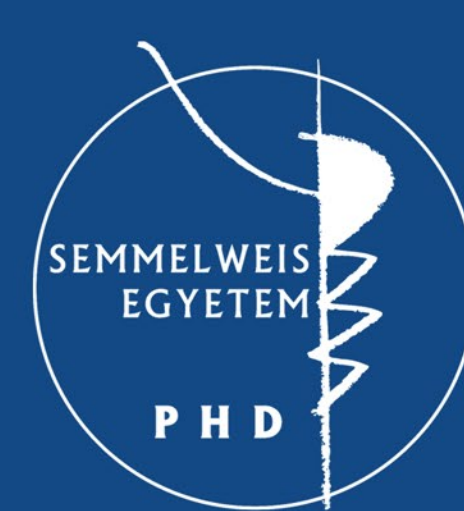


APPLICATION OF INTRAORAL SCANNER TO IDENTIFY MONOZYGOTIC TWINS

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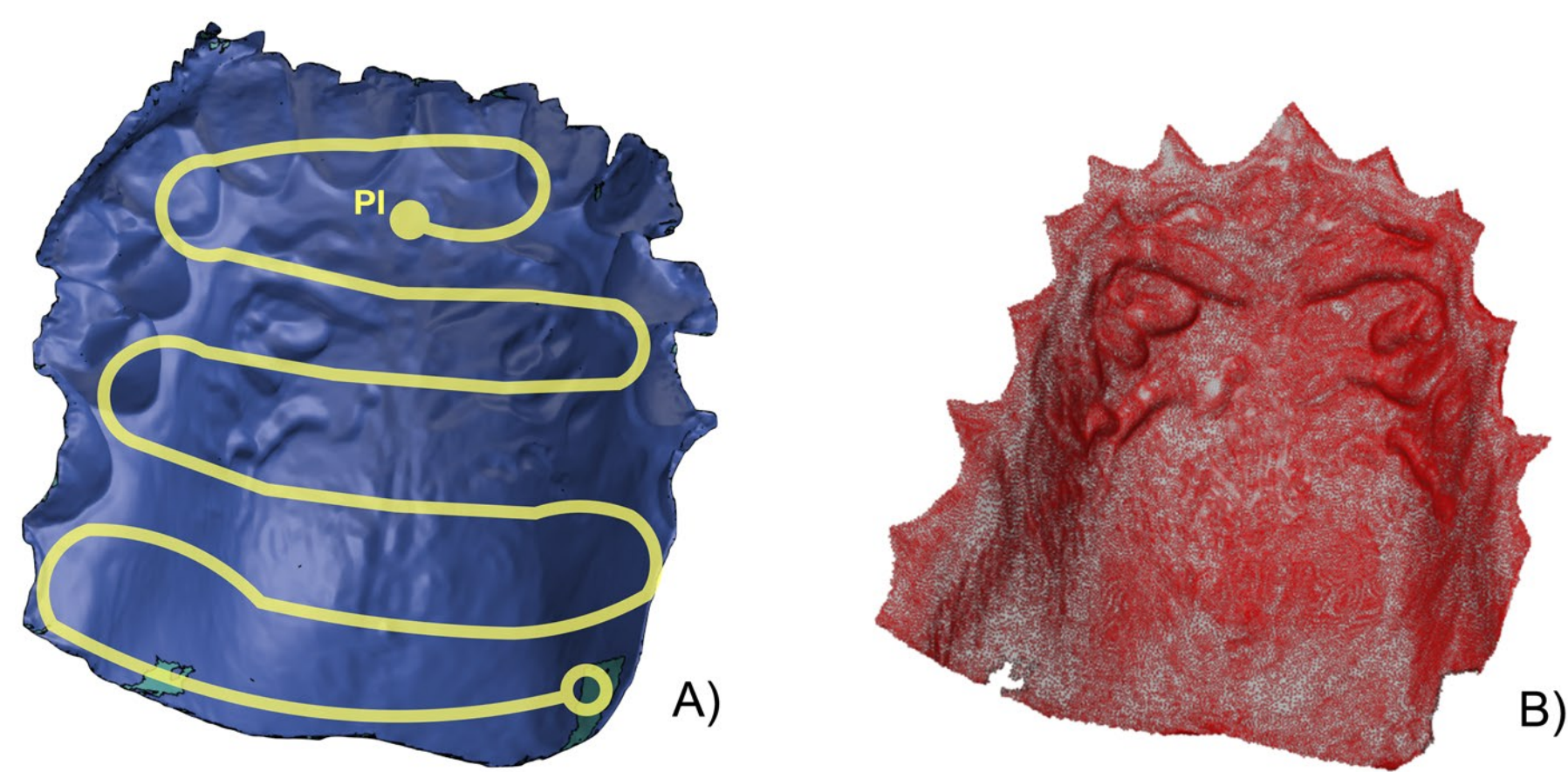


INTRODUCTION

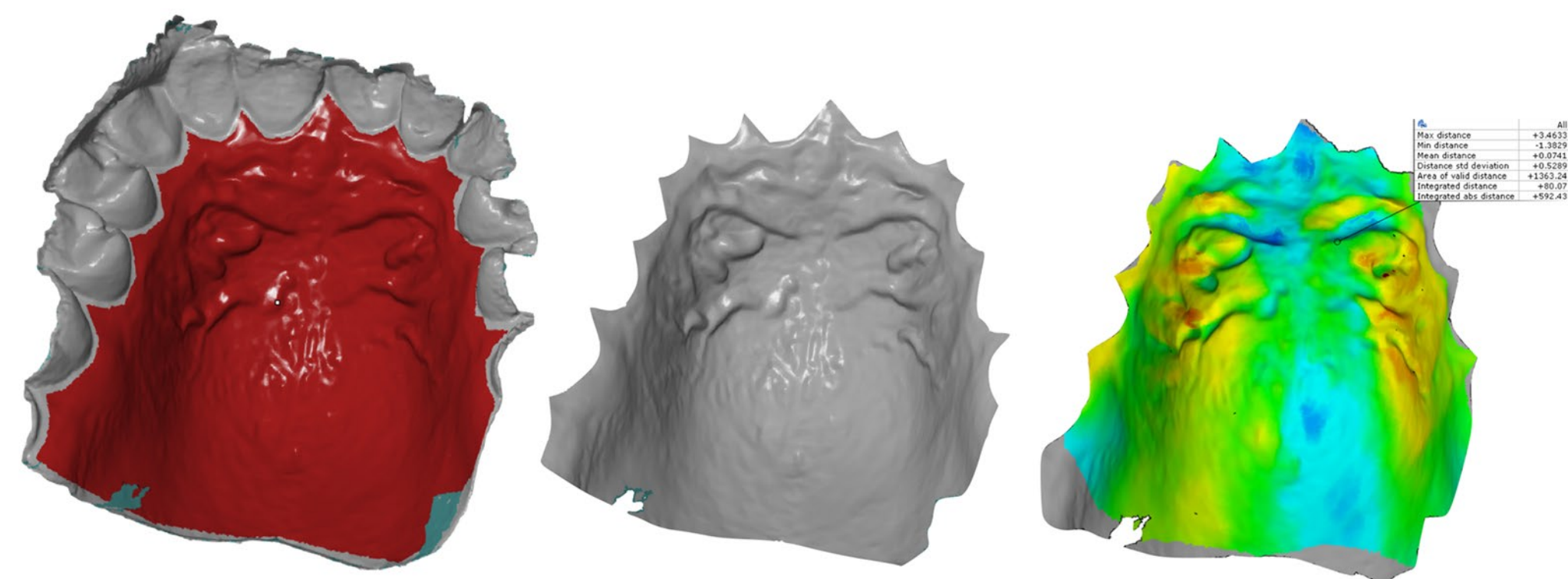
DNA base identification is a proper, high specificity method in most situations (1, 2). However, its identification could be challenged in a situation when there is a lack of database or DNA is identical for example in the case of monozygotic twins. There are approximately 91,7 million twins in the world and 28 million are monozygotic among them (3,4) and the twinning rate is growing in developed countries (4). Therefore, it is getting to be a more relevant problem to identify a monozygotic twin, which could be problematic in forensic science (5) if only DNA is available. The phenotypic differences could be used for identification but MZ twins resemble each other very much therefore it is very challenging to distinguish each other. To develop an automatic recognition method requires stable object overtime and during the measurement with small measurement error. Fingerprint is not identical but very similar between twins (6) thus it could be difficult to use if it is partially damaged, it can be easily ruined by accident or by fire or by water, or on purpose (7). Furthermore, the database is not always available (8). Rugae patterns have been studied for personal identification in the field of forensic odontology as it shows a considerable difference between subjects (9). Orthodontic treatment and extraction affect some part of it but not all and the shape of the rugae is remained constant during orthodontic treatment (10) and is well protected after severe burn of the body (11). Accuracy of intraoral scanners (IOS) are constantly improved, are getting very common in most dental office and are capable to register the 3D morphology of the palate digitally. Therefore this study aimed to assess the repeatability (precision) of palatal intraoral scans in order to distinguish identical twins based on palatal morphology. Our secondary aim was to investigate the differences between monozygotic (MZ) and dizygotic twins (DZ).

MATERIALS AND METHODS

199 participants (64 pair of MZ, 32 pair of DZ, 3 triplets) were selected from the Hungarian Twin Registry (12). The zygosity was determined by the questionnaire (13,14). The age of twins was between 17 and 74 years. The sex of the twins was mostly the same except for seven pairs. The firstborn sibling was denoted by letter A and the second-born sibling by letter B. Using Emerald® intraoral scanner (Planmeca) the palatal area was scanned three times for each subject by serpentine-like movement (A). Teeth were cut off from the scans and only the palate was kept (B).

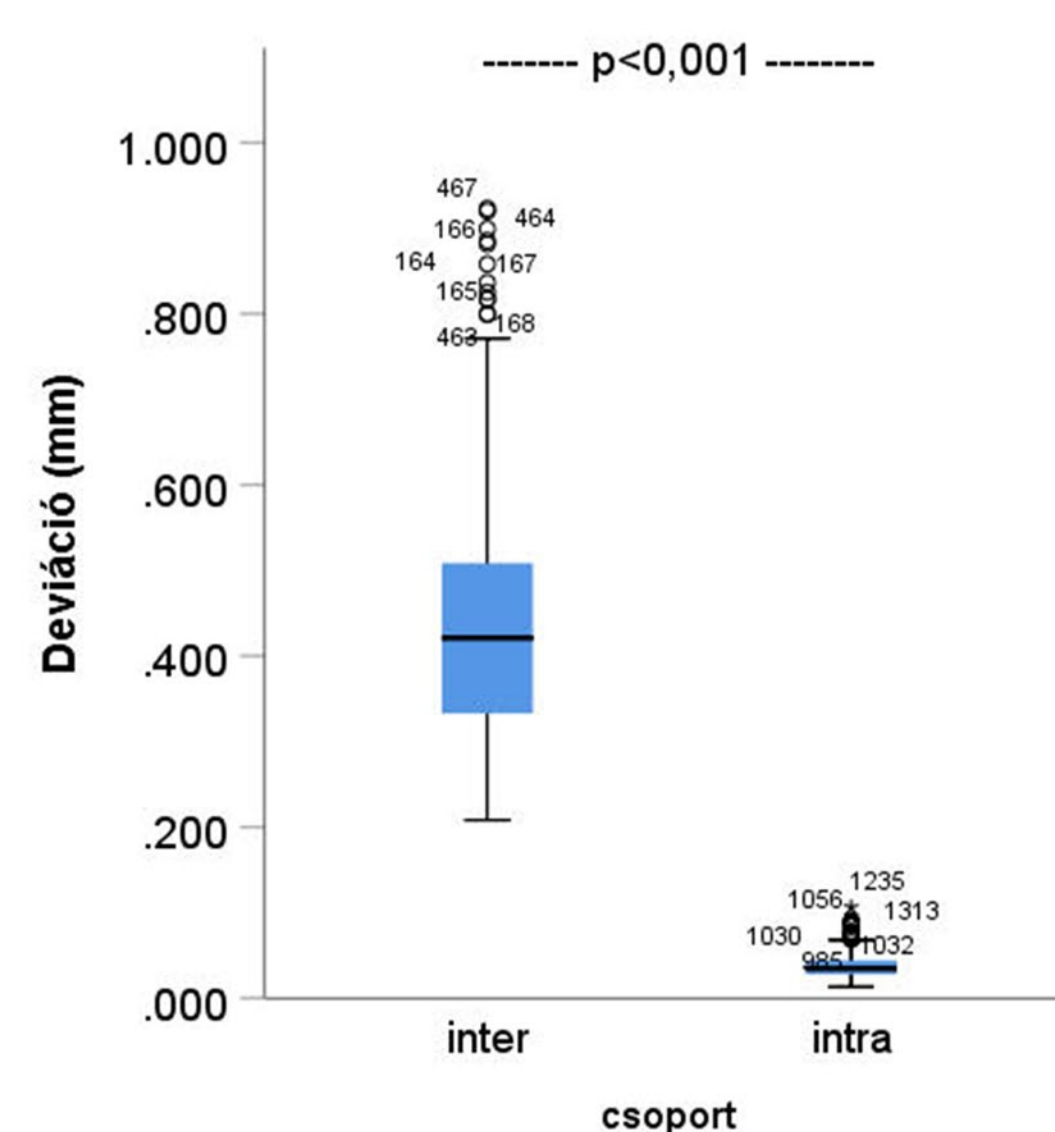


Scans were aligned in GOM Inspect® inspection software 2018 (GOM GmbH). The mean deviation was determined between the three replicates per subject (3 intratwin comparisons) between the two subjects within a twin pair (9 intertwin comparisons)



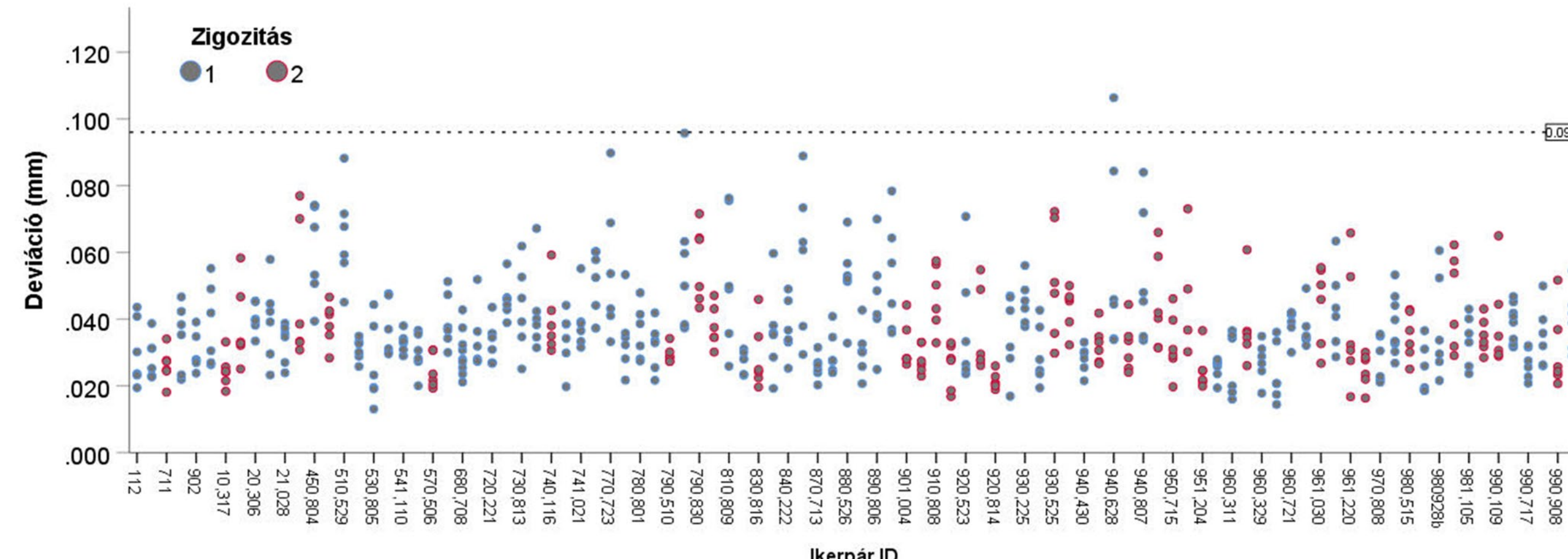
Statistics:
Data in the text and the figures are presented as mean $\pm$ standard error of mean (SEM). The variance for intratwin deviation, the comparison between intra- and intertwin deviations and between mono- and dizygotic intertwin deviations were determined by generalized linear mixed model with gamma distribution and log-link function in SPSS 25 (IBM SPSS Statistics for Windows, Version 24.0).

One-sided tolerance interval with covering the 99% of the population with 99% confidence was calculated for the reproducibility (upper bound) and for the intertwin (lower bound).



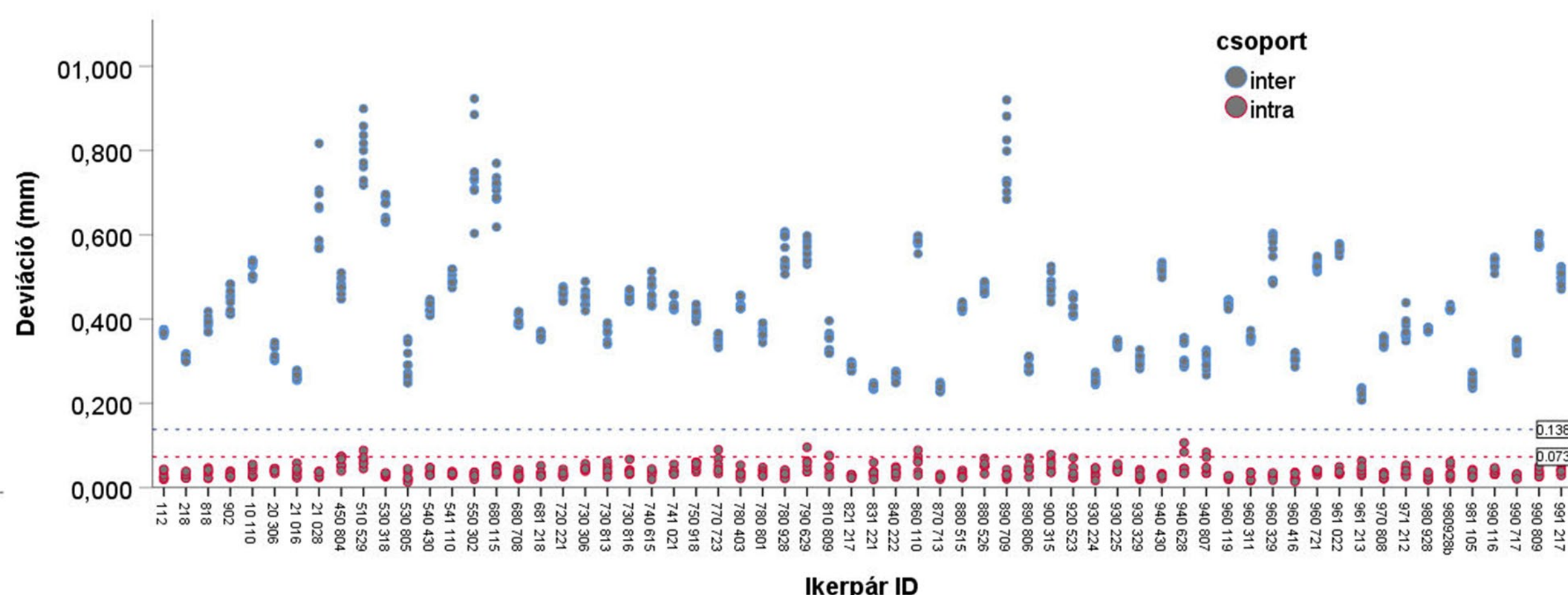
RESULTS

The mean repeatability of the palatal scans was $37 \mu\text{m} \pm 1,2 \mu\text{m}$. No differences were observed between mono- and dizygotic twins ($p < 0.001, n = 199$). The calculated upper tolerance interval was $96 \mu\text{m}$.

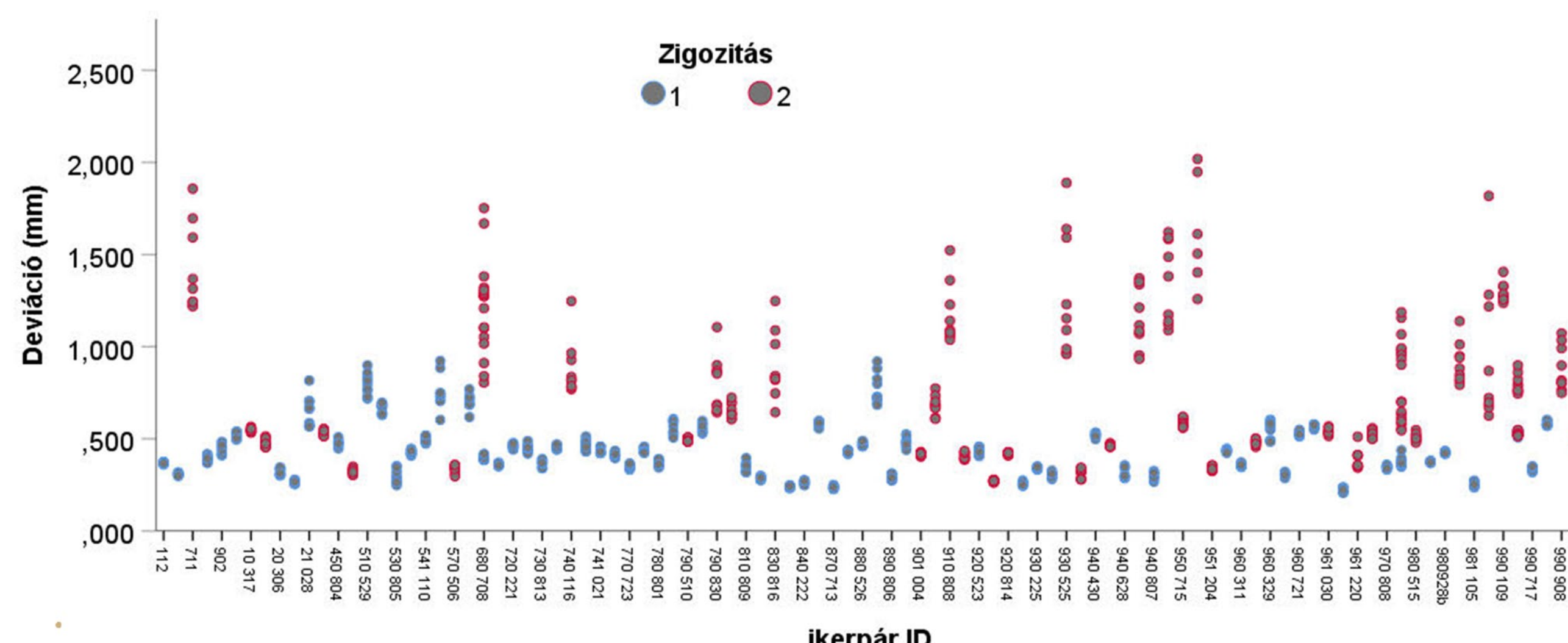
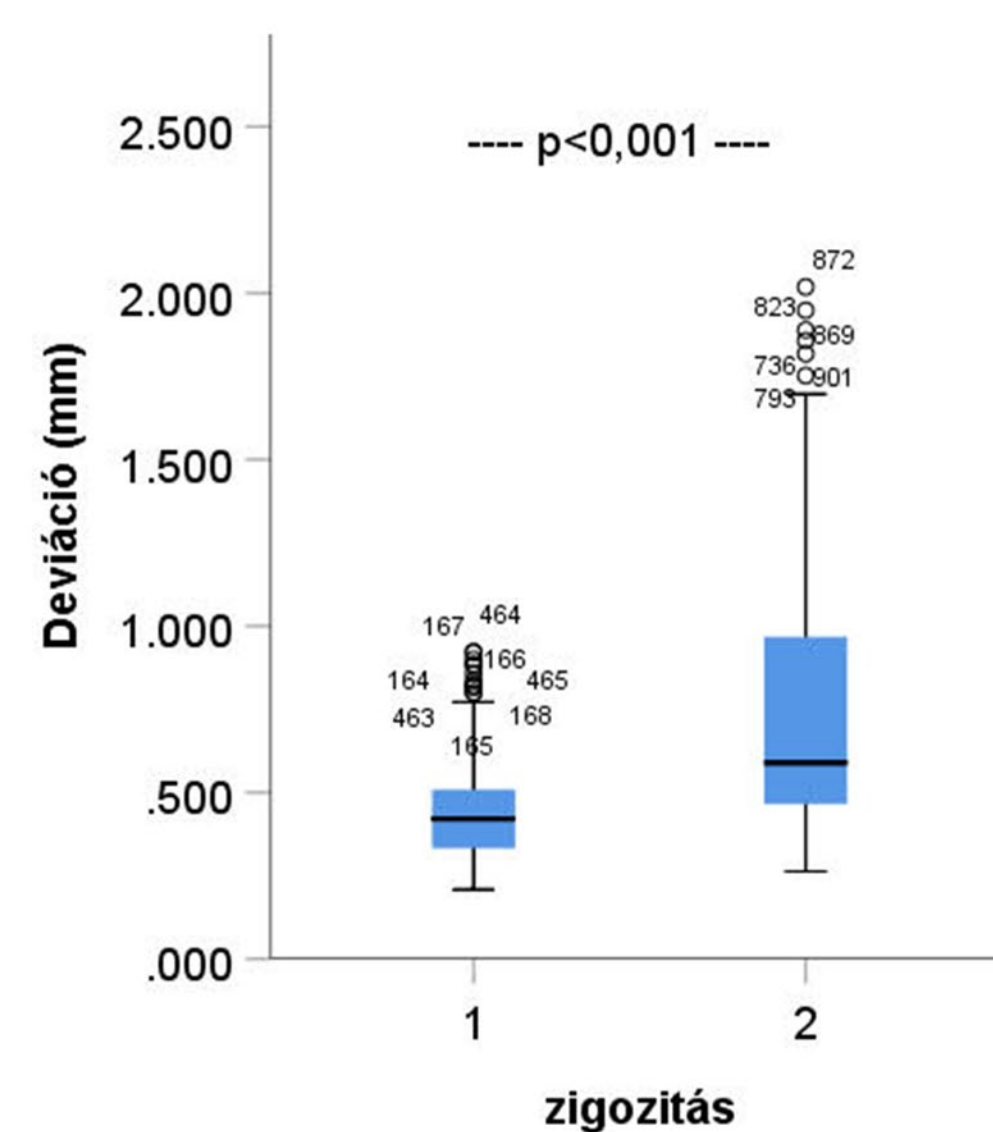


One outlier due to biological reason was excluded in comparison of intertwin deviation to intratwin deviation in monozygotic pairs.

The intertwin deviation of MZ was $411 \mu\text{m} \pm 15,8 \mu\text{m}$ which was significantly ($p < 0.001$) higher than the intratwin deviation values. The lower bound of the intertwin deviation ($138 \mu\text{m}$) was not overlapped with the upper bound of the reproducibility ($73 \mu\text{m}$).



The deviation of dizygotic twin pairs was $650 \mu\text{m} \pm 53 \mu\text{m}$ which was significantly ($p < 0.001$) higher than the deviation of monozygotic pairs.



CONCLUSION

The repeatability of the palatal intraoral scans are excellent and the calculated upper tolerance interval could be used as a reference value for quality control. At least 2 scans are necessary for control and after alignment of the two scans the measured deviation value is higher than $96 \mu\text{m}$ than the scan has to be repeated.

The morphology of the palate between monozygotic (MZ) twin pairs are different in spite of the identical DNA. Scanning repeatability on palatal soft tissues are reliable to differentiate within MZ twin pairs. This could be a great advantage in forensic odontology.



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