Elution of Growth Factor from Platelet-Rich Plasma-Coated Sutures
Delivery for Augmentation of Zone II Flexor Tendon Repairs

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INTRODUCTION: Despite advancements in our understanding of the biology of tendon healing, improved surgical techniques and rehabilitative protocols, Zone II flexor tendon repairs continue to be plagued by complications. The relatively avascular environment within the synovial sheath and propensity for dense scar formation result in risk for tendon rupture and poor postoperative range of motion, both of which have historically earned this area the title no man’s land.

New techniques for augmenting repaired tendons are being investigated. These include application of stem cells and growth factors at the site of repair. Platelets contain growth factors critical for cell differentiation, growth and healing, and are released upon platelet activation at sites of tissue injury. Platelet concentrates have been shown to produce a potent increase in these growth factors.

Our hypothesis is that sutures coated with platelet-rich plasma (PRP) will elute significantly greater concentrations of the growth factor PDGF than those coated with media or collagen alone. Furthermore, that growth factor eluted from PRP-coated sutures will have a mitogenic effect on tenocytes in vitro.

METHODS: Platelet-rich plasma was obtained from donated whole human blood using the Harvest SmartPREP 2 system. Four distinct substrates were used to coat ethibond sutures (media, collagen only, PRP only, and PRP + collagen). Elution of growth factor from sutures was trialed for 3 different coating durations (30, 60 and 90 minutes). Samples were maintained in tissue culture and at 4 time points (day 0, 1, 3 and 7), eluted growth factor concentration was determined by ELISA. Subsequently, after determining the optimal delivery construct, sutures were maintained in cell culture with rat tendon tenocytes. Cell proliferation was determined at early time points (day 0, 1, and 3) by radioactive incorporation of tritiated thymidine to determine the effect of PRP-coated sutures on tenocyte proliferation.

RESULTS: Sutures coated with collagen produced only trace levels of PDGF (0-2.82 pg/ml) and failed to release significantly more PDGF than sutures coated with media alone (p > 0.999) (Fig. 1). PDGF elution was seen for sutures coated with either PRP alone or PRP + collagen for up to 7 days for all 3 coating durations (Fig. 2, Fig. 3). There was a significant effect of coating duration and coating technique on PDGF (p<0.0001 for time and technique) (Fig. 4). At 7 days, sutures coated with PRP + collagen for 90 minutes resulted in the highest mean cell proliferation when compared to sutures coated with media or PRP alone. However, there was no statistically significant effect of coating technique on cellular proliferation (p = 0.194). PDGF elution was seen for sutures coated with either PRP alone or PRP + collagen for up to 7 days for all 3 coating durations (Fig. 5).

DISCUSSION: Coating sutures with PRP and PRP + collagen both led to the elution of PDGF that is significantly greater than sutures coated with media or with collagen alone. Suture coating for a longer time period increases growth factor elution. PDGF eluted from coated sutures did not have a significant mitogenic effect on tenocytes in this in vitro study. Therefore, growth factor delivery methods that allow for delivery of higher concentration of cytokines should be investigated.

SIGNIFICANCE: The findings presented can aid in the repair of the Zone II flexor tendons with coating of platelet rich plasma to deliver greater concentrations of the growth factor PDGF.