

Device and Method for Selective Removal of Bone Versus Soft Tissue Using Ultrashort Laser Pulses and Spectroscopic Feedback

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Technology description

The ability to surgically operate on one tissue structure without inflicting damage to surrounding structures is especially important for the cases in which vasculature and nervous tissues are juxtaposed next to bone. One common example is the laminectomy procedure performed to relieve spinal stenosis, where delicate nerve fibers course throughout the vertebra and are highly sensitive to even minor damage. A second particular example of surgical removal of juxtaposed tissues is the production of a craniotomy for both clinical and research purposes. The removal of bone in all cases is a fine surgical skill, typically performed with a hand-held dental drill. Thus the quality of the laminectomy or craniotomy can vary widely from surgeon-to-surgeon, and even from day-to-day for the same surgeon. This variability can influence the physiology of the underlying brain, including the potential for inflammation and disturbed vasodynamics and cortical spreading depression.

Ultrashort laser pulses are used to induce nonlinear processes that lead to the formation of a plasma in wet or submerged tissue that vaporizes bone at the focus of the beam. The region of ablated bone can be adjusted to range from 1 μm to 100 μm in lateral extent and an equal value in depth. Atomic spectra obtained from the vaporized tissue allow the composition—i.e., bone versus soft tissue—to be determined in real-time. This procedure operates in saline, the bathing solution for physiological tissue, and can be naturally incorporated into robotic surgery.

Advantages

Scientists at UC San Diego have developed a method to rapidly remove bone with microscopic precision in a non-contact process that automatically avoids damage to surrounding and underlying soft tissue including nerve, muscle, and connective tissue.

Institution

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