

Suitability of Dose-reduced Modes in Cone Beam Computed Tomography in Digital Planning of Orthodontic Mini Implants

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Background

Orthodontic mini implants (OMIs) are frequently used as temporary anchorage devices. In the upper jaw they are often inserted in the anterior palate (Wilmes et al., 2015, Ludwig et al., 2011) (Fig. 1). High variability in bone height has been demonstrated in previous studies, and especially in case of low bone quantity detected at lateral cephalogram (ceph) (Möhlhenrich et al., 2021), virtual insertion employing cone beam computed tomography (CBCT) can be beneficial (Jung et al., 2011). With the advent of low dose protocols, the question arises to what extent dose reduction is possible for digital planning.

Methods

Eight ethanol-fixed human cadavers were utilized, and the upper jaws were scanned employing a large field of view (10x11 cm) and a dose reduced mode (DR) as well as in the standard dose mode recommended by the manufacturer (HS) using a single machine. Additional, cephs were recorded. Datasets were registered using a commercial software, and the vertical height of the anterior palate was measured at standardised localisations (Fig. 2 & Fig. 3) by a single operator. All measurements were repeated after two weeks to compute reliability. To compare the obtained vertical height, the Kruskal-Wallis test was used, and in case of significance, the Nemenyi post-hoc test with Bonferroni p-value correction was used. Results were found significant at $p < 0.05$.



Fig. 1: Orthodontic mini implants as temporary anchorage device during treatment

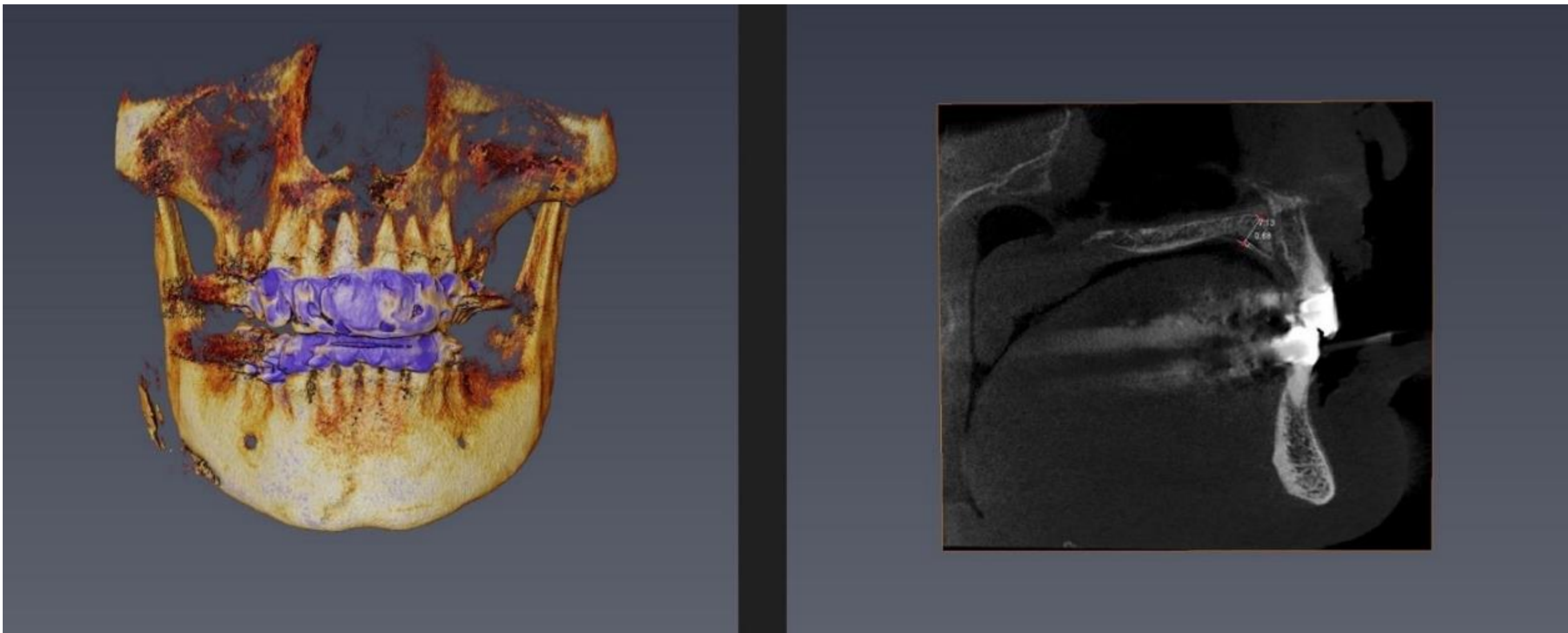


Fig. 2: Dataset registration and vertical measurement, CBCT

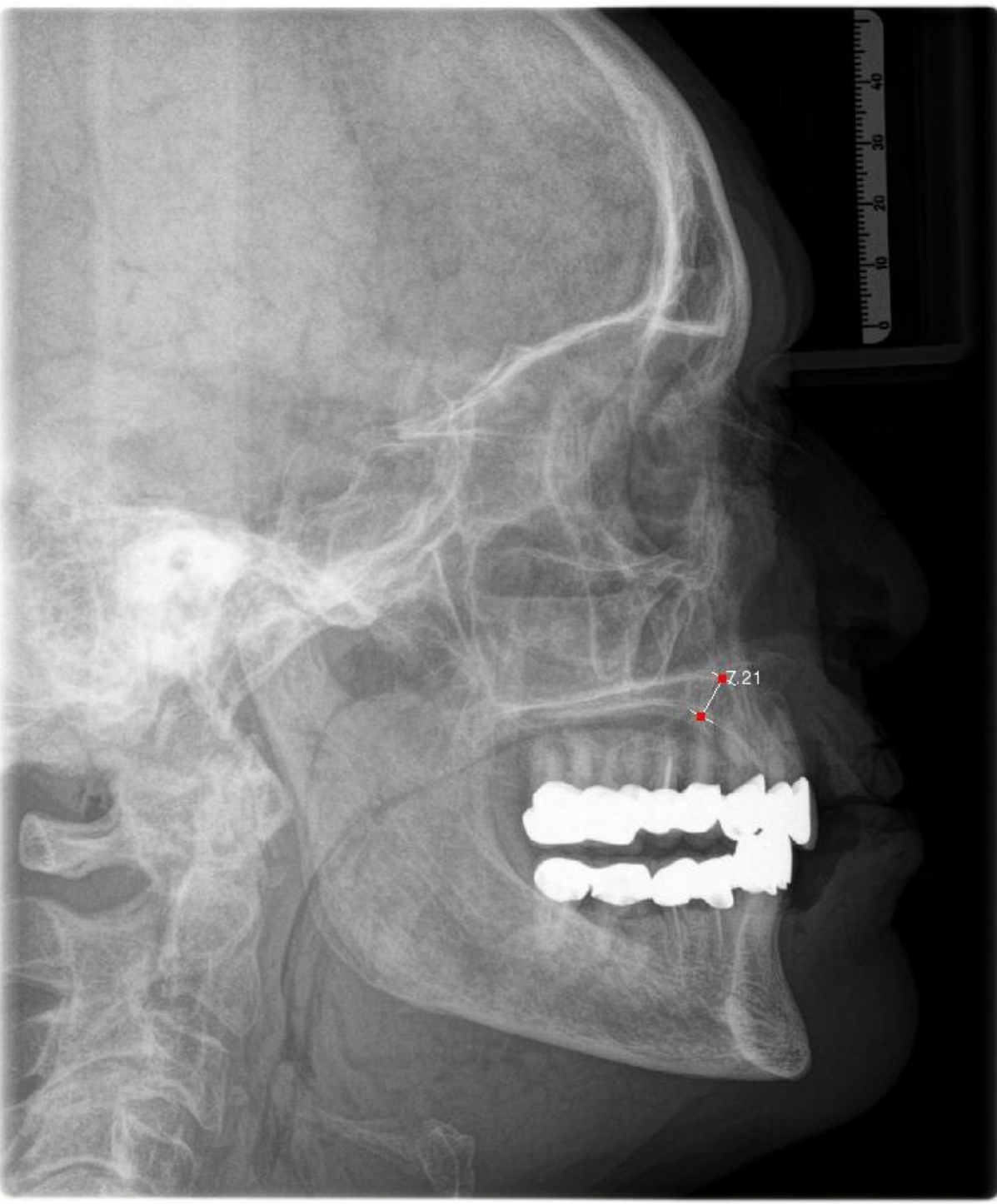


Fig. 3: vertical measurement, Ceph

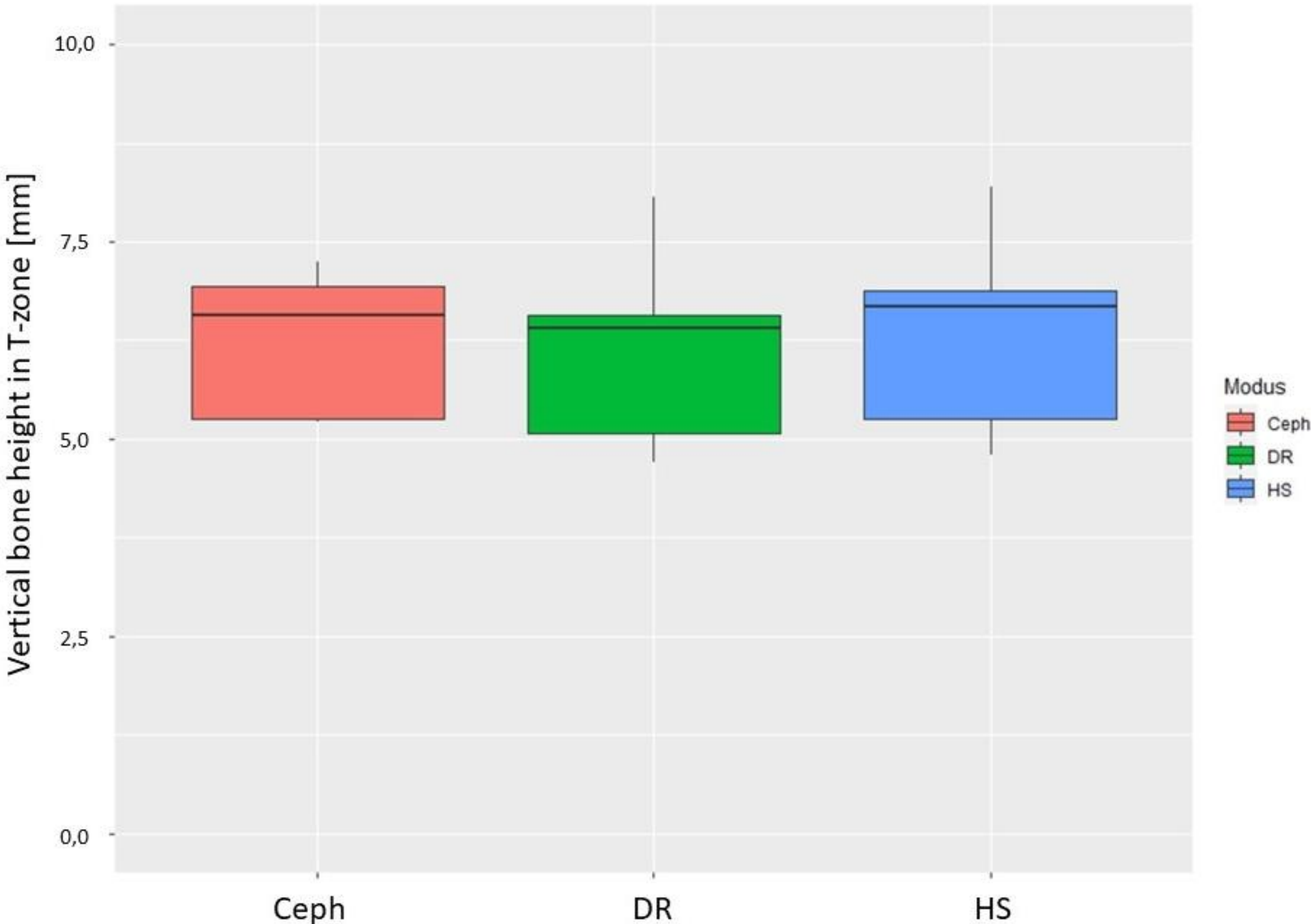


Table 1: Height of vertical bone availability depending on the CBCT device

Results

The reliability of repeated measurements was high (0.99). When comparing the vertical measurements, minor differences were observed among the different protocols ($p=0.609$). Despite, vertical bone height tended to be lower at the anterior palate in DR mode ($6.15 \pm 1.23\text{mm}$) compared to the HS mode ($6.34 \pm 1.24\text{mm}$) and ceph ($6.24 \pm 0.9\text{mm}$) (Table1).

Conclusion

The present investigation confirmed that dose reduction is associated with minor but non-significant dimensional alterations, thus justifying the applicability of the DR protocol for virtual OMI planning when usage of CBCT is justified.

References

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