Reply

To the Editor:

Our study tested three methods of sternal closure applied to polyurethane foam sternal models using a common stress-until-failure technique. The figure-of-eight wire closure that we tested is the method which we employ clinically. As noted, our tests demonstrated the superiority of a cable closure technique as well as the superiority of Pectofix Dynamic Sternal Plates over our standard wire closure. The use of standardized polyurethane foam sternal models allows reproducible and repetitive testing of these closure techniques. We appreciate the fact that static testing does not necessarily provide the same information as fatigue or other dynamic tests, since different material classes behave differently under fatigue loading. The viscoelastic nature of bone and polymeric materials has been demonstrated to have profound effects on the response to static, dynamic, and fatigue loading. Fatigue testing will provide very important information about the longevity of the device, and how the device may interact with the host. This type of testing utilizing our model system is the basis of our current follow-on study. The use of polyurethane models of bone allows inexpensive and simple testing of a wide variety of closure techniques under many different conditions which is its advantage over the use of cadaver or animal specimens.

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MISCELLANEOUS

The Use of Z Scores in Assessing Neuropsychological Change After Cardiac Operations

To the Editor:

I read with considerable interest the recent review by Collie and associates [1] concerning statistical analysis of cognitive change after coronary artery surgical procedures. It is agreed that the percent change and standard deviation "cutoff" methods of deficit analysis are arbitrary, do not take practice effects into account, and are relatively insensitive, especially as the incidence of cognitive decline has decreased. The main alternative advocated [2], group mean analysis has the flaw of allowing patients who show improvement to mask those whose cognitive status deteriorates even if there is a group to control for regression toward the mean. Further alternatives are clearly required.

It is therefore disappointing that although many *potentially* superior statistical methods from the neuropsychological and psychiatric literature were illustrated in Table 1 of the review and discussed, little mention was made of the *z* change score, which was used in a randomized, controlled trial by Arrowsmith and coauthors [3] and an observational study by Steed and colleagues [4] involving patients undergoing coronary artery bypass grafting. Table 1 describes Kneebone and associates [5] as using a "standard deviation index" $[(X_2 - X_1)/\mu SD_1]$. However, they actually used the traditional binary standard deviation method, as they converted a score of $(X_2 - X_1)/\mu SD_1$ greater than 1 to a deficit and compared this with a reliable change index, which was their main outcome measure.

In contrast, the *z* score, which is also calculated as $(X_2 - X_1)/\mu SD_1$, is not then converted to a deficit or no deficit depending on whether it is greater or less than 1. These scores are left as raw numbers and can then be used to give a mean for each test or the sum of a battery of tests for different groups of patients. This method has the advantage of increased sensitivity because it is a continuous measure without absolute cutoffs, thus giving each individual a score. An additional benefit is that it allows group comparisons, which take into account potential learning effects. *Z* scores are a recommended way of analyzing cognitive change that should be considered for future studies of cardiac surgical patients.

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Reply

To the Editor:

We thank Dr Whitaker for his comments on our recent review of the statistical methods used in studies of postoperative cognitive decline (POCD) in patients who have undergone coronary artery surgical procedures [1]. He highlights the important point that the interpretation of statistical tests used to investigate POCD is constrained by both the design and the objectives of the study. Most of the studies cited in our review reduced the standard deviation (SD) index to a binary impairment/no impairment outcome. Importantly, these studies were mostly observational in nature and were designed primarily to determine the incidence of POCD. The use of a binary outcome measure is therefore understandable, although as suggested, alternative approaches exist. As Whitaker states, the SD index can also be treated as a continuous variable, more commonly known as a *z* score. Such an interpretation of the SD index is more appropriate when the study objective is not to determine incidence of POCD, but rather to test a specific hypothesis such as the effects of a putative neuroprotective agent on the severity of POCD [2]

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or to determine the association between a genetic risk factor and the severity of POCD [4].

We concur completely that the use of continuous measures provides greater statistical power and allows more sophisticated analyses than the use of binary outcome measures in studies designed to determine the nature and the severity of POCD. In fact, we [4] recently demonstrated that application of a binary clinical criterion for "cognitive impairment" in older people on a single occasion resulted in a 50% false-positive classification rate. This false-positive rate was reduced dramatically when the same criterion was applied serially and only those individuals who consistently met the criterion were rated as impaired. Further, when serial data collected in individuals were considered on a continuous scale rather than as a binary outcome (below or above the cutoff score), greater sensitivity to subsequent cognitive impairment was observed.

Like Whitaker, we believe the use of continuous data is crucial to understanding the nature and the severity of POCD in patients who have undergone coronary artery surgical procedures. We also believe that observational studies designed to estimate the incidence of POCD using binary classification criteria are likely to contain high rates of false-positive classifications.

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25-Year Follow-Up of Homograft Aortic Conduits for Coarctation Repair

To the Editor:

I read with interest the article by Huttl and associates [1] concerning 40-year follow-up of 4 patients who underwent homograft aortic segment replacement of the aortic isthmus for management of long segment coarctation.

Doctor Robert E. Gross at the Boston Children's Hospital was the first to perform this procedure in humans in 1948. He reported on the first 19 patients in 1951 [2] and between the years 1948 and 1964 carried out this operation in 88 patients. Doctor Gross and I carried out follow-up studies on this patient group in 1968 and again in 1973 [3]. Of the 88 patients, 12 had homografts preserved in nutrient medium as reported by Huttl. The remaining 76 received grafts that were sterilized by irradiation and then preserved by freeze drying. Of the total group, there were 6 initial hospital deaths. Follow-up in 1968 was on 45 patients up to 20 years postoperatively and repeat follow-up in 1973 was on 40 patients up to 25 years postoperatively. During this 25-year period there were 9 known late deaths, only 2 of which were related to the original aortic homograft or coarctation. One patient died 6-1/2 months postoperatively of a ruptured mycotic aneurysm of the superior imesentric artery thought secondary to infection of the homograft. A second patient died 19 years postoperatively with severe recurrent coarctation.

As the authors of the current article state, late follow-up information on homograft aortic material is of great interest today as it is used frequently in the repair of congenital cardiac anomalies as well as for vascular reconstruction in the presence of infection.

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Reply

To the Editor:

We are thankful to Dr Litwin for sharing the long-term results of pioneering work. Even by today's standards the surgical results of Dr Gross' team are outstanding. The management and operative techniques that we perform in our institution are based on his published article [1]. The tissue after homograft preparation becomes nonviable; however, this is probably not significant for aortic wall replacement. There is no evidence that maintaining cell viability during preparation and storage improves long-term results of allograft values [2]. The other similarity between Gross' team and our group is the operating strategy. Nowadays

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