G33 The Trabecular Bone in Identification — Algorithms and Fractal Analysis

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After attending this presentation, attendees will be aware of new information regarding the use of mandibular trabecular bone patterns to establish positive identification.

This presentation will impact the forensic science community by establishing a method of calculating the significance of mandibular trabecular bone patterns to arrive at a positive identification.

According to the University of California, Berkeley's orthopedic biomechanics research, the trabecular bone can be classified as a porous cellular solid, consisting of an irregular 3D array of bony rods and plates called trabeculae, which are composed of a calcified matrix. Bone marrow fills the pore spaces. Because all free bone surfaces are covered with bone cells, bone is a living tissue that is self-healing and has the ability to adjust its morphology in response to changes in its mechanical environment, which is the so-called but poorly understood phenomenon of bone remodeling. As such, the mechanical complexity of this two-phase biological tissue surpasses any engineering material, making it a fascinating subject of study, regardless of clinical applications.

The process of dental identification compares postmortem to antemortem data. It involves the analysis of the following factors: the presence and absence of teeth; crown and root morphology and their interrelationships; evaluation of the periodontal status; the type and extent of restorative, endodontic, fixed, removable, and implanted materials; tori and sinus configuration; anomalies and pathologies of teeth and bone; and, trabecular pattern morphology.

Few studies have been conducted on the statistical reliability of trabecular bone patterns for identification purposes. Some of these studies utilize algorithms, a mathematical expression that produces the answer to a question or the solution to a problem in a finite number of steps. Other studies perform fractal analysis, which involves assigning a fractal dimension or other fractal characteristic to a dataset. The theoretical dataset, pattern, or signal can include natural geometric objects, sound, market fluctuations, heart rates, digital images, molecular motion, and networks. There are several approaches for fractal analysis of odontological data. Fractal geometric techniques and methodological principles can be applied to study the trabecular bone. Radiographs can be analyzed to assess trabecular bone structure and predict elastic modulus and strength. Digital image analysis can be applied to study cadaver mandibular trabecular bone patterns. Fractal dimension and lacunarity analysis can be applied to dental radiographs and periapical radiographs, and morphodigital techniques can be applied to the mandibular trabecular bone in panoramic radiographs. The tile-counting method can be used for fractal analysis of mandibular trabecular bone. Particle counting methods can be applied to determine the anatomical variations of trabecular bone structure in intraoral radiographs. The trabecular bone can be analyzed using site-specific fractal values calculated from cone beam Computed Tomography (CT) images. The fractal dimension can be determined for the mandibular trabecular bone measured on digital and digitized images.[1-11]

As a continuation of the research project The Trabecular Bone in Identification, this current research focuses on algorithms and fractals as an aid and tool for trabecular bone pattern morphometric analysis and comparison.[12,13] This could lead to a revolutionary approach in handling human trabecular jaw bone patterns for identification and could be particularly practical in mass disaster situations involving large numbers of edentulous victims and/or fragmented remains.

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Trabecular Bone, Algorithms, Fractal Analysis