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Cusa (Cavitron Ultrasonic Surgical Aspirator) "The New Armour of Periodontal Therapy"

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Abstract:- The CUSA is a device of modern periodontal treatment that claims to be a breakthrough in minimal invasion surgical technique. While repairing a ship's propeller in 1916, scientist Lord Rayleigh discovered the effect of cavitation. This device, like others, uses low frequency ultrasonic radiation to dissect or split tissues with low fibre content. Ultrasonic pulses in the 23 kHz range are used to create cavitations in tissue a hollow 3 mm tip vibrating at 23,000 times per second delivers this mechanical energy.

CUSA is a surgical device that was developed for ophthalmology but has since gained widespread acceptance in a number of medical disciplines, including neurosurgery, general surgery, gynaecology, urology, and neurotology. This equipment cause, Biofilm disruption and cell stimulation for non-surgical treatment of infrabony defects, as well as ultrasonic debridement and flapless therapy, are said to be effective.

Using this aspirator increases safety and quality while decreasing operational time. There are no known contraindications, but there are financial and personal constraints. As a result, this strategy appears to be a viable option for improving non-surgical minimally invasive therapeutic procedures.

Keywords:- *Cavitron Ultrasonic Surgical Aspirator, Pocket Depth, Non-Surgical Periodontal Therapy, Infrabony Defects*

I. INTRODUCTION

Deep periodontal pockets, which are associated with infrabony abnormalities, have been linked to an increase in periodontal disease and tooth loss.

The flap design preserves interdental space while reducing vertical release, which allows for adhesion and maturation with minimal damage, and primary intention wound closure allows for periodontal tissue regeneration. The development of membranes and biological mediators, such as bone substitutes, was once the main focus of researchers' interest in tissue regeneration. However, with the advent of minimally invasive surgical techniques, this interest has recently shifted to tissue management to produce better results (MIS) [1, 2].

The flap's preservation of interdental space while lowering vertical release permits adhesion and maturation with little harm, and primary purpose wound closure enables the regeneration of periodontal tissue.

In this context, further current research that defines and contrasts the effectiveness of the minimally invasive nonsurgical method (MINST) and the minimally invasive surgical approach is necessary. Extensive subgingival debridement is the aim of MINST while keeping the preoperative gingival architecture, making a small incision, and delicately manipulating the soft and hard tissues to encourage the creation of a stable blood clot by spontaneous filling of the infrabony defect[3, 4].

CUSA was originally designed for ophthalmological surgery, but it has since gained widespread acceptance in a variety of medical disciplines, including neurosurgery, general surgery, gynaecology, urology, neurotology, and, most recently dentistry[5-6] (figure: 1). A well-known medical tool called the Cavitron ultrasonic surgical aspirator (CUSA) is utilised for many different conditions, the most frequent of which being liver illness and neurosurgery. Cell stimulation and biofilm eradication have both been successfully accomplished with CUSA. CUSA's capacity to disrupt, rupture, and aspirate granulation tissue is claimed to increase the size and stability of blood clots when used for nonsurgical healing of infrabony lesions[7].

Fig: 1 Cavitron Ultrasonic Surgical Aspirator (CUSA)

In 1916, when looking at a ship's propeller's damage, Lord Rayleigh learned about cavitations' effects. He deduced that the structural damage was brought on by a tiny water jet stream produced by the bursting bubbles. A similar idea may be utilised to produce a cavitation effect utilising high-speed mechanical waves in non-elastic medium like water. All cells are killed when this phenomenon is used on tissues high in water content, like the liver, while collagen-rich structures, such blood arteries and nerves, which are low in water content, are retained. According to the researchers, a little jet formed as a result of the bubbles collapsing.

II. CAVITATION

Vaporization of a liquid is referred to as cavitation. It enters the phase when exposed to lower pressures at a steady temperature.

In a liquid, boiling happens when the pressure is dropped rather than when the temperature is raised. When the probe-tip retracts with appropriate amplitude and frequency, creating shock waves, gas bubbles suspended in a fluid, released into the environment, or trapped at a solid surface expand and collapse on the negative side of a pressure cycle. This is known as cavitation (figure: 2).

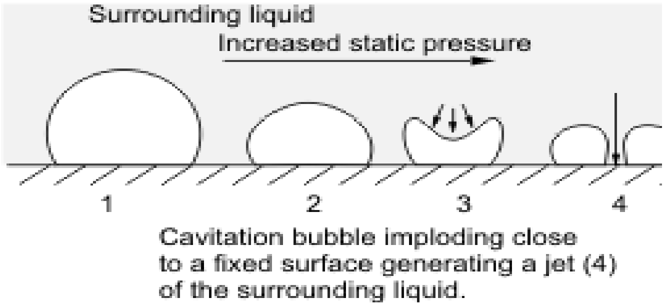

Fig: 2 showing cavitation effect

III. ULTRASOUND

Audible Frequency Range: 20 Hz —- 20,000 Hz Infrasonic waves are sound waves with frequencies less than 20 Hz.

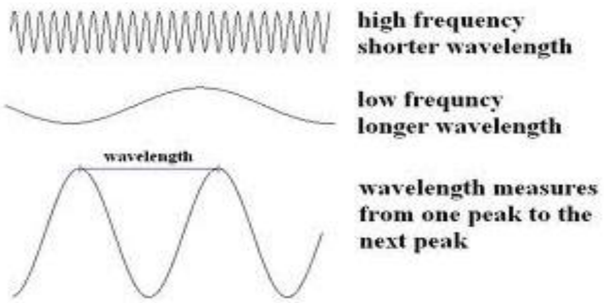

Fig: 3 infrasonic sound wave frequencies

Ultrasonic waves are sound waves with frequencies greater than 20,000 Hz.

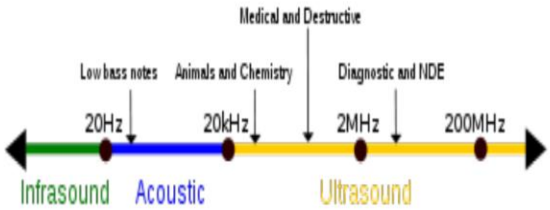

Fig: 4 ultrasonic sound wave frequencies

IV. ASPIRATION

Aspiration is a sucking motion used to draw something in or out.

Depending on how it is used, this term can have two different meanings.

• Aspiration can refer to the act of breathing in a foreign object. Aspiration can also refer to a medical procedure that removes harmful or incorrectly placed substances from the body.

Suction is essentially the aspiration of a gas or fluid by lowering the air pressure over its surface, typically through mechanical means or a negative pressure device.

V. THE CAVITRON ULTRASONIC SURGICAL ASPIRATOR (CUSA)

A Cavitron ultrasonic surgical aspirator (CUSA) is used by neurosurgeons to "cut out" brain tumors while sparing healthy tissue. Tissue cavitations are produced using the Cavitron ultrasonic surgical aspirator (CUSA) equipment using ultrasonic pulses in the 23 kHz range. A 3 mm hollow tip that vibrates at 23,000 times per second carries this mechanical energy. The complete apparatus is equipped with an aspirator and an irrigator to remove tissue debris.

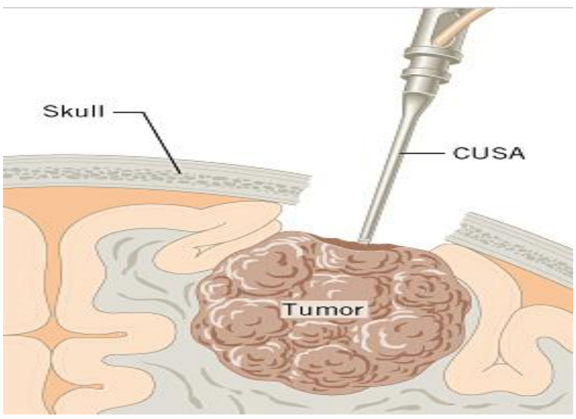

Fig: 5 surgical aspirator

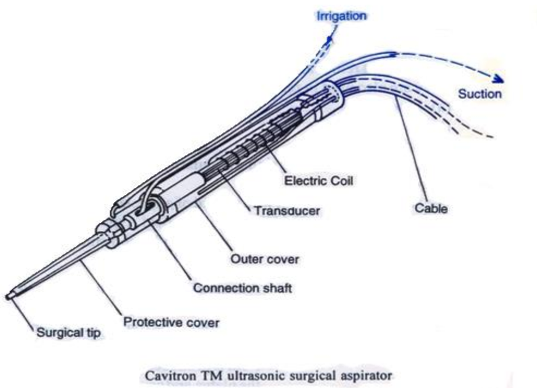

Fig: 6 component of CUSA probe

VI. COMPONENTS OF CUSA PROBE

Three holy elements make up the CUSA investigation:

An apparatus that transforms electrical energy into mechanical vibrations is a transducer. The transducer is composed of a stack of nickel alloy plates. A magnetic field created by a coil wrapped around the plates moves the plates mechanically by around 300 microns.

The connecting body mechanically transmits the transducer's movements to the surgical tip. The transducer's vibration motion is also amplified by it.

Surgical hint: Contacts the tissue while simultaneously completing the motion amplification. As a result, there is sufficient motion amplification since the tip is relatively lengthy in relation to its diameter.

VII. PIEZOELECTRICTRANSDUCER

Ultrasonic waves are produced and detected using a piezoelectric transducer. It is a quartz crystal that converts electrical oscillations (sound) into mechanical vibrations (sound).

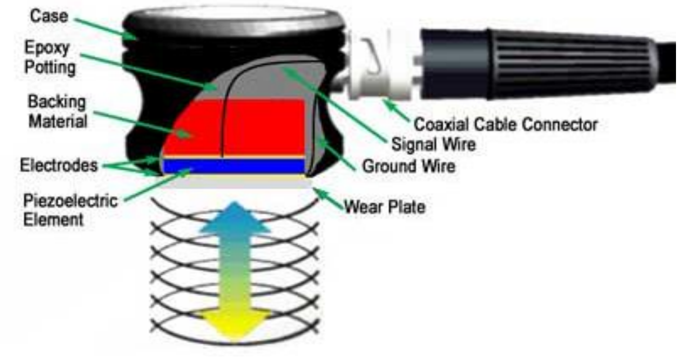

Fig: 7 Piezoelectric Transducer

VIII. MECHANICS OF CUSA

The CUSA console supplies alternating current (24 or 3 kHz) to the hand piece. The current flowing through the coil in the hand piece creates a magnetic field.

A transducer or nickel alloy laminations are then excited by the magnetic field, resulting in oscillating motion (vibration) along the transducer laminated structure's long axis.

A connected surgical tip receives vibrations from the transducer via a metal connecting body.

When the vibrating tip makes contact with tissue, it divides cells (fragmentation). Numerous magnetostrictive hand pieces with various frequencies and tip configurations are compatible with the CUSA system.

IX. EFFECT OF DIFFERENT FREQUENCIES

The powerful 24 kHz hand piece fragments even the most difficult, fibrous, and calcified tumors, whereas the small 35 kHz hand piece is useful during procedures requiring precision, tactile feedback, and delicate control. The hand piece can be tailored to the consistency, location, and depth of the targeted tissue for each procedure.

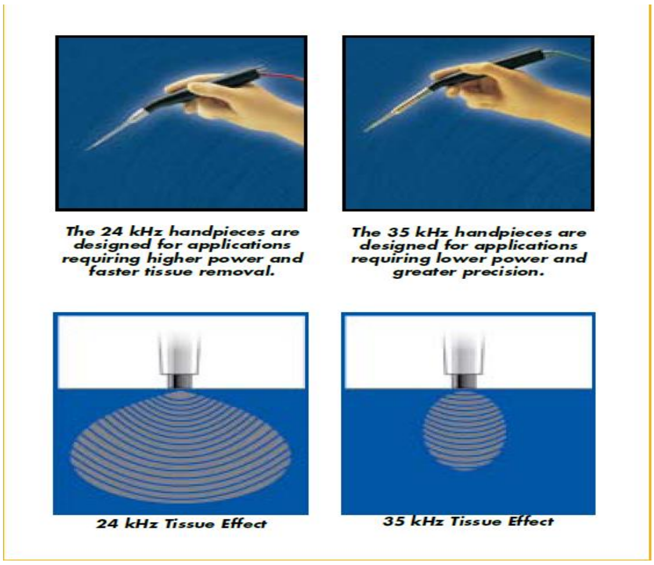

Fig: 8 Effect Of Different Frequencies

X. SUCTION AND IRRIGATION

The CUSA has a self-contained suction capability for removing fragmented tissue and irrigation fluid. In the CUSA operation, suction and irrigation serve three functions:

1. It attracts tissue to the vibrating tip, causing tip/tissue coupling.
2. It keeps debris from irrigation and fragmentation away from the surgical site.
3. Irrigation fluid flows capillary around the outside of the vibrating tip to keep it cool.

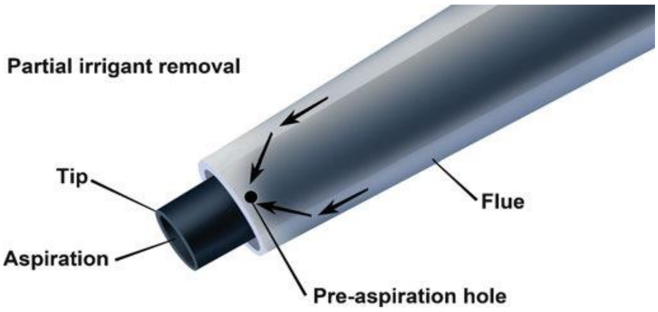

Fig: 9 Suction and Irrigation device

Studies[8, 9] have shown that surgical and nonsurgical interventions both improved CAL increase and PD reduction. However, certain studies back up the authors' initial theory; in particular, using minimally invasive techniques to nonsurgical therapy may result in better outcomes than using a conventional nonsurgical strategy[10]. Another study looked at a novel flapless technique to enhance debridement

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outcomes. As a result, we began our research a year after FMUD and conducted SPT[11] sessions after that.

Following a chronic periodontitis process, the major goal was to remove old and capsulated granulation tissue, allowing the defects to have an appropriate and stable new blood clot as a consequence of a nonsurgical technique. The surgical aspirator is the best tool for this application because it can aspirate and fragment tissue with the capacity to reach all regions of the defect[12].

XI. CONCLUSION

The effects and interactions of the following five variables are involved in surgical aspiration:

- Hand piece operating frequency
- Tip cross-sectional area at the tissue contact site
- Tip stroke amplitude
- Tissue type
- Suction level

Overall, the use of ultrasonic aspiration increases safety, decreases operating time, improves quality, and allows for selective surgery.

There are no known side effects.
There are only constraints (financial, personal, etc.

The flapless approach, on the other hand, was identified as a promising method for enhancing, and in secondary care, the results obtained with nonsurgical therapy, while causing less morbidity than any other surgical technique and providing patient satisfaction. Future randomized control studies are required to better explain the potential of this approach and its various application strategies.

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