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Current Strategies for Removal of Dental Calculus: A Review

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ABSTRACT

Periodontal therapy comprises of treatment modalities aimed at arresting the infection, restoring lost structures and maintaining a healthy periodontium. The mechanical removal of bacterial plaque and dental calculus, proves to be an effective means of altering the inflammatory component of the periodontium, thereby halting periodontal disease progression. According to the cause-related concept of periodontal therapy, thorough removal of subgingival deposits from the root surface without altering the adjacent periodontal tissues is necessary in order to improvise healing at diseased sites. Therefore, a multitude of calculus removal systems have been developed till date, for effective removal of dental calculus which further help in minimizing loss of tooth structure during removal of dental calculus and thus, increasing patient compliance towards further dental treatment.

Introduction

Calculus can be defined as a hard concretion that forms on the teeth or dental prostheses through calcification of bacterial plaque [1]. The Periodontal instrumentation compiles a series of step wise procedures with a variety of sharp instruments, meticulously applied to tooth surfaces which aid in complete removal of deposits [2]. The goal of periodontal instrumentation is to render the tooth surfaces clean, smooth and free of deposits by preventing the formation of supragingival calculus by: reducing the amount of bacterial plaque available for mineralization using certain antimicrobial agents, antiseptic agents and plaque matrix disruption enzymes like mucinase, modifying the attachment of plaque by using anti-adhesive agents like silicones, inhibiting the process of mineralization by using certain crystal growth inhibitors like pyrophosphates, zinc salts, vitamin c, etc [3].

The initial damage caused to gingival margin in periodontal disease is due to immunologic & enzymatic effects of micro-organisms in plaque. The process is enhanced, however by supragingival calculus which provides retentive surface & thus promotes new plaque accumulation on the exogenous and endogenous surface of calculus. The deposit brings bacterial overlay closer to supporting tissues, and thus, interferes with local self-cleansing mechanism making plaque removal more difficult for patients [4-6].

The removal of supragingival and subgingival calculus with overlying layer of bacterial plaque, by scaling and root planing, however, remains cornerstone of Phase I therapy. “Scaling is defined as the removal of calculus accretions from the tooth surface with periodontal instruments. It includes gross removal of deposits.” Similarly, “Root planing is defined as the removal of calculus embedded in cementum and altered cementum from the root, resulting in a smooth glassy surface.”

The Periodontal debridement is defined as “the treatment of gingival and periodontal inflammation through mechanical removal of tooth and root surface irritants to the extent the adjacent soft tissues maintain or return to a healthy, non-inflammed state” [7,8].

The mean force applied per stroke is responsible for the total amount of root substance removed during scaling and rootplaning [9]. The series of strokes during periodontal instrumentation not only remove outwardly projecting spikes of calculus but also shave the tooth surface and thus, periodontal instrumentation prevents plaque accumulation and helps the clinician to restore and maintain periodontal health.

Conventional methods and devices developed were hardly effective in completely removing calculus from diseased root surfaces. Certain factors like dental arch location, gender, age and race are known to affect the accuracy and feasibility of variety of calculus detection and removal techniques [10]. Such integrated systems will prove advantageous over others as they can minimize loss of healthy tooth structure, decrease chairside time and increase operator efficiency in oral prophylaxis. This will indirectly increase patient compliance towards further dental treatments and aid in education and motivation of patients.

2. Calculus Removal Technologies in a Nutshell (Table 1)

Calculus Removal Systems	Manual Calculus Removal	Hand Scaling Instruments
	Power-driven calculus removal	Magnetostrictive ultrasonic scalers Piezoelectric ultrasonic scalers
	Newer ultrasonic device	Vector system
	Ultrasound	Perioscan
	Laser and autofluorescence	Keylaser 3

Table 1. Calculus removal technologies in a nutshell.

2.1. Calculus removal systems

2.1.1. Manual calculus removal: Hand scaling instruments – scaling, root-planing and curettage instruments are used for removal of plaque and calcified deposits from the crown and root of a tooth, removal of altered cementum from the subgingival root surface and debridement of the soft tissues lining the pocket wall.

Scaling and curettage instruments are classified as:

a. **Sickle scalers**: They are heavy instruments used primarily to remove supragingival calculus. They have a flat surface with two cutting edges that converge into a sharply pointed tip and are commonly used with a pull stroke. Most operators prefer, small, curved sickle scalers that can be inserted beneath the gingival margin, since the large sickle scalers at times result in laceration of gingival tissues.

b. **Chisel scalers**: A chisel scaler is a double-ended instrument with a curved shank at one end and a straight shank at the other; the blades are slightly curved and have a straight cutting edge beveled at 45 degrees. The chisel is always inserted from the facial surface of the tooth. The slight curve of the blade makes it possible to stabilize it against the proximal surface of the tooth, while the cutting edge engages the calculus without nicking the tooth. As a result, this instrument is mainly designed for proximal surfaces of teeth. The instrument is activated with a push motion while the side of the blade is held firmly against the root.

c. **Curettes:** Curettes were developed late back in 1930s by Dr. Clayton Gracey. They are preferred by most clinicians for subgingival scaling and root planning as they provide better access to the root surface in deep pockets. They are fine instruments used for subgingival scaling, root-planing and removal of the soft tissue lining of the pocket. Its curved blade, rounded toe and curved back allow the curette to be inserted to the base of the pocket and adapted to variations in tooth contour with minimal tissue displacement and trauma.

The two basic types of curettes are universal and area-specific curettes [11]:

- **Universal curette:** Universal curette is a single curette designed for all areas and surfaces of all teeth. They have cutting edges that may be inserted in most of the areas of the dentition by altering and adapting the finger rest, fulcrum and hand position of the operator. The blade size, angle and length of the shank, may vary, but the face of blade of every universal curette is at a 90 degree angle (perpendicular) to the lower shank when seen in cross-section from the tip. The blade of universal curette is curved in one direction from the head of the blade toward the toe. Few examples of universal curettes are - Barnhart curettes #1-2 and #5-6 and Columbia curettes #13-14, #2R-2L, and #4R-4L, younger-good #7-8, McCall's #17-18 and Indiana university #17-18.
- **Area-specific curettes**: Gracey curettes – they are a set of 14 specific curettes, designed and angled to adapt to specific anatomic areas of the dentition. Double-ended gracey curettes are paired in the following manner : Gracey #1-2 and #3-4 : anterior teeth, Gracey #5-6 : anterior teeth and premolars, Gracey #7-8 and #9-10 : posterior teeth, facial and lingual, Gracey #11-12 : posterior teeth- mesial, Gracey #13-14 : posterior teeth- distal. Gracey curettes are available with either a "rigid" or "finishing" type of shank. The rigid Gracey has a larger, stronger, and less flexible shank and blade than the standard finishing Gracey. The rigid shank allows the removal of moderate to heavy calculus without using a separate set of sickles and hoes. Although some operators prefer the enhanced tactile sensitivity that the flexible shank of the finishing Gracey provides, both types of Gracey curettes are suitable for root planning. More recent additions developed are #15-16 and #17-18. The newer shank angulation of the Gracey #15-16 allows better adaptation to posterior mesial surfaces from a front position with intraoral rests. The Gracey #17-18 is a modification of the #13-14 and has a terminal shank elongated by 3mm and helps provide more accentuated angulation of the shank to provide complete occlusal clearance and better access to all posterior distal surfaces. The horizontal handle position minimizes interference from opposing arches and allows a more relaxed hand position when scaling distal surfaces. In addition, the blade is 1mm shorter to allow better adaptation of the blade to distal tooth surfaces. Newer modifications of the standard Gracey curettes are the extended-shank curettes such as after-five curettes. Their terminal shank is 3mm longer that allows extension into deeper periodontal pockets of 5mm or more. Other features of after five curettes include a thinned blade for smoother subgingival insertion and

reduced tissue distension and a large-diameter, tapered shank. All standard Gracey curettes except for #9-10 (i.e., #1-2, #3-4, #5-6, #7-8, #11-12 or #13-14) are available in after five series. After five curettes are available in finishing or rigid designs. The rigid after five curettes are used for heavy or tenacious calculus removal. For light scaling or deplaquing in a periodontal maintenance patient, the thinner finishing after five curettes are used since they are easily inserted subgingivally.

- **Mini-bladed curettes**: Initially, only morse scaler, a miniature sickle was the only mini-bladed instrument available. Recently, a set of mini-five curettes, a modification of the after-five curettes have been developed. Mini five curettes feature blades that are half the length of after five or standard Gracey curettes. The shorter blade allows easier insertion and deeper adaptation in narrow pockets, furcations, developmental grooves, line angles and also instrumentation of deep, tight, facial, lingual or palatal pockets. Mini five curettes can be used in areas where root morphology or tight tissue prevents full insertion of the standard Gracey or after five curettes. It is used with vertical strokes that results in reduced tissue distention and causes minimal tissue trauma. Mini five curettes are available in both finishing and rigid designs. Rigid mini five curettes are used for calculus removal while the more flexible shanked mini five curettes are approximately used for light scaling and deplaquing in periodontal maintenance patients with tight pockets. The mini five curettes are available in all standard Gracey numbers except #9-10. The recently introduced micro mini five Gracey curettes have blades that are 20% thinner and smaller than the mini five curettes. These are smallest of all curettes, used in vertical stroke and they provide access and adaptation to tight, deep or narrow pockets, narrow furcations, developmental depressions; line angles and deep pockets on facial, lingual or palatal surfaces. In areas where root morphology or tight, thin tissue prevents easy insertion of other mini-bladed curettes.
- **Gracey curvettes**: The Gracey curvettes comprise a set of four mini-bladed curettes; the sub-0 and #1-2 are used for anterior teeth and premolars, the #11-12 is used for posterior mesial surfaces, and the #13-14 is used for posterior distal surfaces. The blade length of these curvettes is 50% shorter than that of the conventional gracey curette, and the blade is curved slightly upward. This curvature allows gracey curvettes to adapt more closely to the tooth surface than any other curettes, especially on the anterior teeth and on line angles. However, the curvature on gracey curette #11-12, #13-14 also carries the risk of grooving into the root surfaces on the proximal surfaces of the posterior teeth. Additional features of standard gracey curettes are a precision-balanced blade tip in direct alignment with the handle, a blade tip perpendicular to the handle, and a shank closer to parallel with the handle [11].
- **Langer and mini-langer curettes**: These comprise a set of three curettes combining the shank design of standard gracey #5-6, #11-12 and #13-14 curettes with a universal blade honed at 90 degrees rather than the offset-blade of the gracey curette. The langer #5-6 curette adapts to the mesial and distal surfaces of anterior teeth; the langer #1-2 curette (gracey #11-12 shank) adapts to the mesial and distal surfaces of mandibular posterior teeth. These instruments can be adapted to both mesial and distal tooth surfaces without changing instruments. The standard langer curette shanks are heavier than a finishing gracey but less rigid than the rigid gracey. Langer curettes are also available with either rigid or finishing shanks and also available in either rigid or finishing shanks, extended-shank (after five) or mini-bladed (mini-five) versions.
- **Quetin- furcation curettes**: They are hoes with shallow, half-moon radius that fits into the roof or floor of the furcation. The curvature of the tip also fits into developmental depressions on the inner aspect of the roots. The shanks are slightly curved for better access and tips are available in two widths. The B-L1 (buccal-lingual) and M-D1 (mesio-distal) instruments are small and fine, with a 0.9mm blade width. The B-L 2 and M-D2 instruments are larger and wider, with a 1.3mm blade width. These instruments reach the inaccessible areas such as furcation where curettes, even mini-bladed curettes, are often too large to gain access and also unintentionally create gouges and grooves.
- **Periodontal maintenance curettes**: The most recent innovation in Gracey curettes is the, Periodontal maintenance Gracey curette, introduced in November 2015. This curettefeature blades that is 1mm shorter and 20% thinner, and the face of the blade is offset from the terminal shank at 60 degrees as opposed to all other gracey designs, which are offset at 70 degrees. This modification of the blade-to-shank angle and the thinner narrow blade allows easier insertion and better access to root surface with tight tissue and loss of attachment. These instruments are specifically designed for patients with tight tissue, recession and residual pocket depth following initial periodontal therapy or periodontal surgery. They can also can be used for periodontally healthy patients in their maintenance phase without attachment loss or recession. The working angulation can be achieved without as much as tissue distension, thus increasing patient comfort. The three-quarter blade length of this new type of gracey curette is between the blade lengths of the standard and mini-bladed gracey curettes. The shorter blade adapts more easily to root anatomy and furcation areas and helps to prevent spanning across root depressions. The length of the shank is 2mm longer compared to the standard gracey curette, but 1mm shorter than that of the extended shank gracey curette. This length enables better access to molar areas with attachment loss but allows ease of use in the anterior areas where a long shank is not necessary. The shank angle of the new gracey #11-12 is between the regular gracey #11-12 and the gracey #15-16, and the shank angle of the new gracey #17-18. These shank angle modifications were developed to enhance across to the mesial and distal surfaces of the posterior teeth. The shanks of these curettes are so rigid that they can withstand firm pressure when removal of residual burnished calculus is necessary. However, they are not designed for moderate to heavy calculus removal [11].
- **Schwartz periotrievers**: The Schwartz Periotrievers comprise a set of two-double ended highly magnetized instruments designed specifically for removal of broken curette tips from a periodontal pocket or a furcation [12].

d) Hoe, chisel and file scalers: Hoe, chisel and file scalers are used to remove tenacious, subgingivalcalculus and altered cementum.

3. Plastic and Titanium Instruments for Implants

Plastic and titanium instruments are mainly preferred around implants as they cause insignificant alteration around implants. Mini-bladed titanium implant instruments are now available in both Universal and Gracey curette designs. Most of the standard titanium implant instrument blades are large, the newer mini-bladed titanium curettes insert more easily under tight tissue and adapt more easily around implants and implant restorations. They may also be used for patients on implant maintenance with light-pressured strokes for removal of biofilm and calculus. These instruments should not be intended for removal of heavy calculus or cement around the implant. Upon insertion of the plastic or titanium instruments, the blade should be held close to the abutment and opened against the deposit, thus, engaging it apically with the stroke extending coronally. Based on the location of the deposit, horizontal, oblique or vertical, short working strokes with light pressure should be used, in order to prevent trauma to delicate peri-implant sulcus. Occasionally, hard concretions may be found around an implant, which can be treated with, SofScale it is a pre-scaling gel, containing disodium EDTA and sodium lauryl sulphate, which is claimed to soften calculus and therefore facilitate its removal [13,14].

Few examples of commercially available scalers and curettes for cleaning implant surfaces are : Implacare (HuFriedy, IL, USA) made of Plasteel, a high grade resin; 3iImplant Innovations, Inc., (West Palm Beach, FL) implant scaler made up of high-tech plastic; Steri-Oss scaler system (Yorba Linda, California) constructed of graphite-reinforced nylon; Implant Cleaning Kits (Brevet Inc., Irvine, CA); and so forth [15].

3.1 Power-driven calculus removal

Ultrasonic scaling devices are power-driven units that convert electrical energy to mechanical energy to remove deposits of calculus and stains from the teeth. The power scalers used in dentistry include sonic scalers, magnetostrictive scalers and piezoelectric scalers.

Principles of ultrasonic and sonic energy: Ultrasonic systems are countertop units that require a water source and are activated by foot controls. The units produce a high-frequency current that creates vibrations ranging from 20,000 to 40,000 cycles per second. Mechanical energy produced through an electrical transducer or air pressure results in a rapid vibration of the instrument tip, causing it to dislodge calculus when placed against deposits.

The power setting on the ultrasonic unit controls the amplitude of the vibration during the procedure. Heat is generated by the transducer and is reduced by cooling with water. The water flows through the instrument tip and creates a cavitation of minute vaccum bubbles in the spray. The vibrational action helps to remove the deposits while the cavitational action aids in the cleaning process. Other factors that are responsible for the effect of the ultrasonic device are the application of force, resistance of the tissues, and movement of the tip over the surfaces.

The sonic scalers operate in a similar manner to that of ultrasonic scalers, but their vibrational frequency is much less, ranging from 2300 to 6300 cycles per second. The sonic systems are smaller in size and attach directly to the air hose on the dental unit. They resemble the dental hand piece in appearance and size.

The following types of power driven devices are available:

Sonic unit: sonic units are small, air-pressure driven hand pieces that connect to the hand piece delivery system of the dental unit. The direction of the ultrasonic tip is orbital.

Magnetostrictive ultrasonic unit: The magnetostrictive ultrasonic unit produces heat and is cooled by a water system. The direction of the movement of the insert tip is elliptical.

Piezoelectric ultrasonic unit: The direction of the insert tip movement is linear. The piezoelectric ultrasonic unit does not produce heat but is still used with a water spray. Water contributes to three physiologic effects that play a role in the efficacy.

Acoustic streaming is the unidirectional fluid flow caused by ultrasound waves. Acoustic turbulence is created when the movement of the tip causes the coolant to accelerate, producing an intensified swirling effect. This turbulence continuous until cavitation occurs. Cavitation is the formation of bubbles in water caused by the high turbulence. The bubbles implode and produce shock waves in the liquid, creating further shock waves throughout the water.

The studies have shown combination of acoustic streaming, acoustic turbulence and cavitation has been shown to disrupt subgingival microflora. The 3 types of power scalers have scaling insert tips available in variety of shapes and sizes. These tips lack cutting edges and hence do not require sharpening. The rounded or blunted tip design allows maximum distribution of the vibrations and thus reduces damage to the tooth structure. The selection of the insert tip should be based on the location and amount of deposits present and the area to be scaled. The universal insert tip is similar in shape to a curette and can be used on all tooth surfaces. Other insert tip designs available are similar to chisel, beavertail, sickle scaler or periodontal probe. The manufacturer of the insert tip provides directions and suggestions for tip placement, usage and maintenance. Altered shaped tips and broken tips should be discarded.

Indications: Sonic and ultrasonic scalers are utilized to aid in the removal of medium to heavy deposits of calculus, tenacious calculus, tenacious or heavy extrinsic stains, necrotic root tissues, overhanging amalgam margins, orthodontic cements after band placement or removal, temperature of the coolant spray often causes discomfort for patients with sensitive teeth.

Contraindications: In the presence of certain cardiac pacemakers, on patients with infectious diseases, on resin restorative materials.

Certain advantages and disadvantages of power-driven instruments compared with manual instruments:

Advantages: increased efficiency, multiple sizes-surfaces-shapes of tips are available that help removing deposits from inaccessible areas, no need to sharpen, less trauma caused to adjacent periodontal tissues, large hand piece size, reduced lateral pressure, less tissue distention, water, lavage, irrigation, acoustic microstreaming, reduces patient and operator fatigue, re-sharpening is not required

Disadvantages: more precautions and limitations, patient comfort (water spraying),aerosol production, temporary hearing shifts, noise production, less tactile sensation, reduced visibility [16-19].

4. Protocol to be Followed when using Ultrasonic Device during COVID-19

a. The operator and the assistant should wear personal protective equipment before entering the operatory room.

b. Clean the ultrasonic unit with a disinfectant. Attach a sterile, autoclavable ultrasonic tip to the hand piece. Cover the ultrasonic unit with plastic or latex barriers. Flush the water lines and hand piece for 2 minutes to decrease the micro-organisms in the water lines. Use water line filter or sterile water.

c. Ask the patient to rinse his/her mouth with any antimicrobial rinse, such as povidone iodine, 0.12% chlorhexidine. Such pre-procedural rinse will help reduce aerosol.

d. Use high speed evacuation to minimize aerosol production.

e. Turn on the ultrasonic unit, select an insert, place it into the hand piece, and then adjust the water control knob to produce a light mist of water at the working tip.

f. Power settings should be adjusted accordingly from low to medium and the ultrasonic tip should be placed parallel to the tooth surface.

g. The instrument should be grasped with a light to moderate pen or modified pen grasp, and a finger rest or extraoral fulcrum is advised while working on maxillary teeth.

h. Use short, light, vertical, horizontal or oblique overlapping strokes. Keep the working tip adapted to the tooth surface as it passes over the deposit. The vibrational energy created at the tip of the instrument, dislodges the calculus.

i. Avoid using heavy lateral pressure, as this can result in unnecessary removal of tooth structure from the root surface.

j. The working tip should be kept at 15° to the tooth surface, and should be kept in constant motion so as to avoid etching or grooving on to the tooth surface.

k. The ultrasonic unit should be switched off at regular intervals to allow proper aspiration of water and the tooth surface should be examined frequently with an explorer.

l. Any remaining irregularities of the root surface, may be removed and smoothened with sharp standard or mini-bladed curettes wherever necessary.

5. Vector System

The Vector system (Duerr dental, bietigheim-bissingen, Germany) generates vibrations at 25khz and this helps deflect horizontal vibrations vertically.

As a result, the ultrasonic instrument tip vibrates parallel to the tooth surface which specially helps to reduce the amount of tooth structure loss during oral prophylaxis. The unique feature of this system lies in the oscillations produced by the ultrasonic tips. Its efficiency of removal of subgingival deposits relies mainly on the abrasive fluid that is being used. The polishing fluids like hydroxyapatite or abrasive fluids like silicon carbide containing fluids are commonly used in conjunction with this system to scale and polish the tooth surface. The abrasive fluid through the ultrasonic tip contacts the tooth surface and cleans it by exerting hydrodynamic forces such as cavitation or acoustic streaming and not just by the chipping action of the ultrasonic tip. Vertical vibrations produced in the ultrasonic tip help reduce pain perception of the patient. This system removes calculus efficiently. Reduction in post-operative dentinal hypersensitivity due to use of abrasive fluid which forms smear layer on scaled tooth surface [20,21].

Advantages of this system are- helps reduce loss of tooth structure during the procedure also helps to treat periodontal tissues less aggressively.

Disadvantages commonly associated with this system are- least efficient when polishing fluid is used with straight metal tip and use of abrasive fluid in this system is known to cause more tooth substance loss as compared to hand instruments.

6. Ultrasound Technology (Perioscan)

The ultrasonic calculus detection device named Perioscan (sirona, germany) is based on conventional piezo-driven ultrasonic scaler. It is a device that works on acoustic principles, which is similar to tapping on a glass surface with a hard substance that analyses the sound. This device efficiently differentiates between calculus and healthy root surfaces. Perioscan a combination of detection and removal mechanism is advantageous since calculus is removed just by switching the mode from detection to removal. The diagnostic and treatment modes can be used successively on the surface of the same tooth. Once the ultrasonic tip touches the tooth surface, it produces different colour light signals both in the hand piece and in a display of the table unit. The presence of green light indicates cementum whereas blue light indicates calculus. The device emits an additional acoustic signal sound upon detection of calculus [22,23].

Advantages: a) decrease in tooth substance removal during subgingival debridement b) detection as well as removal provision incorporated in single system c) visibility of operator is enhanced as fiberoptic system is incorporated in to it d) overzealous instrumentation is avoided e) colourblind operator will also be able to detect calculus due to incorporation of acoustic system in to this technology.

Disadvantages: a) this system has low specificity b) irregularities and anatomic variation son root surface can be mistaken for calculus.

7. Lasers for Detection as well as Removal of Dental Calculus: Keylaser 3

LASER, an abbreviation for Light Amplification By Stimulated Emission of Radiation. The selection of specific laser is carried out according to its variety of wavelengths suited for soft and hard tissue procedures Lasers help detect calculus through a non-contact and minimally-invasive technology. In Periodontology, laser has applications in Non-surgical and Surgical Periodontal Therapy [24-27].

The Erbium wavelengths are known to have the highest absorption of water and therefore causes less damage to hard tissues due to reduced heat production and also a great affinity for hydroxyapatite. The Er:YAG laser was introduced by Zharikov in 1974.Earlier developed, Keylaser 1 and Keylaser 2 comprising of Er:YAG laser only could be used for calculus detection.The Er:YAG laser (KEY II, KaVo, Biberach, Germany) has a therapeutic wavelength of 2.94µm along with a pilot wavelength of 635 µm for laser irradiation. Certain instructions as given by manufacturer are that the laser is used in contact mode at energy levels of 120,140, 160 and 180 mJ/pulse at a repetition rate of 10 to 15 Hz along with water irrigation (15ml/min) [28-30].

Keylaser 3 is the only commercially available combination system comprising of two different lasers at two different wavelengths incorporated for two different purposes. The InGaAs laser at 655nm works on autofluoroscence technology is used for detection of calculus whereas 2940nm Er:YAG laser for removal of calculus. The effectiveness of calculus removal depends on irradiation energy level. Keylaser 3 has highest accuracy and reproducibility amongst all the available laser fluorescence devices.

No major adverse effects like thermal damage were found when the laser application was carried out at lower energy levels (radiation energy 50-160MJ) along with concomitant water irrigation.

Along with detection of calculus, Er:YAG laser also known to shown high bactericidal potential along with capacity to reduce lipopolysaccharide contamination of the root surface [31]. A number of studies have been carried out to assess efficacy of Er:YAG laser in detection of calculus. The clinical outcome 6 months after periodontal therapy with an Er:YAG laser was equivalent to scaling and root planing (Schwarz et al 2001).

A few studies have shown Er:YAG lasers benefits in detection of calculus, out of which in one study done by Sherman et al 1990, where they evaluated therapeutic wavelength of Er:YAG laser 2.94 µm and a pilot wavelength of 635 µm for laser irradiation. The laser is used at an energy level of 160 MJ at a rate of 10 to 15hz along with water irrigation. The authors thus concluded, clinical outcome 6 months post periodontal therapy with an Er:YAG laser was equivalent to scaling and rootplaning [32].

Krause et al 2007 in a study evaluated the selective removal of subgingival calculus depending on different threshold levels of the fluorescence feedback-controlled Er:YAG laser. Additionally, also assessed, the amount of root cementum removal depending on the feedback-controlled endpoint of calculus removal. They concluded that calculus removal would be most effective without a feedback system. However, using the Er:YAG laser without a feedback system would result in a continuous emission of laser energy, even if there is no calculus present. As a result, laser energy might lead to root substance removal and thus over-instrumentation could occur. As a result, the manufacturer recommend that the Er:YAG laser be used at settings of 140MJ and 10 Hz at a threshold level lower than 5 so as to avoid undesirable root surface alterations during non-surgical periodontal therapy [33].

8. Summary

Dental calculus is always covered with bacterial biofilm and therefore, should be regarded as secondary etiological factor in initiation and progression of periodontitis. Thus, the cause related anti-infective periodontal therapy is necessary that aims to eliminate the microbial biofilm and calcified deposits from the diseased root surfaces by means of root surface debridement. Certain factors like variations in tooth anatomy, over-hanging restorations, tooth malposition, gingival contour, probing depth, instrument design, operator efficiency also contribute to the efficacy of dental calculus removal. As a result, a number of different technologies have been incorporated into dental devices for the purpose of identifying and selectively removing the dental calculus. These devices will enhance long-term treatment results, resulting into decreased residual probing depth, reduced need for periodontal surgical therapy and lessen hypersensitivity post periodontal therapy. Thus, enhancing patient compliance towards further dental treatments.

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