

BONE – DEFECTS HEALING BY HIGH-MOLECULAR HYALURONIC ACID: PRELIMINARY RESULTS

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Aim
The aim of this study is to evaluate the capability to improve bone regeneration of a hyaluronan-based biopolymer, namely Hyaloss™ matrix (Fab – Fidia Advanced Biopolymers – Padova – Italy), used as organic scaffold in bone repair defects. Hyaloss™ matrix contributes to the improvement of tissue repair processes creating an ideal milieu which helps healing and restoration. Hyaloss™ matrix is entirely composed of HYAFF®, a biopolymer based on hyaluronan, a very large polysaccharide found in extra-cellular matrices, at the cell surface and inside cells. Many works, concerning the molecular characteristics of hyaluronan, contribute to show its physiological function for its hydrodynamic properties and instructive effects on cell signalling and behaviour. The hyaluronan acid may be used both as scaffold, neo-forming tissue inducer as well as a delivery vehicle for cells and growth factors.

Materials and methods
The high-molecular-weight hyaluronic acid (Hyaloss™ matrix, Fab – Fidia Advanced Biopolymers – Padova – Italy) was associated with autologous cortical bone harvested by Safescraper® curve (Meta – Reggio Emilia – Italy) in the repair of post-extractive sites. Safescraper® is a cutting edge system that allows to collect autologous cortical bone, avoiding to perform traditional incision-based collection techniques with important discomfort to the patient. The bone collection procedure permits to use autologous bone in particularly large quantities of bone (2 to 5 cc) of surface osseous cortices. So the use of Hyaloss™ matrix, as adjunct in autologous bone grafting, improves graft handling and application inside the defect. During the collection process the intertwined lamellae of bone mix with blood and Hyaloss™ matrix to form a high density bone concentrate to be used as a very good filler in bone tissue regenerative therapy. Post-extractive sites, filled by autologous cortical graft only, constitute the suitable control.



Hyaloss™ matrix loose fibers before the hydration with venous blood.



The Safescraper® Curve device for bone harvesting near the bone defect.



The Hyaloss™ matrix fibers after gelation and mixed with autologous cortical bone.

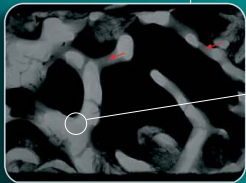
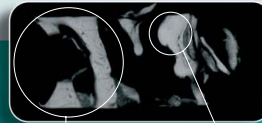
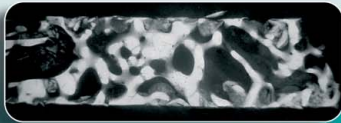


Two post-extractive sites before the grafting.



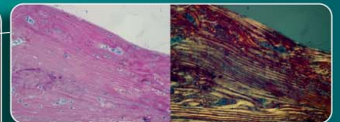
The implant placement at 3 months from grafting. The mesial implant is the control (only cortical autologous bone), the distal implant is the treated (Hyaloss™ matrix with cortical autologous bone).

Microradiographs of biptic samples from maxillary post-extractive sites of the same patient, three months after grafting. The control (left image) end the treated (right image).



Grafted autologous bone (OA) surrounded by newly-formed bone (N). The polarized light image allows to better distinguish the lamellar central area (grafted bone) from the peripheral area with woven fibres (newly-formed bone). Toluidine blue stain shows the presence of living osteocytes (black arrow) both in newly-formed bone and in grafted autologous bone.

Microradiographs with higher magnification of the control samples, grafted with autologous bone only. Bone trabeculae are the result of recent bone deposition activities (red arrows), erosion activities are few.



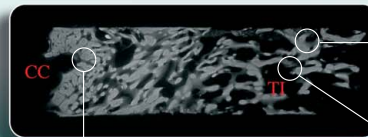
Microradiographs with even higher magnification of the biopsy treated with hyaluronan based matrices. It is possible to notice the different neo-depositions on the grafted autologous cortical bone (red arrows). Erosions are present, both in newly-formed bone in previous or more recent times (yellow arrow) and in grafted autologous bone.

Microradiographs with higher magnification of the biopsy treated with hyaluronan-based matrices. The bone trabeculae, particularly thick, show a large amount of vascular neo-cavities.

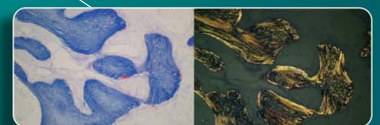
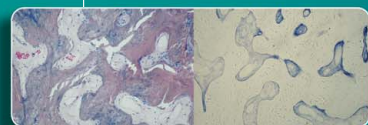
Microradiographs of biptic samples from mandible post-extractive sites of the same patient, three months after grafting. The control (left image) end the treated (right image).



In the control site there is very little bone, almost completely constituted by fibrous tissue.



Microradiographs of biopsy from post-extraction site in mandible treated with hyaluronan based matrices and autologous cortical bone, 3 months after grafting. Notice the rich trabecular bone network, and partial remodelling of internal trabeculae (T1).



RESULTS

Clinical and histological evaluations were performed 3 months after grafting in the maxilla and in the mandible. The results show that in the mandible, where the loads are high, Hyaloss™ matrix improves the development of a rich network of bone trabeculae which is only partly removed by bone remodelling. In the maxilla, the control sites show a higher quantity of bone, while the ones treated with Hyaloss™ matrix show a lower bone presence. The bone structure is however very different, while the control sites are made up of a thin bone structure trabeculate with few erosive activities precluding remodelling, the treated ones consist of thick trabeculae formed thanks to a dimensional increase of the initial trabeculae through bone neo-apposition. Again, in the treated ones there is a presence of a number of erosive activities due to both high angiogenesis and bone remodelling.

CONCLUSIONS

The results show an acceleration both of bone deposition activities and bone remodelling due to the presence of Hyaloss™ matrix, which can reduce the time required for bone regeneration when associated with autologous cortical bone.