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Aids of Ultrasound in Dentistry.

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ABSTRACT

The aim of the review is to provide the clinicians with an overview of the recent advances in ultrasound imaging in dentistry. Ultrasound has become one of the common imaging modality next to conventional radiology. This review highlights the advancements in field of ultrasonography in dentistry. Dental imaging protocols begins with hard tissue imaging to evaluate the osseous contours, the position and relationship of hard and soft tissue. Apart from intra oral periapical radiograph there are advanced radiographic technique such as computed tomography,CBMT,magnetic resonance imaging and ultrasound have also found place in modern dentistry. Radiographs are valuable diagnostic tool, as the adjunct to clinical examination in the diagnosis of dental diseases. Ultrasound imaging technology has been extensively explored in recent years due to several advantages.

Keywords: Transducer, sound waves, three dimension, two dimension, ultrasound,salivary gland tumor,

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INTRODUCTION

After William Roentgen discovered x-rays in 1895, the head and neck region began to be explored in ways that had never been possible before. Dental radiology has long played an exerting and critical diagnostic role in dentistry. The technology for producing ultrasound imaging and the characteristics of sonic waves has been known for many years. Though the first attempt of practical application of ultrasound imaging was to search the sunken titanic in 1912 and the medical application being used after World War II in late 1940s and early 1950s. The imaging techniques were not sufficiently developed those days. As technology improved, Computed tomography (CT) had been used occasionally to aid in diagnosis of conditions in the bone. However, routine use of CT is associated with high radiation doses. Low dose cone beam CT has been developed specifically for use in the dental and maxillofacial regions[3]. Inultrasonography the mechanism of action depends on the ultrasonic waves that are produced by electrically stimulating a piezoelectric crystal called a transducer. As the beam strikes an interface or boundary between tissues of varying acoustic impedance (e.g. muscle and blood) some of the sound waves are reflected back to the transducer as echoes. The echoes are then converted into electrical impulses that are displayed on an oscilloscope, presenting a 'picture' of the tissues under examination [5]. Ultrasonography (US) is one method of imaging which lacks radiation hazards, this imaging technique can be used for bone and soft tissue examination, either normal or pathological lesions, detection of calculi in major salivary glands, TMJ imaging, detection of fractures & vascular lesions. Proper application of this method can be of great importance in dentistry[3].

Principle of Ultrasound

Ultrasound waves are created by a piezoelectric crystal within a ceramic probe. The electric current causes crystal to vibrate, returning waves create electric current. This propagates through reflections, refraction, diffraction, attenuation and scattering. Waves travel through the tissue and are partly reflected at each tissue interface. Ultrasound transducers send out high frequency sound waves into the body tissue and receive reflected echoes, that are processed and displayed as images. Clinical purpose ultrasound is generated by transducers which convert electric energy into ultrasonic waves. This is produced by piezoelectricity and magnetostriction [4]. Each transducer is focused at a particular depth. In pulsed operating modes, ultrasound pulses contain additional frequencies with both higher and lower frequencies. The range of frequency produced by a given transducer is termed as bandwidth. Shorter the pulse of ultrasound produced by the transducer , greater the bandwidth [1]. For continuous wave, a constant alternating current is applied to the transducer. Ultrasound echogenicities were described in comparison with adjacent structure as follows hyper echoic (brighter), Hypo echoic (dark), isoechoic (equal) and anechoic (no internal echoes) or mixed signals. Ultrasonography can be indicated in inflammatory soft tissue conditions of the head and neck region and superficial tissue disorders of the maxillofacial region [3].

Application of Ultrasound In Dentistry

In particular, in the oral and maxillofacial regions, Ultrasound may be clinically applied to evaluate salivary gland-related diseases, lymph node-related diseases, subcutaneous diseases and tongue related diseases. However, most dentists do not know the utilities of ultrasound for the diagnosis of various kinds of oral diseases and it is very disadvantageous for patients with any of the diseases[6].

Ultrasound in Healing

The effects of ultrasound imaging in bone repair has several mechanisms. In physical effect, vibrations generated in all tissue components, including intracellular and extracellular fluids and cell membranes, which produce a micro massage effect in tissues, causing mechanical stimulation. Application of ultrasound increases synthesis of angiogenesis related cytokines such as interleukin, fibroblast growth factor, and vascular endothelial growth factor. The rate of angiogenesis is one of the basic elements in the bone healing process. Ultrasound has been used in remodeling phase of wound healing [6].

Ultrasound Imaging in Sterilization

Ultrasound imaging waves are generally used to clean surfaces and achieve therapeutic benefits [6]. In many of those applications, ultrasound imaging creates its enhanced cleaning or therapeutic effects from its

interaction with bubbles. Bubbles are microspheres of air stabilized by a thin film on their exterior. When subjected to the rhythmic pulsations of pressure created by ultrasound imaging waves, expand and contract, generating local fluid motion around the bubble called acoustic micro streaming [2]. This acoustic micro streaming can generate sufficient shear on the surrounding surfaces or tissue to mechanically alter those surfaces, achieving the desired effect [6].

Ultrasound for Treatment of Microbial Disease

The science of photodynamic antimicrobial chemotherapy utilizes photo sensitizers and light of appropriate wavelength to produce highly reactive free radical species, which then destroy the microbial pathogens. It has been shown to be ineffective against some microbial because of the limited tissue penetration of visible light. Recently, some photo sensitizers have been discovered which produce free radicals on irradiation with US. These photo sensitizers are termed sonosensitizers. Focused US can penetrate into tissue more deeply than light and can be focused into a small region to activate sonosensitizers, which was termed sonodynamic therapy which can destroy bacteria, yeasts, viruses and parasites [6].

Ultrasound in Detection of Foreign Bodies

Radiolucent foreign body like wood, bamboo twig, thorn, fish bone etc., pose a diagnostic challenge. Ultrasound imaging is an excellent diagnostic aid in diagnosing and locating wooden foreign body [4]. Wood is a highly echogenic material. A high frequency linear transducer ultrasound imaging from 7.5MHZ can detect even smallest wooden foreign body of 3mm and the specificity is 95%[6]. Wood is seen as hyper echoic foci with accompanying acoustic shadows.The shadows may be complete or incomplete due to the angulations of insonation or the composition of the foreign body [6].

Ultrasound in Odontogenic Cysts of Maxillofacial Region

Ultrasound can be used to identify many cysts in head and neck region which is extending both into hard tissue and soft tissue. It can provide information on the pathological nature of the lesion, content of lesion, inflammatory process, and capsular thickness of lesions. It can also differentiate between simple and complex cyst[6].

Ultrasound in salivary gland tumor

Ultrasound helps in differential diagnosis of salivary gland diseases. In acute inflammation, the glands are enlarged and hypo echoic with increased blood flow, they may contain multiple small, oval, hypo echoic areas. In chronic inflammation, the glands are smaller or normal sized, hypo echoic and Inhomogeneous [8].

Ultrasound in differentiating Nature of the Mass

Identification of the mass is more difficult. Almost all of the salivary gland tumors (benign and malignant) have been reported as hypo echoic, thus an absolute differentiation is impossible. Differentiation is possible to some extent based on additional findings for lesion being benign in nature, like the presence of sharp borders. Well-circumscribed tumors are more often benign.[8]

Ultrasound in TMJ disorders

Ultrasound serves as a diagnostic instrument in the study of TMJ disc displacement. it have proved to be accurate in the detection of joints with effusion and to study clinically painful joints [12]. Ultrasound at high intensities caused thermal damage in bone and lower intensity doses lead to new periosteal bone formation. The therapeutic efficacy of ultrasound alone in the temperomandibular disorders is lacking and it is always used in the combination of electrical stimulation. The therapeutic of ultrasound is reported to be due to its thermal properties [6].

Ultrasound in Neck and Cervical Lymph Nodes:

High resolution sonography has become a first line imaging modality for the evaluation of cervical lymph

nodes. The thyroid gland, parathyroid gland and major blood vessel tumors of the neck can be easily assessed. The high resolution Ultrasound images which is currently available can detect lymph nodes, reveal changes in the architecture of cervical lymph nodes and assess their characteristics[6].

CONCLUSION

Ultrasound imaging in dentistry has been increasingly developed and studied in recent years. This technology will gain more space in dental practices. Ultrasound has been in use from many years which is known for its therapeutic use being effectively used as an adjuvant therapy for pain, tissue healing, inflammation and swelling [3]. Ultrasonography may provide a significant benefit to patients by allowing early detection of tooth lesions and defect [7]. Though diagnostic ultrasound has been used as a reliable diagnostic tool in medical field, but still not found its place as a routine diagnostic aid in orofacial region. It has several advantages over conventional radiography namely, its non- invasive nature, early reproducibility, possibility of real time imaging and inexpensive technique.

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