E-APPENDIX

Precision

Precision is defined as the closeness of agreement between repeated independent test results obtained under stipulated conditions. When making thirty or more measurements of the same value with use of the same instrument, the ASTM standard practice E177-90a recommends that precision for the instrument at the measured value be expressed using a 95% level of confidence as shown in the following equation:

$$\mathrm{Pr}\,ecision(ASTM)_{>30\ measurements} = \pm 1.96 * S$$

where S = standard deviation of the measurement series.

When fewer than thirty observations exist in the series, it is more appropriate to use the following equation:

$$\mathrm{Pr}\,ecision(ASTM)_{<30\ measurements} = \pm t_{n-1} * \sqrt{2} * S$$

where S = standard deviation of the measurement series and n = the number of observations in the series.

When assessing the precision between two separate instruments (or separate observers), Bland and Altman advocated using the 95% confidence interval of the standard error to estimate the precision of agreement between measurement pairs obtained by different methods or different observers, as shown in the following equation:

$$\mathrm{Pr}\,ecision(ASTM)_{measurement\_pairs} = \pm t_{n-1} * \sqrt{2} * S_{diff}$$

where S_{diff} = standard deviation of the difference between measurement pairs, n = the number of observations in the series, t represents the two-tailed 95% confidence value from the t-distribution tables for n-1 degrees of freedom and n = the number of observations in the study. It approaches 2 (1.96) when the sample size is >30.

Accuracy

Accuracy is the closeness of a measurement to the true value. A standard method of reporting accuracy has not been well established in the literature for clinical wear assessment. The ASTM standard recommends reporting bias and precision rather than accuracy. Authors of published wear studies have reported the accuracy of polyethylene wear measurements in a variety of ways, making direct comparisons of accuracy between published techniques difficult. However, when the raw measurement data are given, the root mean square error (RMSE) may be calculated with the following equation:

$$\mathrm{R}MSE = \sqrt{\frac{1}{n}\sum_{i=1}^{n}(x_i - T)^2}$$

where x = individual measurement and T= true value for measurement.

Accuracy may also be reported as the standard error (SE), as shown in the following equation:

$$\mathrm{Accuracy} = \pm(SE) = \pm\frac{S_{dif}}{\sqrt{n}}$$

where S_{dif} = standard deviation (measured value – true value) and n = total number of observations.

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