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An In-Vitro Comparison of Different Palatal Sites for Orthodontic Miniscrew Insertion: The Effect of Bone Quality and Quantity on Primary Stability

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Introduction: The maxillary hard palate is a desirable location for orthodontic miniscrew (OMS) placement. The related anatomy is well known, but little data exists regarding the primary stability of palatal OMSs.

Purpose: To assess the quality and quantity of human cadaveric palatal bone at different insertion sites using microCT imaging, and to determine their effect on the primary stability of OMSs.

Materials and Methods: One hundred and thirty OMSs (VectorTAS™, 6 mm) were inserted into ten human cadaveric maxillary hard palates and maximal insertion torques (IT) were recorded. MicroCT images were obtained before and after OMS insertion for assessment of bone quality and quantity [bone mineral density (BMD), bone thickness (BT) and length of screw engagement (LSE)]. Statistical analyses were carried out to assess differences in BMD, BT, LSE and IT at the different insertion sites, as well as correlations between IT and measurements of BMD, BT and LSE. Perforations into the nasal cavity were recorded.

Results: Significant differences ($p < 0.0005$) were found among insertion sites for IT, BT, and LSE, but not BMD ($p = 0.004$). Correlations were found between IT and BMD ($r_s = 0.42$, $p < 0.0005$); IT and BT ($r_s = 0.58$, $p < 0.0005$); and IT and LSE ($r_s = 0.58$, $p < 0.0005$). A high number of OMS perforations into the nasal cavity were recorded posterior to the permanent second premolars.

Conclusions: The primary stability of OMSs is moderately affected by bone quality and quantity. Higher primary stability may be obtained anterior to the second premolars and parasagittally at the level of the permanent first molars. The posterior palate is more susceptible to OMS perforations into the nasal cavity.