



Patient specific reconstruction of cleft palate deformities in dogs with innovative 3D-printed organo-mineral cements

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Abstract :

Surgical correction of cleft lip and palate deformities is an ongoing challenge in child surgery, especially regarding the reconstruction of the maxillary bone defect. Currently, bone filling is performed with autologous bone graft which unfortunately

implies many limitations. To date, synthetic materials have failed to induce enough bone regeneration to be routinely used for the reconstruction of such defects, although additive manufacturing has brought new perspectives. This study aimed to assess the potential of 3D-printed organo-mineral scaffolds with evolutive mechanical properties to treat dog patients with spontaneous cleft lip and palate.

To date 8 puppies with cleft palate/lip spontaneous deformities have been recruited and treated. Two weeks prior surgery, a CT-scan of patient's skull was performed and used to design a 3D virtual model of the defect and implant. Virtual models were printed in polymer for surgical planning and validation. Scaffolds were then 3D printed with organo-mineral pastes. Surgical intervention implied one step reconstruction of soft tissues and placement of the scaffold soaked with autologous bone marrow. Bone formation was followed by CT imaging 3, 6 and 12 months after reconstruction, and a biopsy at 6 months was performed for more detailed analyses (μ CT, histology, SEM).

Scaffolds displayed great handling properties and were inserted without significant issue with a relevant bone edges/scaffold contact. Osteointegration of the scaffolds was observed after 3 months, and bone formation within the scaffold macroporous network seemed to occur. Preliminary results showed an interesting potential of this strategy in such spontaneous clinical presentation without using any experimental animal model.

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