EDITORIAL

Where are all the materials articles?

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Dr David Tidy has been Materials Sub-Editor for the *Journal of Orthodontics* for a number of years. The Journal thanks David for his immense contribution, and wishes him a most happy retirement.

The *Journal of Orthodontics* has always found a place for laboratory studies on materials or mechanics. Why would a journal largely read by clinicians do this? It is because such studies have the potential to predict the performance of materials in clinical service or to illuminate some complex issues in mechanics. Judicious laboratory testing may, for example, support the case for a clinical trial to be carried out or, conversely, serve to eliminate inferior products. However, readers may have noticed fewer such articles in the Scientific section of the Journal over the last couple of years. Happily, this deficit has been made good to some extent by articles describing actual clinical trials on materials. These reports of clinical trials on materials illustrate nicely how useful research can be done in the context of busy clinical practice, to the extent that one such article in this Journal was recently awarded the FEO prize for the best article in a European orthodontic journal in 2005.

To return to laboratory studies, the apparent decline does not reflect any change in editorial policy. Journals can only publish what is submitted. As part of normal quality control, all articles go through a peer review process, and this is where the difficulty arises. Acting on the recommendation of its referees, the Journal has latterly had to reject the majority of laboratory studies on materials or mechanics. A rejection is disappointing for the Journal staff and even more so for the authors, for whom the article represents the culmination of many hours of dedicated research work.

Articles may sometimes be rejected because they lack originality or substance. However, rejection of a scientific article most often means that it is fundamentally flawed in some way, probably because of a major fault in experimental design. It is instructive to look over some of the reasons for the recent rejections.

One surprisingly recurrent fault is the 'sample of one'. The authors have perhaps designed a novel device, of which they have a single sample made and then compare it with a sample of another design. Repeated tests are undertaken on the two samples, giving high levels of reproducibility, and an apparently significant difference is detected. Unfortunately, the conclusion is far from robust, as custom-made devices can vary appreciably in their construction, and if additional samples were tested, a different conclusion might be reached.

The commonest problem is the systematic error in one form or another. Random errors are usually obvious, and authors often discuss them at great length with the aid of standard statistical routines. However, systematic errors are more insidious, harder to detect and more often fatal to the conclusions. Examples are diverse. A test rig set up to simulate a clinical problem will produce meaningless results if the simulation is invalidated by a basic error in the design. Observer bias, familiar as a problem in clinical trials, can also contaminate laboratory studies: microscopic structures may be incorrectly identified; an unsuspected confounding factor may overwhelm the effect being studied and lead to completely spurious results; measurements on force systems that give results in conflict with basic physical laws will be regarded with more than a touch of scepticism.

Aspiring experimenters in the field clearly need to discover the pitfalls at an early stage while they can be remedied. Sadly for some authors, errors remained unsuspected throughout the process of testing and writing up, and only came to light afterwards. Detection of errors often depends on a combination of good mechanical insight, familiarity with the materials or test method in question, and a clear understanding of the clinical situation that the test is intended to simulate. Such wide-ranging attributes cannot be learnt in a short course on research methods. A particular difficulty is that attributes cross the boundary between materials science and clinical application. Clinicians may have limited knowledge of mechanics and laboratory technique, while materials scientists may not fully appreciate the clinical issues. One can only encourage closer contact and cooperation between colleagues in the two disciplines, with a view to teasing out errors in advance, rather than leaving it to referees at a later date.

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