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Stereological analysis of subchondral angiogenesis in bone marrow stimulated cartilage repair

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"Division of Hematology, Hopital Sainte-Justine, Canada Bone marrow stimulation in combination with chitosan-GP/blood implant increases the quality of the repair cartilage, through mechanisms involving transient subchondral angiogenesis [1,2]. Although *in situ* solidification of the implant can be accelerated using clotting factors [4], their effect on early osteochondral repair is unknown. The purpose of this study was to test the hypothesis that clotting factors, including thrombin (IIa), tissue factor (TF) and recombinant human factor rhFVIIa, would enhance implant-induced subchondral angiogenesis in repairing drilled defects.

Full-thickness cartilage defects were created bilaterally in 12 skeletally mature NZW rabbits, and microdrilled to ~4mm deep. N=6 defects served as drill-only controls. Other defects were treated with implant solidified without (N=6) or with distinct clotting factors (N=4 per factor), resulting in total of N=24 defects. A quantitative stereology method was used to evaluate new blood vessel length (Lv), surface (Sv), and volume density (Vv) formed 3 weeks post-operative in repairing microdrill holes. Gomori-stained cryosections were generated through two distal 1.0 mm diameter drill holes, and 4 digital 40x magnification images acquired at 4 systematic depths in each repairing drill hole.

For all stereological parameters, blood vessel density increased in a depth-dependent manner (p<0.001). Between treatment groups, blood vessel Lv was not significantly different whereas Sv was significantly higher for Implant-rhFVIIa *vs* drill-only controls (Sv=269mm⁻¹ treated *vs* Sv=165mm⁻¹ drill-only). For the volume density, significant differences were found for Implant-rhFVIIa and Implant-IIa (Implant-rhFVIIa Vv=11.6%; Implant-IIa Vv=10.1%; control Vv=3.7%).

Despite some variability in the defect morphology (hole depth, sectioning angle), significant differences could be obtained in the center of repairing drill holes treated with rhFVIIa for Sv and Vv and with thrombin for Vv. Thus, blood vessel stereology revealed those clot factor implants stimulated the formation of larger blood vessels rather than stimulating formation of more blood vessels compared to drill-only controls.

Biography

C. Mathieu has completed a bachelor in chemical engineering at Ecole Polytechnique de MontrEal and is now a M.Sc.A. candidate at Ecole Polytechnique under the supervision of Prof. C. Hoemann.