Letter to the Editor

Cutting cartilage—surgical perspective

Sir

Redman et al.’s (2004) paper elegantly delineates the cellular response of articular cartilage to trauma. Cell death was ascertained using a fluorescence live/dead assay with confocal laser scanning microscopy. Using microautoradiography to analyse isotope incorporation, it documents the failure of proliferative and synthetic responses in the zone of marginal death associated with wounding by a trephine. It provides a sensible rationale for the failure of reparative response by cartilage in such situations. More excitingly, this study raises the possibility of an upregulated response near wound edges of sharp scalpel incisions.

Two types of trauma were administered, designated ‘sharp’ and ‘blunt’. There is no mention of quantification of ‘sharpness’ for the two blades used in this paper. ‘Sharpness’ is an awkward parameter to quantify and the surrogate measurements often used tend to alter the very parameter they seek to describe. The force required to cut through tissue varies inversely with the sharpness of the cutting edge. However, with each cut, the edge tends to blunt. Edge retention, an important parameter for instruments intended for more than single use, is partly a function of toughness, a concept understood by swordsmiths and knifemakers.

There are further important differences between the blades and their modes of application, in addition to sharpness and edge retention, which may also be important in determining the margin of cell death, especially as cartilage is a complex, anisotropic heterogeneous structure.

The trephine cut is made with a circular blade—but there is no description of the profile of the trephine, nor in the paper referenced. The internal diameter of the trephine is different in the two studies: 1.7 mm and 1.2 mm, respectively.

Figure 1 shows two blade profiles, of ostensibly similar cutting-tip sharpness—they would be expected to perform similarly in experiments measuring the peak “push-through” force required to sever a uniform thread. Nevertheless they may cause different amounts of margin damage in thicker tissue because the second blade has a longer bevel (behind the cutting edge) and a thicker main contour. In the context of cartilage, the second blade would be expected to cause more compression of the tissue margin. Therefore the geometry of the blade behind the cutting tip is also important, as is the roughness of the “blade face”.

The scalpel number 23 blade used [Fig. 2(A)] is fixed in the zx plane—however the curved cutting edge lies in multiple xy planes. Conversely the trephine-tip [Fig. 2(B)], applied perpendicular to the cartilage surface, has a circular cutting edge the apex of which exists in a single xy plane; the tip of the trephine has an external bevel. A number 11 blade (straight) might therefore provide a better comparison [Fig. 2(C)] for the trephine.

The mode of application of force is not discussed. Two modes of cutting are (i) push-through in which the force is applied perpendicular to the tissue, with no (abrasive) movement within the horizontal plane of the blade (ie any point on the blade moves in the z-axis alone), and (ii) abrasion in which the side-to-side movements disrupt the tissue. They may be thought of as axe and saw cuts, respectively. In this study, the mode of force was directly perpendicular to the articular surface—and push-through, with no rotational abrasive action. This is analogous to the cutting action at osteochondral harvest for autologous transfer.

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Currently, there is great interest in alternative modes of cutting, including laser\textsuperscript{10} and ultrasound\textsuperscript{7,11}, though for cartilage, these have not yet been developed to a stage where they show any advantage over a sharp scalpel blade. However, in surgery it may be necessary to cut with a tougher implement than a scalpel blade. For instance, autologous osteochondral transfer (mosaicplasty) requires harvest of a composite cartilage-bone graft\textsuperscript{9}, for which a No. 23 scalpel blade is not feasible.

This discussion is in no way meant to detract from an excellent study—I congratulate the authors on their assessment of metabolic responses near the wound edge. For surgery, in addition to instrument sharpness, the mode of cutting, blade profile and material parameters are critical design features to consider. Minimisation of cell death at the tissue edge is likely to optimise surgical outcomes.

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References