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The Effect of Platelet-Rich Plasma on Autologous Osteochondral Transplants in a Rabbit Model

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Summary:
Autologous osteochondral transplants (AOT) have been shown in in-vivo studies to exhibit poor integration at the chondral interface as well as degeneration of the cartilage. We investigated the effect of platelet-rich plasma as a biological adjunct in a rabbit AOT model, and we report improved gross and histological results.

Abstract:
OBJECTIVES:
Autologous osteochondral transplantation restores a full-thickness cartilage defect with a cylindrical unit of bone and viable articular cartilage. Despite this, previous in-vivo studies have described poor graft integration at the chondral interface as well as degeneration of the cartilage, potentially compromising long-term viability. This has prompted the investigation into biological adjuncts to address these concerns. One such biological adjunct is platelet-rich plasma (PRP), which has the potential to improve integration of the bone and cartilage at the graft-host interface. The purpose of this study was to evaluate the effect of PRP on soft tissue healing of osteochondral grafts in a rabbit model.
METHODS:
Bilateral osteochondral defects (2.7 mm in diameter, 5 mm in depth) were created on the weight-bearing surface of the femoral condyles of 12 New Zealand white rabbits. Blood was drawn from the aural artery and centrifuged to produce PRP using a standard, commercially available centrifugation system. Osteochondral grafts were harvested from the ipsilateral femoral condyle and, after randomization, treated with either PRP or saline before implantation into the defect site. The rabbits were euthanized at 3, 6, and 12 weeks post-operatively. Cytological analysis was performed on whole blood prior to centrifugation and on PRP. Repair cartilage was assessed using the ICRS macroscopic and modified ICRS histological scoring systems. Additionally, proteoglycan staining was assessed as well as immunohistochemistry performed for type-II collagen content.
RESULTS:
The PRP contained a significantly increased platelet count (5.1 fold; 819.2 +/- 169.6 X 103 / ul; mean and standard deviation) compared to whole blood (161.8 +/- 56.1 X 103 / ul; mean and standard deviation; p = 0.001). Additionally, the white blood cell count was significantly increased in the PRP (1.9 fold; 9.9 +/- 4.4 X 103 / ul; mean and standard deviation) compared to whole blood (5.1 +/- 1.1 X 103 / ul; mean and standard deviation; p = 0.03). The red blood cell count was significantly decreased in the PRP group (0.28 fold; 10.14 +/- 2.3 X 103 / ul; mean and standard deviation) compared to whole blood (35.9 +/- 2.2 X 103 / ul; mean and standard deviation; p = 0.000005). Macroscopic assessment revealed an improved mean ICRS macroscopic score in the PRP treated group (mean 11.2 +/- 0.9) compared to the control group (mean 10.4 +/- 0.9), although this was not statistically significant (p = 0.09). PRP treated grafts resulted in improved integration of the osteochondral graft with blurring of the demarcation between the graft and surrounding native tissue. Additionally, the surface of the PRP treated grafts showed less evidence of fibrillation and fissuring compared to the control group. The mean modified ICRS histological score at all time points for the PRP treated osteochondral transplants was significantly better (mean 19.2 +/- 4.3) compared to

the control group (13.5 +/- 3.3; p = 0.002). Assessing graft integration specifically, the mean score for the PRP treated group was significantly better (mean 2.5 +/- 0.9) compared to the control group (1.6 +/- 0.7; p = 0.004). There was greater alcian blue staining at the borders of the osteochondral graft as well as at the interface when compared to the control group, indicating increased proteoglycan content. The PRP group also demonstrated greater type II collagen immunoreaction versus the control group. No adverse events occurred as a result of the surgical procedure or PRP.

CONCLUSION:

Platelet-rich plasma may improve healing of an osteochondral graft, and has the potential to be used clinically as a biological adjunct in cartilage repair. Further work must be done to characterize the contents of PRP and their effect on soft tissue healing.