http://dx.doi.org/10.2106/JBJS.17.00790

Appendix

Method of Measurement of Material Loss Profile

A Talyrond 365 roundness-measuring machine (Taylor Hobson) was used to measure the material loss profiles on the conical-shaped segments of the neck male tapers. Focus was placed on the examination of the conical-shaped aspects of the neck male tapers, which constitute three-fourths of the whole taper, excluding the flat sides, as they have been shown to be the area in which the damage is predominantly localized for the Rejuvenate design. The contact profilometer measures complex microfeatures. The use of the tool is of great value when associated with clinical variables to interrogate how implant design, manufacturing, surgical technique, patient history, and other factors may affect the material loss at the junctions. The machine is designed to measure cylindricity with a spindle accuracy of within 0.02 µm and a 0.0012-µm resolution. Prior to wear measurements, the tapers were gently cleansed with an alcohol-soaked cloth to eliminate remaining gross deposits on the metal surfaces. Successively, they were mounted on the air spindle that rotates while the stylus of the profilometer designs longitudinal profiles or traces on the surface for data acquisition. Each neck was positioned on the custom-made fixture mounted on the x-y translational stage so that the taper axis was aligned with the spindle axis.

Five equally spaced longitudinal profiles, or traces, were taken on each conical section of the taper surface at 45° increments to calculate the relative depth of damage.

In this way, the capture of the whole surface was ensured. The 3 centrally taken traces were representative of the most prominent part of the conical-shaped aspects of the tapers that predominantly ensure the taper fit and were shown to be the area that mostly goes through mechanically assisted corrosion with a given distribution. The 2 lateral traces accounted for the remainder of the surface. The measurements were conducted making sure that the start and end points of the traces were located on the unengaged surfaces, thus comprising the unworn region ensured by the Rejuvenate taper design because of the chamfered aspect of the stem bore taper.

The maximum linear wear depth of the 5 traces, both on the medial and lateral sides of the conical surfaces, was calculated. The traces provided a 2-dimensional cross-sectional area with accuracy of details to submicron level as well as a measure of the deviation from the metal surface as manufactured. Each trace was individually normalized relative to the unaffected (due to its being unengaged) surface of the taper and a sectional wear area (in square millimeters) was calculated (Fig. 2).

The maximum linear penetration depth on both the medial aspect of the neck (r^2 = 0.58, $p < 0.0001$) and the lateral aspect of the neck (r^2 = 0.71, $p < 0.0001$) were strongly correlated with the summed area of the 5 traces (Figs. E-1 and E-2).

Therefore, the summed area of these 10 traces per neck was used for comparative purpose within our cohort (Fig. 9). The result obtained was normalized by time in situ (years).

The reproducibility of such a method was assessed by a second examiner on a subset of consecutively selected implants.

http://dx.doi.org/10.2106/JBJS.17.00790

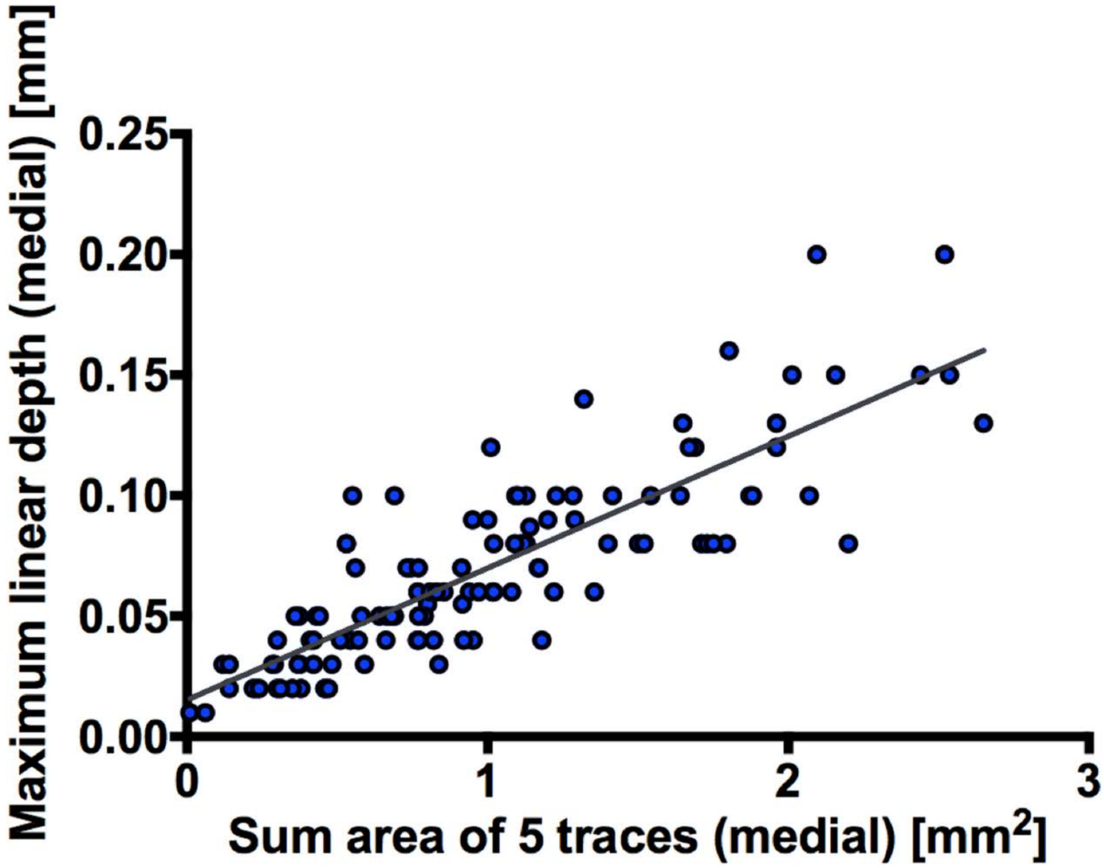

Fig. E-1
Scatterplot showing the correlation between the maximum linear penetration depth on the medial aspect of the necks with the summed area of the 5 traces ($r^2 = 0.71$, $p < 0.0001$).

http://dx.doi.org/10.2106/JBJS.17.00790

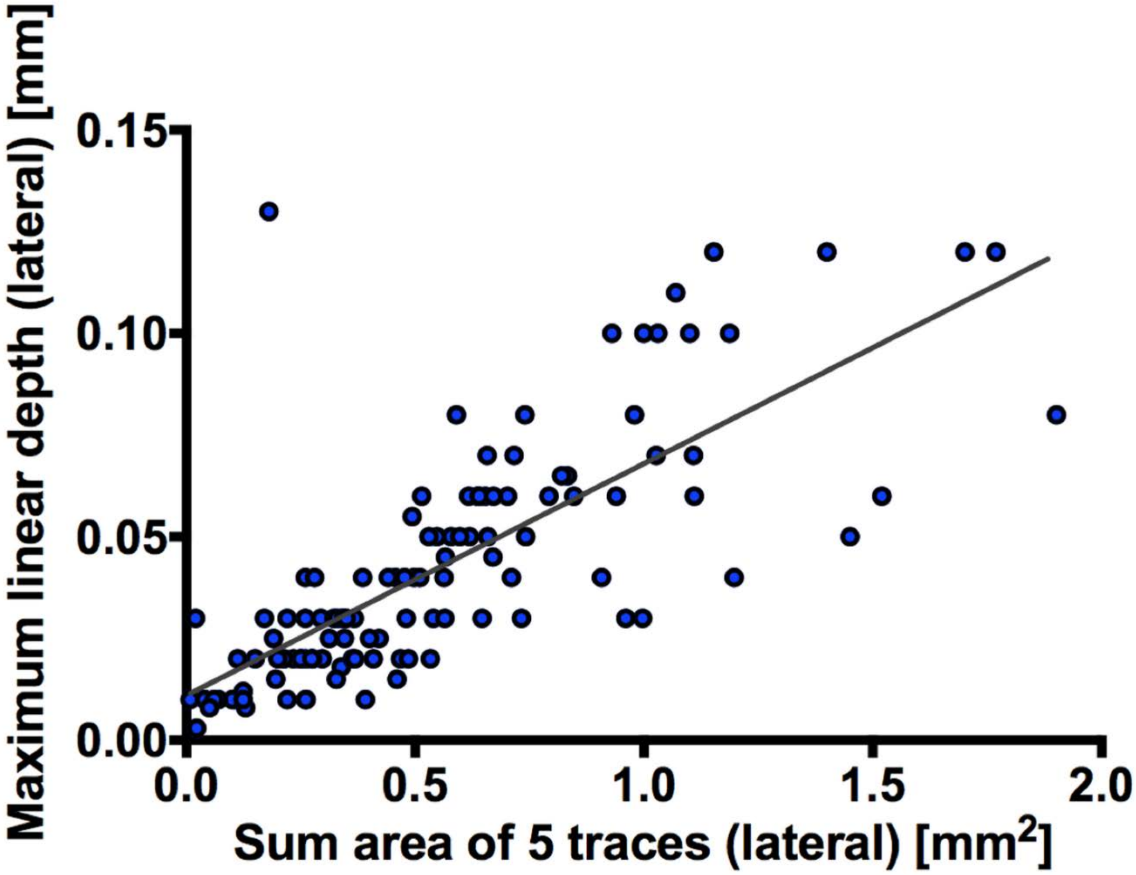

Fig. E-2
Scatterplot showing the correlation between the maximum linear penetration depth on the lateral aspect of the necks with the summed area of the 5 traces ($r^2 = 0.58$, $p < 0.0001$).