International Journal of Enhanced Research in Medicines & Dental Care (IJERMDC),
ISSN: 2349-1590, Vol. 8 Issue 10, October 2021, Impact Factor: 7.125

Ultrasonics In Dentistry

Dr. Sania[1], Dr. Pranav Gupta[2], Dr. Nipun Sharma[3]

[1]Reader,Dept of Periodontology, Institute Of Dental Sciences, Jammu
[2]Reader, Dept of Pediatric Dentistry, Kothiwal Dental College And Research Centre
[3]MDS,Consultant Endodontist

ABSTRACT

Ultrasonography is one of the most common imaging modality used in dental as well as medical sciences. The use of ultrasonography when discovered was as a therapeutic aid, but in recent times, it has become one of the most common imaging modality next to conventional radiology The term "ultrasound" applies to sound waves that vibrate at a frequency higher than the frequency that can be heard by human ear (20,000 hertz or 20 kilohertz). (20,000 hertz or 20 kilohertz).The uses of these waves ranges from detecting subcutaneous body structures including tendons, muscles, joints, vessels and internal organs for structural changes, pathology and lesions tovarious therapeutic purposes. They have been in use various fields of medicine for early detection of structural changes in human body. Ultrasound has the advantage of being a safe, non-invasive, cost effective and non deleterious waves. Ultrasoundis making its way in various areas of diagnosis and therapeutics in the field of dentistry.

Keywords: ultrasonic, dentistry

INTRODUCTION

The term "ultrasound" applies to sound waves that vibrate at a frequency higher than the frequency that can be heard by human ear (20,000 hertz or 20 kilohertz).The unit used to measure the frequency of any wave is the hertz and one hertz is defined as the passage of a single wave per second. In other words ultrasonic waves pass at least 20,000 times per second at a givenpoint.

Ultrasound (US) is one of the advanced imaging techniques which uses sound waves for viewing the normal and pathological conditions of bone and soft tissue of the oral and maxillofacial region The ultrasounds was first used during the World War I, for the detection of submarines. It was later introduced in the field of obstetrics, and after that in all the other fields of the medicine including dentistry. The diagnostic ultrasonic devices operate in the frequency range of 2 to 18 megahertz, much higher than the limit of human hearing. There are two types of ultrasound based on the applications and ultrasonic intensities -
Diagnostic ultrasound (intensities between 5 – 500 mW/cm2)
and Therapeutic Ultrasound (intensities between 1 – 3 W/cm2).

PRODUCTION OF ULTRASONIC WAVES

Principle of ultrasonic waves generation is to cause some dense material to vibrate very rapidly. These vibrations results in the vibration of surrounding air to vibrate with the same frequency and spread out in the form of ultrasonic waves.

ULTRASOUND IN DENTISTRY

Ultrasound offers great potential in development of a noninvasive periodontal assessment tool that would offer great yield real time information, regarding clinical features such as pocket depth, attachment level, tissue thickness, histological change, calculus, bone morphology, as well as evaluation of tooth structure for fracture cracks. In therapeutics, ultrasonic instrumentation is proven effective and efficient in treating periodontal disease. When used properly, ultrasound-based instrument is kind to the soft tissues, require less healing time, and are less tiring for the operator. Ultrasound offers great potential in development of a noninvasive periodontal assessment tool that would offer great yield real time information, regarding clinical features such as pocket depth, attachment level, tissue thickness, histological change, calculus, bone morphology, as well as evaluation of tooth structure for fracture cracks Microultrasonic instruments have been developed

with the aim of improving root-surface debridement. The dye/paper method of mapping ultrasound fields demonstrated cavitational activity in an ultrasonic cleaning bath. Piezosurgery resulted in more favorable osseous repair and remodeling in comparison with carbide and diamond burs[1]

1. Diagnosis of zygomatic fractures

Ultrasound can be used as an additional diagnostic aid to conventional radiography of the facial bones and is well tolerated by recently injured patients. Many studies have shown upto 85% accuracy in diagnosing fractures of the zygomatico-orbital complex and also the condyle, although it was not accurate enough to replace plain radiography as the principal mode of imaging. The other possible roles of ultrasound may include preoperative assistance in closed reduction of the malar complex. The technique can also be useful when there is a coexisting injury to the cervical spine and also in the assessment of uncooperative patients when CT is impracticable. Ultrasound may be also used to assess the remodelling around the infraorbital foramen, which may be used as a prognostic tool to predict infraorbital nerve recovery but this requires further investigation.[2]

2. Healing of orthodontically induced root resorption

LIPUS(Low intensity pulsed ultrasound) is a medical technology, using 1.5 MHz frequency pulses, with a pulse width of 200 μs, repeated at 1 kHz, at a spatial average and temporal average intensity of 30 mW/cm2, 20 minutes/day.The mechanical stimulus induces a strong release of inflammatory factors, like the tumor necrosis factor-a (TNF-a), interleukin-b (IL-b), and prostaglandin E2 (PGE2), from the periodontal ligament. These inflammatory factors can elevate the expression of RANKL. LIPUS can reduce the levels of these inflammatory factors, TNF-a and IL-b, thereby reducing RANKL expression and osteoclast differentiation. Treatment with LIPUS increases level of OPG and reduces RANKL expression, thereby reducing the number and activity of osteoclasts and therefore decreasing root resorption.[3]

3. Imaging condylar position

Ultrasound can be applied as imaging technique for guidance in orthognathic surgery. Nearly 20% of the total cases which have undergone mandibular advancement tend to relapse after a few years of treatment due to the inability to locate the accurate presurgical position of the TMJ. It assists the surgeons to visualize the segment of TMJ and direct it to its presurgical position, as it is considered to be more biologically stable. Ultrasound can be used to assess the soft tissues before and after the surgical procedure. It is quite an efficient way to capture the TMJ position as well as its dynamic properties.[4–6]

4. Accelerating orthodontic tooth movement

LIPUS can be used to gently massage the area of interest. It accelerates alveolar bone remodelling, thus causing a potential decrease in orthodontic treatment time. LIPUS stimulation enhances orthodontic tooth movement by elevation of the HGF/Runx2/BMP-2 signalling pathway gene expression and RANKL expression. Because LIPUS is harmless and non-invasive , it would be a safer adjuvant therapy for accelerating orthodontic tooth movement, which could result in faster orthodontic tooth movement.[7,8]

5. Diagnosis of infantile and mature swallow

Tongue proportions, posture and function are of great importance in the etiology of malocclusion. The tongue function and posture is quite difficult to examine due to the various structures surrounding it. Ultrasound can be used for the objective assessment of the tongue. This can be used for functional diagnostics before, during and after orthodontic treatment. It helps in differential diagnosis of visceral and somatic swallow. According to a study done by Chien-LunPeng ,ultrasound was used to conclude that movement of the genioglossus muscle could be used as a reliable means to diagnose infantile and mature swallow[9].

6. Determining masseter muscle mass

Ultrasonography is used to measure the thickness of the masseter muscle. The results can be compared to those obtained with Magnetic Resonance Imaging. Raadsheer et al compared both Ultrasound and MRI in measuring the mid-belly masseter muscle thickness and showed Ultrasound to be a precise and reproducible imaging technique. However, Ultrasound imaging also lets us detect pathological changes in the muscle on the basis of amplified echo intensity.[10] To study the masseter muscle, water based gel is applied to the probe. The transducer is angled perpendicular to the surface of the skin and special care is taken not to avoid too much pressure. The thickest part of the masseter muscle at the level of the occlusal plane is considered as the ideal site for examination. These measurements and imaging are done bilaterally and carried out with the patient in supine position. The muscle mass is measured under two different conditions-muscle in relaxed position, and during maximum clenching when the muscle is contracted. This measurement would help us to predict the prognosis of functional appliances used in the field of orthodontics.

7. Selection of proper mini-screws in clinical orthodontic practice

An ultrasonic gingival-thickness meter can used to quantify the soft-tissue thickness in the buccal-attached gingiva just adjacent to the mucogingival junction of the upper and lower arches. A study by Bong-KuenCha et al, concluded that significantly greater thickness of soft tissue was seen in the upper anterior and lower posterior region. These finding could help clinicians to choose the proper mini-screws with greater ease.[11]

8. VARIOUS APPLICATION IN THE FIELD OF ENDODONTICS[12]

- Access refinement, finding calcified canals, and removal of pulp stones
- Removal of intracanal obstructions viz separated instruments, fractured posts etc
- Increased action of irrigating solutions
- Ultrasonic condensation of guttapercha
- Placement of MTA
- Surgical endodontics and root canal preparation

CONCLUSION

Ultrasonography has evolved the world of medicine as a diagnostic and therapeutic aid. It is rapidly being used as an adjunctive aid in various dental field especially endodontics and has the advantages such as being safe, radiation free , non-invasive method and good acceptance by patients, which makes it capable of being used in various other specialties as well..

REFERENCES

[1]. **V**ivek K. Bains, Ranjana Mohan ,Rhythm Bains. Application Of Ultrasound In Periodontics: Part IIJ Indian SocPeriodontol. 2008 Sep-Dec; 12(3): 55–61.
[2]. McCann PJ, Brocklebank LM, Ayoub a F. Assessment of zygomatico-orbital complex fractures using ultrasonography. *Br J Oral Maxillofac Surg*. 2000;38(5):525-529.
[3]. Liu Z, Xu J, E L, Wang D. Ultrasound enhances the healing of orthodontically induced root resorption in rats. *Angle Orthod*. 2012;82(1):48-55.
[4]. Baqaien M a, Barra J, Muessig D. Computerized axiographic evaluation of the changes in sagittal condylar path inclination with dental and physical development. *Am J OrthodDentofacialOrthop*. 2009;135(1):88-94.
[5]. Bettega G, Cinquin P, Lebeau J, Raphaël B. Computer-assisted orthognathic surgery: Clinical evaluation of a mandibular condyle repositioning system. *J Oral Maxillofac Surg*. 2002;60(1):27-34.
[6]. Gateno J, Miloro M, H. Hendler B, Horrow M. The use of ultrasound to determine the position of the mandibular condyle.*J Oral Maxillofac Surg*. 1993;51(10):1081-1086.
[7]. Xue H, Zheng J, Cui Z, et al. Low-intensity pulsed ultrasound accelerates tooth movement via activation of the BMP-2 signaling pathway. *PLoS One*. 2013;8(7):e68926.
[8]. Xue H, Zheng J, Yuching Chou M, Zhou H, Duan Y. The effects of low-intensity pulsed ultrasound on the rate of orthodontic tooth movement. *SeminOrthod*. 2015;21(3):219-223
[9]. Volk J, Kadivec M, Mušič MM, Ovsenik M. Three - dimensional ultrasound diagnostics of tongue posture in children with unilateral posterior crossbite. *Am J OrthodDentofacialOrthop*. 2010;138(5):608-612.
[10]. Naser-Ud-Din S, Sampson WJ, Dreyer CW, Thoirs K. Ultrasound measurements of the masseter muscle as predictors of cephalometric indices in orthodontics: a pilot study. *Ultrasound Med Biol*. 2010;36(9):1412-1421.
[11]. Soft Tissue Thickness for Placement of an Orthodontic Miniscrew Using an Ultrasonic Device. Bong-KuenCha**,** Yeon-HeeLee**,** Nam- KiLee**,** Dong-SoonChoi**and** Seung-HakBaek. The Angle Orthodontist.Vol 78, Issue 3:403-408 (May 2008)
[12]. Ultrasonics in endodontics: A review of literature Gianlucaplotino e tal JOE vol 33, no. 2 feb 2007