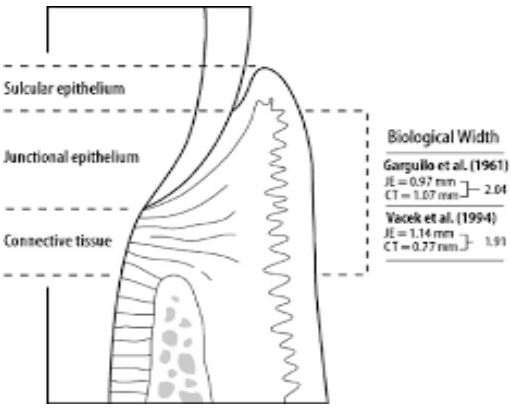

Figure 1

Violation of biological width is common occurrence in the practice of restorative dentistry when the situation of deep subgingival restoration occurs the biological width can be violated which can be dictated by external root resorption, caries or a need to increase the axial height of the tooth prepared for retention purposes. These areas can be easily affected by mechanical and hygiene practices or a chronic inflammation[13].

The biological width appears to constitute a constant feature in the human periodontium and which has been suggested as an inviolate therapeutic parameter.

Laser vs surgery

Lasers are used in conventional dental therapy for performing gingivectomy and gingivoplasty. Use of lasers results in minimal or no bleeding and adequate exposure of the tooth.

Compared to a scalpel, lasers can reshape the oral soft tissue more easily with minimal bleeding and no need for suturing[13].

Compared to a conventional scalpel, less wound contraction and minimal scarring are seen in laser use[1].

In case of a surgical therapy using scalpel[16], area around the teeth which should undergo the procedure must be sufficiently anesthetized. the initial probing depth is measured and the biological width calculations is done by transgingival probing method using William's periodontal probe[17]. After the calculations of biological width the amount of gingival tissue to be excised is demarcated to attain a proper exposure of the tooth structure an external bevel incision is preferred. A smooth surface is attained by removing left out tissue tags and granulation tissue[16,18,19,20].

In case of laser assisted soft tissue crown lengthening procedures, topical anesthetic gel was applied to the area prior to the procedure as it is a minimal invasive procedure a local anesthetic gel is sufficient. Safety procedure such as a safety glass was put on by the clinician and the patient. A diode laser with a wavelength of almost 940nms can be used after sufficient anesthesia is achieved. The laser unit comprising of 400 m disposable tip was used in a constant mode with paintbrush like strokes progressing slowly to remove gingival tissue and expose adequate amount of tooth structure. The tip is constantly checked for any debris and may be cleaned

with sterile moist gauze and physiologic gingival contour is achieved. The procedure observed emphasizes that laser can be safe and an effective alternative to crown lengthening procedures which is performed by scalpel.

Diode lasers

The diode laser is a solid state semiconductor laser that typically uses a combination of Gallium, Arsenide and other elements such as Aluminium and Indium. It has a wavelength ranging from 810 to 980 nm.

Mode of action:

Laser radiant energy interacts with tissue in many ways: reflection, transmission, scattering and absorption[7]. Initially when heat is applied on the tissue using laser beam, tissue is subjectd to warming (37C to 60˚C), welding 70 to 900˚C, vaporization 100˚C to 150˚C and carbonization 200˚C. Rapid cell vaporization with loss of intracellular fluid, chemical mediators and denaturation of intracellular substance and protein results in a less intense local inflammatory response and consequently less pain and edema[21].

Laser assisted-crown lengthening in esthetic zone

The rationale for crown lengthening procedures has progressively become more esthetic driven due to the increasing popularity of smile enhancement therapy. It is essential for clinicians to understand the diagnostic criteria, treatment planning process and biological parameters involved to determine the appropriate indications, as well as the surgical and restorative protocols that are available to enhance the potential for predictable outcomes in the esthetic zone.

Key diagnostic factors in analyzing the amount of gingival excision and bone removal:[22]

- Identifying the desired incisal edge position
- Determine an adequate clinical crown length
- Design the postsurgical gingival margin outline

Bone sounding

It is performed for esthetic crown lengthening procedures to determine the location of alveolar crest on the labial aspect and sometimes proximal areas as well. Bone sounding is utilized to determine the thickness of soft tissue layer and proximity of the alveolar bone during the planning stages of various surgical procedures. This procedure involves application of local anesthesia, a measuring instrument which is introduced into the gingival sulcus, subsequently penetrating the junctional epithelium and connective tissue attachment until contact is made with the alveolar crest[22].

A classification system[22] may be more dependent on the relationship between the alveolar crest position to the anticipated post surgical gingival margin level.

Type I aesthetic crown lengthening: characterized by sufficient gingival tissue coronal to the alveolar crest, allowing the surgical alteration of the gingival margin levels without need for osseosrecontouring. A gingivectomy or gingivoplasty procedure will usually suffice to establish the desired gingival margin position while simultaneously avoiding a violation of the biologic width.

Type II aesthetic crown lengthening: is characterized by soft tissue dimensions that allow the surgical repositioning of the gingival margin without exposure of the osseous crest. Osseous correction is required subsequent to the gingival excision, for the purpose of recontouring the alveolar crest to a level where the biologic width is re-established.

Type III aesthetic crown lengthening: bone sounding may reveal a scenario where repositioning the gingival margin will result in exposure of the osseous crest.

Type IV aesthetic crown lengthening: It is reserved for scenarios where the degree of gingival excision is compromised by an insufficient amount of attached gingiva.

Osseous crown lengthening using erbium lasers

Erbium laser allows the clinician to offer the patient a minimally invasive alternative to osseous crown lengthening so that adverse side effects associated with conventional treatment can be minimized[23]. The treatment of this type requires minimal tissue displacement which prevents swelling and the need for sutures. This procedure produces less collateral tissue damage and stable post operative margins. Because only a small intrasulcular incision is made into the gingival tissue the papillae can remain attached and the clinician does not have to make more extensive incisions to displace the tissue. The erbium laser uses a noncontact mode with a water spray for ablating the tissue, thereby minimizing the heat generation that could lead to thermal side effects[24,25].

Conclusion

Crown lengthening procedure is a valuable procedure in improving treatment outcome in the esthetic zone and an important adjunct to restorative dentistry. Laser technology helps in bridging the patient's desire, shorter healing time, less discomfort and dentist's need to follow sound biological principles and techniques to achieve the best possible and long lasting results.

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