In Reply: Commentary: Utilization of Quantitative Susceptibility Mapping for Direct Targeting of the Subthalamic Nucleus During Deep Brain Stimulation Surgery

To the Editor:

We agree with the authors1 wholeheartedly that Bland and Altman2 developed their analysis to address the inappropriate use of the correlation coefficient as a means of comparing 2 methods of measuring the same clinical parameter. However, a careful reading of their manuscript shows that the short-coming they sought to address was of mistaking a high degree of correlation for agreement (or concordance) between 2 measurement techniques. In that paper they state the following.

1. “r (the correlation coefficient) measures the strength of a relation between two variables, not agreement between them. We have perfect agreement if the points lie along the line of equality (ie, a regression line with a slope of 1), but we have perfect correlation if the points along any straight line.” 2. “Data which seem to be in poor agreement can produce quite high correlations.”

At no point in their paper do Bland and Altman argue that data exhibiting a low degree of correlation can be in agreement and this makes sense, for if the data points do not fall on any line, how can they fall on the “line of equality”? Furthermore, in describing their technique for “measuring agreement”, Bland and Altman state: “How far apart measurements can be without causing difficulties will be a question of judgement. Ideally it should be defined in advance to help in the interpretation of the method comparison and to choose the sample size.”

In their analysis, Rasouli et al3 accept that the raw measurements they derived by the 2 methods (microelectrode recording [MER] vs quantitative susceptibility mapping [QSM]) do not exhibit a high degree of correlation. They offer several reasons for this (differences in resolution, standard deviations, and narrow range of measurements), thereby justifying the use of normalized data and the Bland–Altman analysis. In contrast to the Bland–Altman analysis, which suggests agreement, the intra-correlation coefficient (ICC) = 0.12 implies that there is high variability between QSM and MER measurements within an individual (ie, they are not in good agreement). More useful in our view would be to see how well the actual measurements made with the 2 methods agree on a case by case basis. How often do the measurements agree within 0.1, 0.5, 1, 2 mm, etc.? Such valuable information would allow the readers to decide for themselves whether a measured subthalamic nucleus (STN) span on QSM is a legitimate proxy for the gold standard of measuring the STN with MER and we urge the authors to publish this data in a subsequent letter.

As for the 14% first-pass miss rate, Dr Alterman concluded his original commentary4 by stating that this consistently published figure might represent the limits of the Leksell Model G frame (Elekta AB, Stockholm, Sweden), so it would seem we are in agreement here. The critical point is that there is no imaging technique yet described that, when used with the Leksell Model G frame, yields a 100% first pass hit rate. Therefore, one must have some means of detecting a miss (whether by MER or intraoperative imaging) and plans to adjust electrode position as necessary. In the end, QSM may well prove useful for targeting the STN but we are not convinced that there is high concordance (agreement) between MER- and QSM-derived measurements of STN span (likely due to the fact that the spatial resolution of MER is an order of magnitude better than MRI of any type) and one should not assume that just because the STN is well visualized on targeting images, that it will be properly targeted 100% of the time.

Disclosure

The authors have no personal, financial, or institutional interest in any of the drugs, materials, or devices described in this article.

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REFERENCES


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