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The Effect of Cutting Edge Smoothness on Wound Healing Response

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1 Introduction

The inflammatory response continues to be a major source of morbidity following operative procedures. Our hypothesis in this study has been that surgical tools with sharp cutting edges and highly polished faces may reduce the tissue disruption at the site of incision and have the potential to decrease the adverse consequences of the inflammatory response including morbidity, inflammation, infection, wound strength and scarring.

2 Materials and Methods

Here, we use a guinea pig model (animal protocol approved by the University of Chicago Institutional Animal Care and Use Committee) to perform a systematic assessment of the inflammatory response and scarring in skin incisions made with an experimental blade that has an ultra-sharp, smooth cutting edge. A standard surgical blade (Bard-Park #15) is analyzed alongside the experimental blade (polished by Cabot Microelectronics Corporation using a proprietary process) and we compare differences in immunohistochemistry staining for macrophage marker, collagen deposition, and scarring. A decrease in the density of microphages and collagen deposition area at the site of injury is indicative of decreased inflammation and improved repairing. Three animals were sacrificed at 1, 2, 5, 7, 9, 16 days and 6 months post-surgery. The incisions were harvested and fixed in 10% formalin, embedded in paraffin and processed. Histology and immunohistochemistry slides were scanned and analyzed using the high-power field (HPF) of a Nikon light microscope.

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3 Results

The morphometric analysis of the wounds reveals that, 2 days after skin incisions, the wounds produced by standard surgical blades (SBs) did not achieve closure. In contrast, the closure (> 90%) occurred very rapidly in skin incisions by experimental blades (EBs). The relative difference M between the microphage density in skin incisions made with the EB versus the one corresponding to incisions made with a SB is displayed in **Fig. 1**. This shows that the microphage infiltration exhibited a significant decrease (between 30 and 70%) in skin incisions made with the EB compared with that corresponding to skin incisions made with the SB.

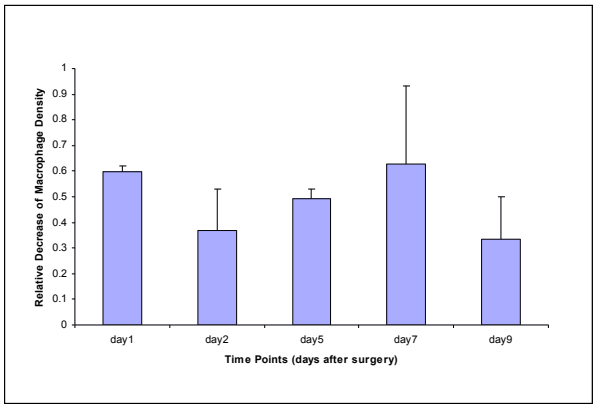

Figure 1 : The relative decrease of the macrophage density in skin incisions made with the EB relative to that corresponding to skin incisions made with a SB.

In **Fig. 2** we display the average values of the ratio C measuring the decrease of the collagen deposition area in skin incisions made with the EB relative to the collagen deposition area in skin incisions made with the SB. We can observe that

$C < 1$ at all time points, which mean that significantly less scar occurs in skin incisions by EBs in comparison with SBs. Moreover, the value of $C < 1$ shows an evident decreasing trend in time which suggests that the wound contracture and healing takes place faster at the site of the sharpened blade skin incision. Generally, we can see that the reduction of the collagen deposition area in skin incisions made with the polished experimental blade is about 50% during the proliferation phase, and reaches values of about 90% 6 months post-op.

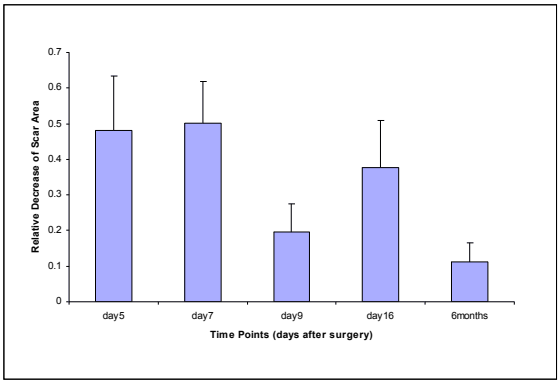

Figure 2 : The relative decrease of the amount of granulation tissue surrounding skin incisions made with the EB relative to that corresponding to skin incisions made with a SB.

4 Conclusion

These findings demonstrate that the prevention of unneccesary disruption of tissue surrounding the incisions by using an ultrasharp and smooth blade is a key feature of the reduced inflammation and scarring.

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