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IMPACT OF INTRAORAL SCANNER SLEEVES ON STL FILE ACCURACY: A METROLOGICAL APPROACH

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IMPACT OF INTRAORAL SCANNER SLEEVES ON STL FILE ACCURACY: A METROLOGICAL APPROACH

Max Troizier-Cheyne, Nicolas Lebon, Floriane Laverne

- Most accuracy studies rely on superimposition of a reference scan and a test scan using local best-fit algorithms
- Errors minimized, especially across larger objects
- Errors are always relative, and measure is not objective

Objective 1

Create a protocol to assess accuracy using an objective metrological approach.

- Intraoral scanner manufacturers have introduced different protective sleeves to limit cross-contamination
- Scanning sleeves must maintain scanning performance while satisfying rigorous cross-contamination protocols

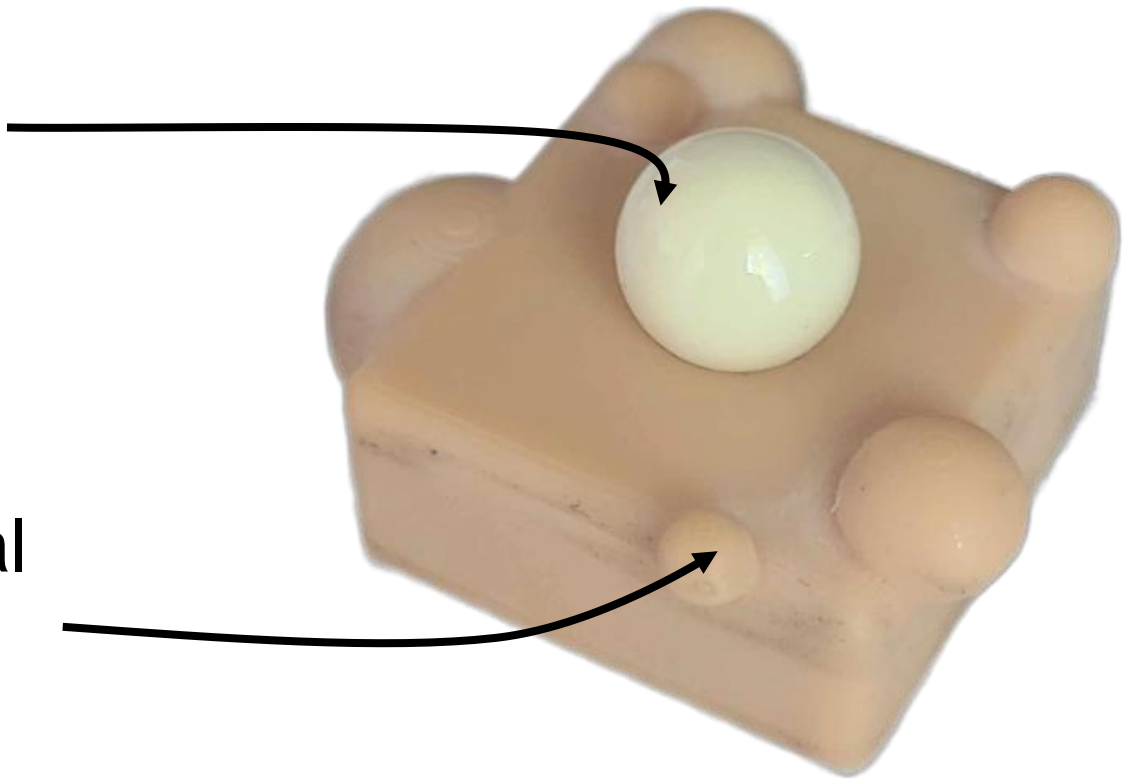
Objective 2

Compare the quality of STL files produced using different scanning sleeves

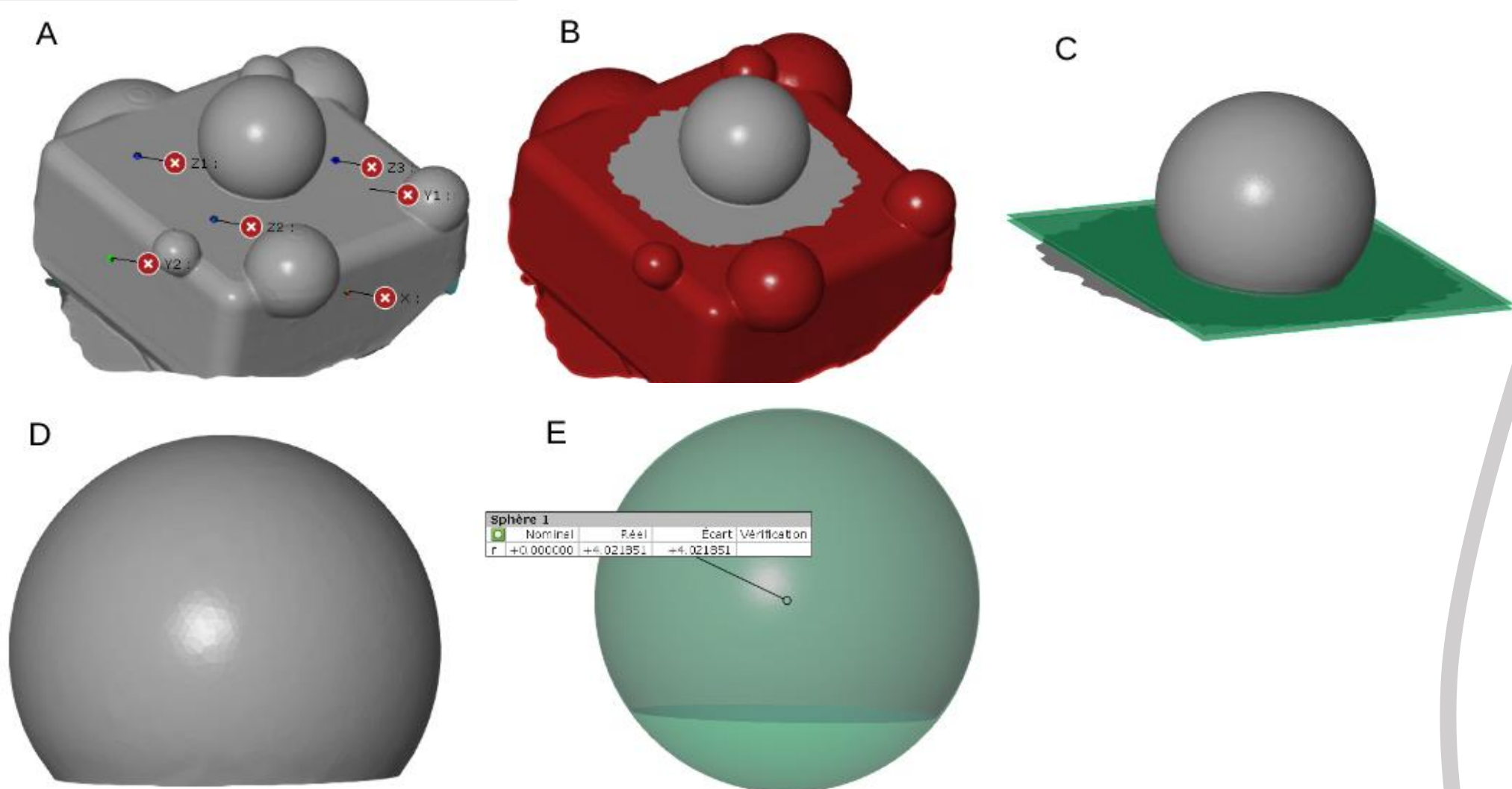
Reference Object

8 mm Al₂O₃ Sphere
Grade 10 = max diameter deviation of 0.25 μm

3D printed support structure with spherical landmarks to facilitate scanning



Mesh Processing



- Creation of reference coordinate system in GOM Inspect
- Deletion of landmarks and support structure
- Parallel plane fitted to the surface and mesh deleted below a parallel plan 0.2 mm above it
- Isolated sphere
- Gaussian fitted sphere

Calculations

Trueness : Difference between the average of numerous tests and a true or accepted reference value

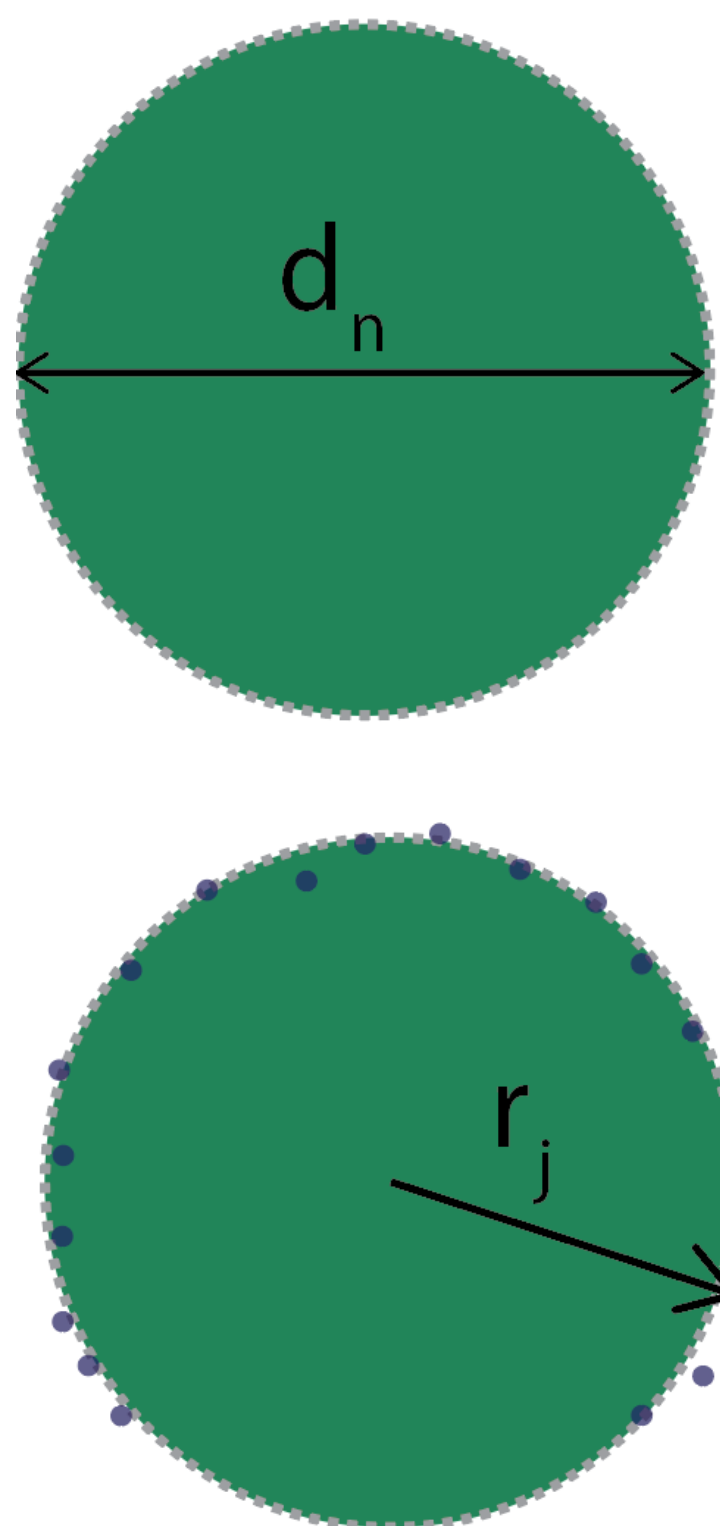
$$T = \bar{d} - d_R$$

Precision : Closeness of agreement between independent tests

$$P = \sqrt{\frac{1}{n-1} \sum_{i=1}^{n=24} (d_i - \bar{d})^2}$$

Digitizing Noise : Random artifacts of signal that are introduced during the recording

$$\sigma_N = \sqrt{\frac{1}{m-1} \sum_{j=1}^m (r_j - \bar{r})^2}$$



Materials and Methods

- Primescan intraoral scanner (Dentsply Sirona)
- 24 scans of the reference object per sleeve
- Mesh processing and calculations performed according to the metrological protocol



Results

Trueness

Precision

Digitizing Noise

	Standard (SS)	Autoclavable (AS)	Disposable (DS)
Trueness	-9.72 μm	2.55 μm	-9.66 μm
Precision	6.71 μm	7.91 μm	7.17 μm
Digitizing Noise	7.31 μm	6.37 μm	8.72 μm

- **Trueness** : Significant differences between AS-DS ($p < 0.001$) and AS-SS ($p < 0.001$)
- **Precision** : No significant differences between the sleeves for ($p = 0.623$)
- **Digitizing noise** : Significant differences between DS-AS ($p < 0.001$), DS-SS ($p = 0.001$), and SS-AS ($p = 0.001$)

Conclusion

- Significant differences between sleeves
- Errors appear to be within clinically acceptable limits
- Metrological approach is valid
- Further studies needed using reference objects with more measurable dimensions

