Tupel Ltd.

Accuracy testing of the MK2 Tupel 3D Implant Scanner

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SUMMARY

Repeatability
We scanned the same set of posts 3 times on the same scanner. The typical repeatability of a scanner was found to be ± 6 micrometers, and 1/30th of a degree.

Absolute accuracy
We scanned posts separated by a known distance to measure the absolute accuracy of the scanner. We found that the absolute accuracy of post measurements was ± 9 micrometers, over a distance of 60mm.

Note that these tests are performed in ideal conditions, for example in a laboratory with good scanning technique. Clinical use data will follow.

1.0 REPEATABILITY TESTING

If the same abutments are scanned twice, the two scans should, in theory, match perfectly. We made multiple scans of an abutment test setup (Figure 1) to find out how close our Implant scanner is to having perfect repeatability.

Figure 1: A stone cast model with 6 abutments embedded, used to measure the repeatability of post scanning measurements.

We tested 3 different scanners from our first production batch. With each scanner we scanned the test model 3 times. To find the repeatability, we align the 3 scans together, and calculate the standard deviation in position for each post. We also calculate the standard deviation in angular error for each post. The results are recorded in the following table.

Scanner serial number	Positional error (stdev in micrometers)	Angular error (stdev in degrees)
0011	±5.9	±0.031
0022	±6.3	±0.028
0024	±5.7	±0.044

The typical positional repeatability for 1 scanner was: ±6 micrometers
The typical angular repeatability for 1 scanner was: ±0.034 degrees (~1/ 30 of a degree).

2.0 ABSOLUTE MEASUREMENT ACCURACY TESTING

We must also measure the absolute accuracy of the implant scanner. The posts (Figure 2 below) are pushed against a steel block known to be 60.0 mm wide. If the scanner accurately measures the position of the posts, they should be spaced exactly 60.0 mm apart.

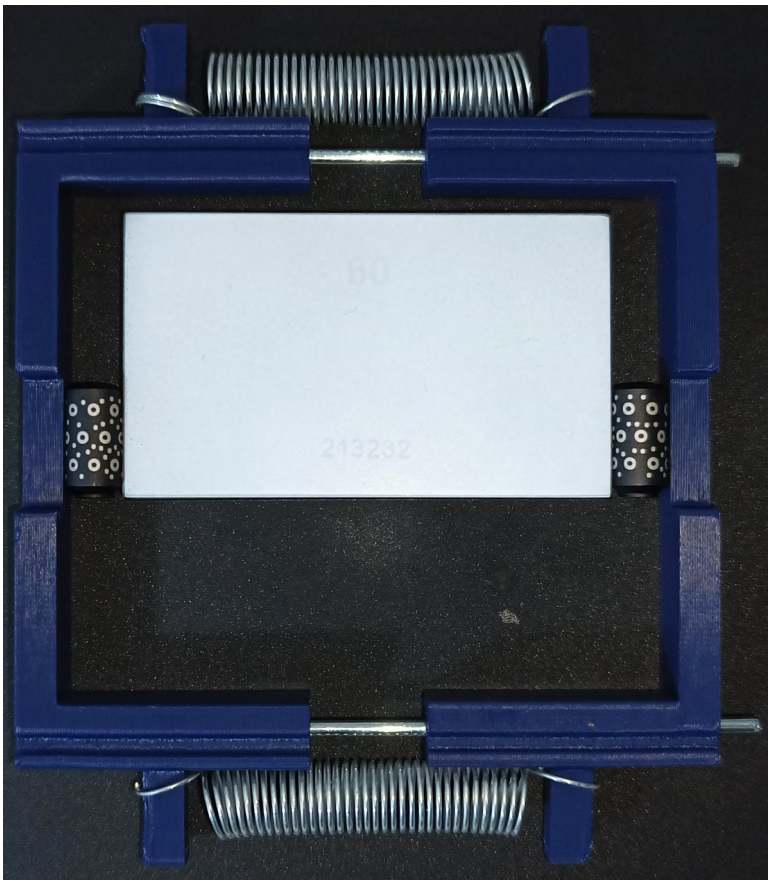

Figure 2: Posts pushed against a calibration block of known width, used to measure absolute accuracy.

The steel calibration block is certificated to be 60.0 mm ± 0.12 micrometers. Actually, the scanner should measure 60.0 mm + one post diameter since it measures centre to centre. We measured the diameter of the posts as 6.997 mm ± 5 micrometers (using with a calibrated micrometer). So the expected measurement distance is 60.0+6.997=66.997 mm.

The table below shows the actual measurement results.

Scanner serial number	Measured post separation, average of 10 scans (millimeters)	Absolute measurement error (micrometers)
0030	67.00529	+8.29
0033	66.99744	+0.44
0032	66.98628	-10.72

The average absolute measurement error over 3 scanners was: -0.66 micrometers ± 9 micrometers.

4.0 SIGN OFF

We confirm that the results herein are accurate, correct and complete (13th Sept 2023):

Signed: 

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Position: Production Engineer, Tupel Ltd.

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