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Increasing elastin fibre production in a tissue engineered mesh for pelvic floor surgery

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INTRODUCTION & OBJECTIVES: Polypropylene mesh for pelvic floor surgery is associated with serious complications (e.g. erosion). A biodegradable tissue engineered mesh composed of a polylactic acid (PLA) scaffold seeded with autologous cells is a promising alternative. However, thus far elastin content (important for elastic recoil) in this tissue has been low. We aimed to increase elastin expression and test the resultant tensile properties.

MATERIAL & METHODS: Oral fibroblasts were isolated from oral mucosa biopsies taken with consent and ethical approval. PLA electrospun scaffolds were seeded with 500,000 cells and placed into 6-well plates and cultured for 14 days. Media was either normal DMEM (control) or DMEM supplemented with either dexamethasone (10-5 or 10-9)) or retinoic acid (10-7 or 10-11), media was changed 3 times per week.

RESULTS: Cells proliferated on scaffolds, shown by increased metabolic activity (AlamarBlue assay) during the 14 days–this was not influenced by either additive. Collagen production (measured by Sirius red assay) was significantly increased by dexamethasone at both concentrations but not by retinoic acid (Figure 1). Elastin expression, measured by immunofluorescence staining (figure 2) assessed by blinded observer assessment, was increased by dexamethasone and retinoic acid (at both concentrations). While all samples had equivalent tensile strength (all > normal paravaginal fascia) dexamethasone resulted in the greatest elastic modulus (20.9 and 21.8 MPa for concentrations of 10-5 or 10-9 M respectively) and had the most confluent extracellular matrix (ECM) on scanning electron microscopy (SEM)(figure 2).

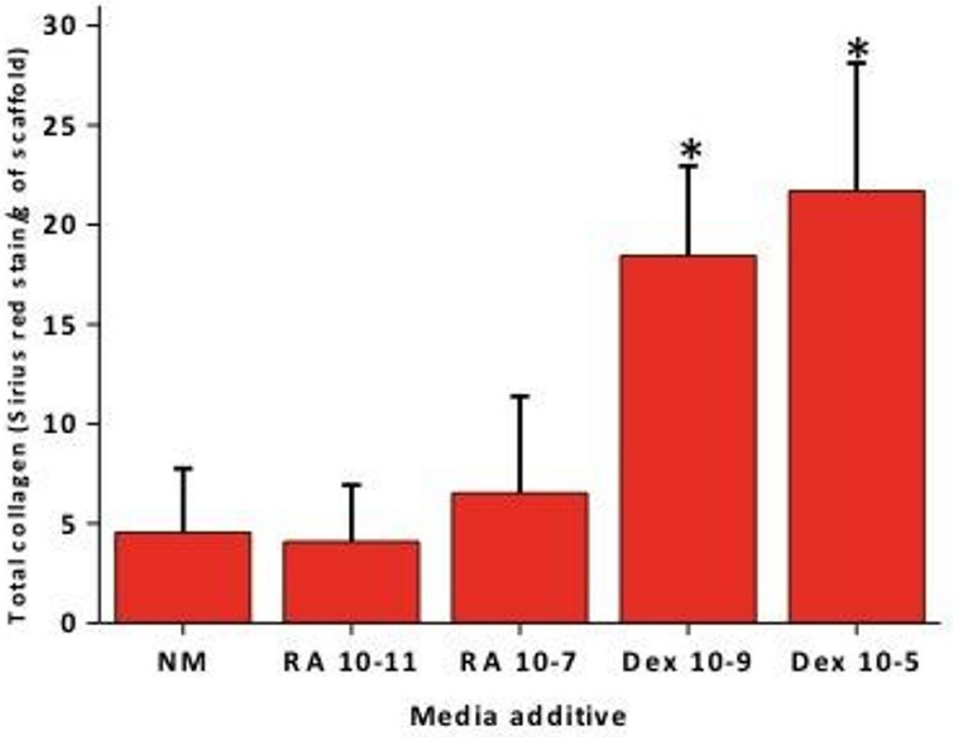

Figure 1: Collagen production (sirus red assay).
NM= normal media, RA= retinoic acid, Dex= dexamethasone, n=9 ± sem, * = significant ($p<0.05$) difference versus NM.

Figure 2: Representative images for ECM production on SEM(top row) and Elastin fibres on immunofluorescence(bottom row)

CONCLUSIONS: Dexamethasone (10-5 or 10-9 M) was a useful additive for the culture of oral fibroblasts on PLA scaffolds improving the production of elastin and collagen on the scaffold. Future work will study the effect of subjecting the cell-seeded scaffolds to physiological dynamic strain on elastin organization and tensile properties.