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Neurosurgery

USING OF DENTAL ULTRASONIC SCALER AS COST EFFECTIVE ULTRASONIC SCALPEL IN NEUROSURGERY

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ABSTRACT For brain and spine tumour excision CUSA(cavitron ultrasonic surgical aspirator) knife is commonly used in neurosurgery. Neurosurgeons working in peripheral hospitals particularly developing country like india could not afford commercially available CUSA Knife because of the high cost or non availability or poor quality.Dental ultrasonic scaler working in same principle is a viable alternative to sophisticated CUSA knife. Availability,low cost,maintainance,service, durability consider the dental ultrasonic scaler as the cost effective equipment in neurosurgerical tumour excision .

KEYWORDS : brain and spine tumour,CUSA knife,dental ultrasonic scaler

INTRODUCTION

There are three types of tumour excision instruments commonly used in Neurosrgical procedures at present: cold scalpel,bipolar diathermy and CUSA knife. CUSA knife is having several advantages over other methods because CUSA selectively ablates tissues with high water content such as neoplastic tissue.Speciffic frequency is used to cut spine and skull bone also. This instrument is most useful when removing particularly “non-resectable” brain and spine tumours.But commercially available CUSA system is very costly and this article discusses the use of low cost dental ultrasonic scaler working in the same principle[1] as viable alternative to CUSA for brain and spine tumour excision surgeries.

TECHNICAL NOTE

Ultrasonic scalers are used to remove calculus rapidly from the tooth surface[2,3,4,6]]. The scaling tip vibrates in the ultrasonic range of 20-45 kHz (i.e. 20,000 to 45,000 times per second), with an optimum frequency between 18 kHz and 32kHz. Most of the scaling power is available at the tip, which is cooled with a jet of water. There are three basic types - magnetostrictive, piezo-electric and Odontoson™

The scaling tip vibrates[5] and follows a pattern depending on power rating and type - elliptical, curved linear or figure of 8. The water is energised as it passes over the tip to provide cavitation, which results in a scouring action. Daniel Bernoulli, an eighteenth-century Swiss scientist known for his work in heterodynamics, stated that when the velocity of fluid increases, its pressure decreases. According to Bernoulli's law, when a high speed water jet stream is generated, the pressure within the stream drops so low that the water vaporizes. This process is called “cavitation”. Because of the heat generated at the tip, it is essential to keep the tip moving over the tissue[7,8,9].

A good guide is that one should not spend more than 10 seconds on any individual tissue and never to press harder than one ounce of pressure. Pressing hard stops the tip from vibrating and reduces the effectiveness of the tip of dental scaler scaler[10]. It also concentrates heat in one area with possibly lethal consequences for the tissue. Best practice involves selecting the area and scaling it in sequence to prevent over-heating.

Different shapes are available for scaling tips and some units offer interchangeable inserts, which allow various functions to be performed for bone and soft tissues with high water content.

The newer inserts, with thinner, longer tips, carry their own water supply with them (either through the tip itself or via an external "trombone") and can, therefore, be used for tumour excision and ultrasonically irrigating the area. The thinner the tip the finer the action.

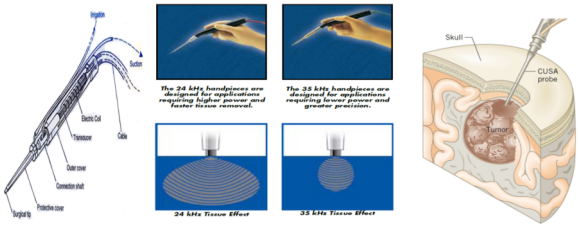

Figure 1 Cusa Kniff Internal Parts And Mode Of Action

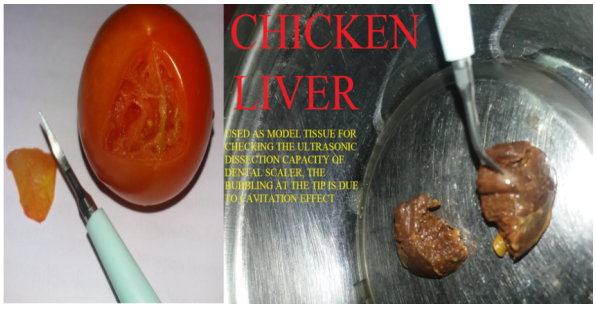

Figure 2 Tomato Dissection The Scaler Dissects Only The Wster Rich Pulp And Not Affecting The Fibrous Septa, Chicken Liver Dissection With Dental Ultrasonic Scaler

Figure 3 In Vtro Schwannoma Tumour Tissue Dissection And Skull Bone Cutting With Dental Scaler.bubbles Are Due To Cavitation Effect

Figure 4 Skull Bone Flap Cutting With Dental Scaler And The Prototype Dentalultra Sonic Scaler We Used

RESULTS

Since CUSA and ulta sonic scalers are functioning in the same principle dental scaler works well in dissecting vegetable,animal and human schwannoma tissues in our lab.

Bone cutting efficiency also checked with dry and cadaver wet bones and gives favourable results in our study

DISCUSSION

The cost effectiveness of Ultra sonic dental scaler are 1. Low cost around 10000 INR which is 15 times cheaper than good quality ultrasurgery-II ultrasonic scalpel unit(Wood pecker)

and 70 times cheaper than the CUSA knif.2. Designed for hard use for teeth hence strong and robust.so, malfunctioning is very rare in soft use neuro surgical field.3. There are three frequency specifications like general scaling,perio and endodontic works. The perioodontic mode works well for cutting skull and spine bone and other modes suitable for soft tumour surgeries.5.Fast, effective surgery if used properly - light touch & short time on the dissection area.
6.Skull bone work is possible with the correct type of tip.
7.small unit ; small footprint The disadvantages are
1.Iatrogenic heat damage to the adjacent neural tissue is possible if not used carefully[11].

Standard beavertail shape tips cannot be used in narrow surgical corridor.2. Handpieces can heat up considerably during long surgical procedures, if water pressure is not consistent. Garden water bottle reservoirs generally fail to provide a consistent and useful level of water pressure. If an air compressor is available, plumbing the unit in provides a better result. The detachable hand piece is autoclavable. Sterile outer ready made plastic transparent sleeves are available for using during the procedure.

Table 1. Shows the comparison of CUSA System and Dental scaler

Sno	Parameter	CUSA system	Dental Ultra sonic Scaler
1	Availability	Order and wait for minimum one month	Readily availablable in all Dental marts
2	Cost	70 Lakhs INR	7000-12000 INR The proto type used in this study is Wood pecker UDS-P model
3	Size	Large unit	Portable
4	Maintainace	Company maintainace,very difficult for OT technicians	Simple
5	Weight	Heavy and needs trolly for shifting	< 2kg
6	Working [12]frequency	25KHz- 38 KHz	28 KHz- 42 KHz Amplitude 10-100micrometer
7	Power	35 Watts	20 Watts
8	Sterility	Autoclavable hand piece	Autoclavable hand piece at 135degreeC at 0.22MPa
8	Aspirator	Inbuilt aspirator system available for clearing dissected tissues	Additional suction needed
9	Working tip	Can be changed,straint piece available	Can be changed,Beaver tailed tips
10	Saline irrigation system	Available	Available

Khz- KiloHertz Watts- Wattage MPa- Mega Pascal

CONCLUSION

The dental scaler has got several advantages over highly sophisticated ultra sonic scalpel units. In neurosurgery.the major disadvantages are not provided with aspirator mechanism, beaver tailed tip 15 watts and 7 KHz lower specification than that of CUSA system. But with minimal cost, comparative function, durability,maintainace,maneuverability in surgeon's hands,light source and without post operative complications can be used in routine tumour excision surgery and bone trimming work in low resource setting countries atleast in emergency which is life saving in neurosurgical field

CONFLICT OF INTEREST:

There is no conflict of interest to declare for the author side.

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