Abstract Submission

Comparison of Structured Light 3D Scanning to MicroCT for Measurement of Bone Defect Volumes in Simulated Revision Total Knee Arthroplasty

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Purpose:
Failures of Total Knee Arthroplasty (TKA) may be associated with significant bone loss. Restoration of bone loss is critical for success of revision TKA and depends on location and size of bone defects. Currently there is no method of quantitatively measuring bone defects intraoperatively. The aim of our study is to utilize Structured Light (SL) 3D scanning to quantitatively measure volume of bone defects. Our primary objective is to compare accuracy of SL 3D scanning to micro Computed Tomography (mCT) for measuring volume of tibial bone defects in simulated revision TKA.

Methods:
Revision TKA was simulated on four native knees in two cadavers. Contained tibial defects were prepared using 38-44mm acetabular reamers. Bone defects were scanned *in situ* with SL scanner (Polyga Inc., Compact S1) and subsequently with mCT. Volumes of reconstructed 3D models were measured five times for each specimen. Agreement between mCT and SL volume measurements were analyzed using Bland-Altman plots with mCT as gold standard. Measurement bias, limits of agreement and 95% confidence intervals were calculated with Stata software (17.0). A priori mean difference of 5mL between mCT and SL was set as threshold for clinical significance.

Results:
Bone defect volumes ranged from 35.27 mL (SD 0.36 mL) to 41.72 mL (SD 0.23 mL) as measured by mCT and from 34.05 mL (SD 0.48 mL) to 38.82 mL (SD 0.38 mL) as measured by SL. Bland-Altman analysis revealed a mean difference of 0.97 mL (95% CI 0.33 to 1.62 mL) between mCT and SL measurements. Limits of agreement ranged from -1.73 mL (95% CI -3.18 to -0.90 mL) to 3.68mL (95% CI 2.85 to 5.13 mL).

Conclusion:
Based on mean difference of mCT and SL volume measurements being smaller than the a priori threshold and all the measurements falling within the limits of agreement, we conclude that SL 3D scanning is an accurate method to measure bone defects intraoperatively.

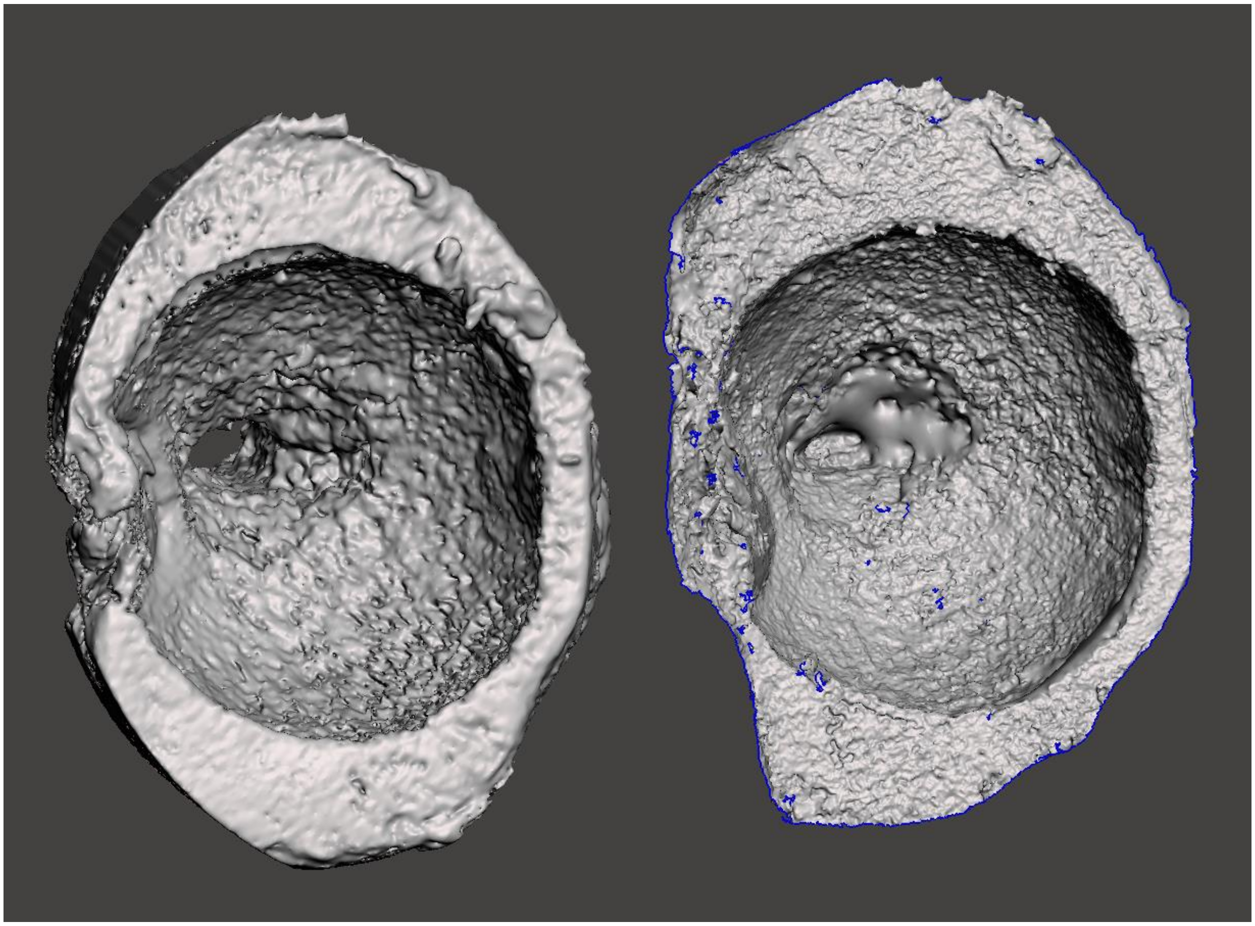

Figure 1: Comparison of 3D mesh models of the same cadaveric tibia as generated by micro Computed Tomography on the left and Structured Light on the right.

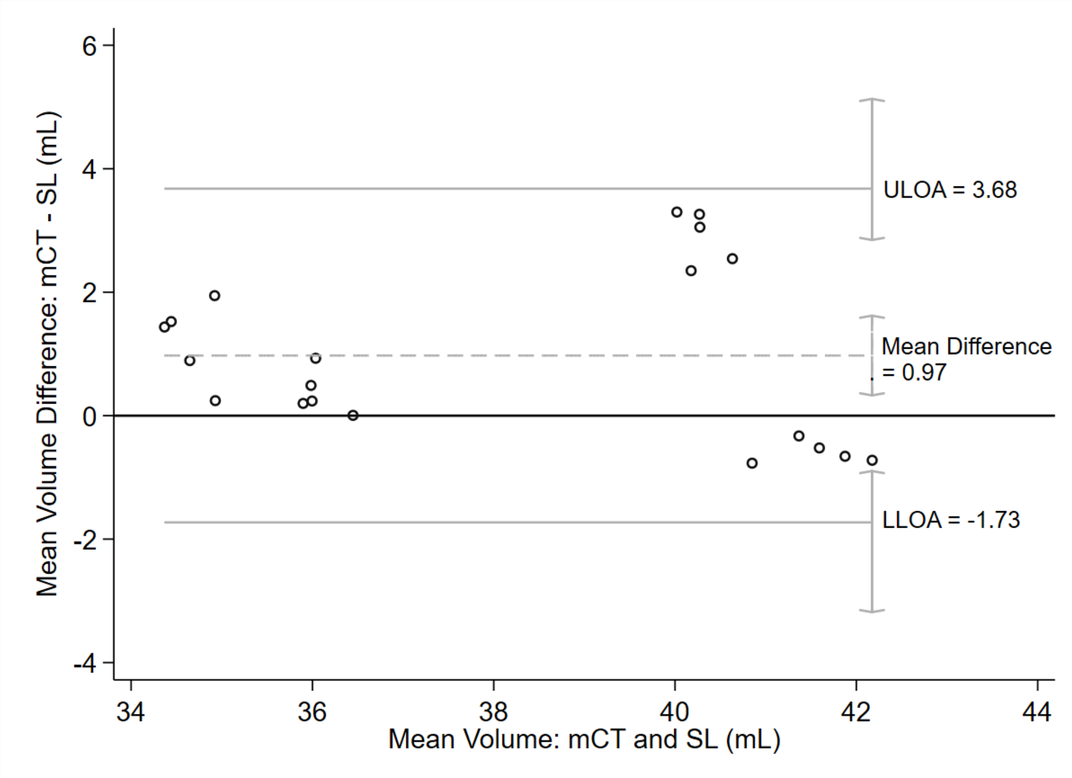

Figure 2: Bland-Altman plot for bone defect volumes measured by micro CT (mCT) and Structured Light (SL).

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do "C:\Users\Shar\AppData\Local\Temp\STD4570_000000.tmp"

. blandaltman ct sl, plot(difference) h l(95) cibias ciloa xti("Mean Volume: mCT and SL (mL)") yti("Mean Volume Differe
> nce: mCT - SL (mL)") xlabel(34(2)44)

A: ct                    CT
B: sl                    SL

DIFFERENCES...
Calculation              N        Mean         SD       Interval(s)
A-B                     20    .9739548   1.379351
                           95% limits of agreement: -1.729524  3.677433
                                     95% CI (LLOA): -3.183414 -.8971132
                                     95% CI (ULOA):  2.845023  5.131323
                               95% CI (Mean diff.):  .3283986  1.619511
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Figure 3: STATA table for Blandaltman plotting of bone defect volumes measured by CT and SL.