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Biomechanical Aspects of Primary Implant Stability: A Human Cadaver Study

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ABSTRACT

Background: The quality of bone is an important factor in the successful implant treatment, and it is evident that higher implant failure is more likely in poor quality of bone. The primary stability of oral implants related to resistance to micromotion during healing is influenced by bone quality, surgical technique, and implant design.

Purposes: The aims of this biomechanical study were to explore the effect of bone quality on initial intraosseous stability of implants, and to determine the correlations between the bone quality and implant stability parameters.

Materials and Methods: Twenty-four implants (Neoss Ltd., Mölnlycke, Sweden) were placed into anterior and posterior regions of three human cadaver mandibles. The bone densities of implant recipient sites were preoperatively determined using computerized tomography (CT) in Hounsfield unit (HU). The maximum insertion torque values were recorded, and primary implant stability measurements were noninvasively performed by means of resonance frequency analysis (RFA).

Results: The bone density values ranged from -267 HU to 553 HU. It was found that mean bone density, insertion torque, and RFA values were 113 ± 270 HU, 41.9 ± 5 Ncm, and 70 ± 7 implant stability quotient (ISQ), respectively. Statistically significant correlations were found between bone density and insertion torque values ($r = 0.690$, $p < .001$); bone density and ISQ values ($r = 0.557$, $p < .05$); and insertion torque and ISQ values ($r = 0.853$, $p < .001$).

Conclusion: CT is a useful tool to assess bone quantity and quality in implant recipient sites, and bone density has a prevailing effect on implant stability at placement.

KEY WORDS: bone density, CT, human cadaver, implants, implant stability, insertion torque, resonance frequency analysis
