Perspective

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Remove Tooth Lesions during Dental Surgery

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Description

In surgery, bone cutting is a frequent and crucial operation. Ultrasonic Orthopedic Scalpels (UOSs) are a type of orthopedic device that have gained widespread use because of its ease and safety. In order to enhance cutter design and supplement the fundamental theory of the bone-cutting mechanism, it is crucial to have a thorough grasp of the cutting process and the bone removal behavior of a UOS. On the other hand, not much research has been done on the properties of ultrasonic cutting. This work explored the behavior of bone removal in ultrasonic bone cutting and characterized the bone-cutting processes of a UOS based on bone structure. According to this study, distinct cutting properties would result from an ultrasonic vibration direction that differed from the lamellar arrangement and collagen fiber orientation. The cutting modes were categorized into four common sorts based on this. The four cutting modes' crack propagation and chip generation in compact bone were examined and analyzed, and this led to the definition of the ultrasonic bone cutting removal behaviors. Simultaneously, the surface morphology demonstrated notable variations in the surface damage for various cutting modes, corroborating the notion that the bone removal behaviors varied for various modes.

Bone tissue

Additionally, the analysis of the force signals revealed that the various cutting modes had distinct cutting forces. Additionally examined were the cutting forces' static and dynamic components. The study showed that the microscopic and submicroscopic structure of bone during ultrasonic cutting is correlated with bone loss. These findings offered suggestions for assessing bone tissue damage brought about by UOSs, enhancing bone-cutting surgery, enhancing orthopedic instrument design, and enhancing the fundamental principles of bone-cutting theory. Bone cutting is a crucial cutting technique used in bone plasty, bone healing, and the treatment of bone disorders. Cutting through bone can be difficult because cutting causes damage to the bone tissue and wears out the cutting tool. Bone saws, bone chisels, and rongeurs instruments frequently used in the medical field for cutting bone have a number of disadvantages that lead to burns and damage to bone tissue.

By doing this, bone cutting is stopped from developing. An ultrasonic orthopedic scalpel uses high-energy ultrasonic vibration produced by piezoelectric ceramics to remove bone tissue more effectively than traditional bone-cutting tools. A UOS, for instance, can successfully remove tooth lesions during dental surgery without endangering the nearby blood vessels or gums. Furthermore, a UOS can be performed with a laminectomy in order to successfully remove hard bone and shield the nearby meninges. This new kind of orthopedic medical device is referred to as a little precision surgical tool that uses little power since it can extract bone gently and smoothly with little harm, lowering the dangers associated with bone surgery.

Bone cutting

Conventional methods of bone tissue removal are typically the focus of studies on cutting behaviors and removal mechanisms. The cutting direction is typically divided into multiple distinct directions due to the highly organized structure of bone tissue. This has led to the proposal of an orthogonal cutting model to study the cutting forces, surface morphology, chip creation, and crack propagation during the bone-cutting process. By means of trials involving orthogonal cutting on the compact bone, investigated crack propagation and fracture toughness, analyzed the surface morphology and chip formation, and supplemented the basic theory of the cutting process. The fracture mechanism was established for varying depths of cut after observing and analyzing the characteristics of three cutting directions, during which the cutting forces and surface damage were recorded to determine the chip formation mechanism.

However, several researchers have increasingly included ultrasonic vibration into the cutting process in an effort to enhance the cutting performance of conventional instruments. When ultrasonic vibration was used to medical drilling, it was discovered that vascular rupture and debris production could be successfully avoided. A novel machining technique employing an ultrasonic-impact cutting approach was proposed, based on the exploration of the effects of various vibration parameters on the cutting force during ultrasonic-assisted bone drilling or milling.

Created sagittal saws with ultrasonically aided technology a piezoelectric ceramic plate was used to generate ultrasonic vibration at the tooltips of the saws. The outcomes demonstrated that, in comparison to the control blades, the cutting temperature and time were somewhat lowered. It's also crucial to remember that ultrasonic energy was only utilized as a cutting auxiliary in the research mentioned above. In the interim, a number of researchers have created surgical instruments that primarily use ultrasonic radiation. Created a longitudinal-torsional ultrasonic needle for deep bone penetration. After thoroughly examining the design, vibration properties, and *in vitro* cutting of the needle, it was shown that ultrasonic vibration may greatly enhance the effect of bone penetration. Created a unique UOS device for bone cutting that uses cymbal transducers; the process of bone tissue cutting has not been investigated; the cymbal configuration eliminates the need to adjust the cutting insert to resonance. When compared to instruments that use ultrasonic assistance, UOSs focus energy on the narrow front of a tool, allowing the ultrasonic energy to take center stage in the process of cutting bone. Thus, in this study, ultrasonic cutting as opposed to ultrasonic-assisted cutting is used to characterize the bone-cutting procedure of UOSs. Moreover, research on UOS chip generation and bone cutting behavior is scarce.