OsteoBiol® by Tecnoss

# Could the enrichment of a biomaterial with conditioned medium or extracellular vesicles modify bone-remodeling kinetics during a defect healing? Evaluations on rat calvaria with synchrotron-based microtomography



A Giuliani[1]
G Sena[2]
G Tromba[3]
E Mazzon[4]
A Fontana[5]
F Diomede[6]
A Piattelli[6]
O Trubiani[6]

1 | Department of Clinical Sciences, Polytechnic University of Marche, Ancona, Italy
2 | COPPE, Federal University of Rio de Janeiro, Rio de Janeiro, Brazil
3 | Elettra Sincrotrone Trieste S.C.p.A, Trieste, Italy
4 | IRCCS Centro Neurolesi "Bonino Pulejo", Messina, Italy
5 | Department of Pharmacy, University "G. d'Annunzio", Chieti, Italy
6 | Department of Medical Oral and Biotechnological Sciences, "G. d'Annunzio", 66100 Chieti, Italy

**ORIGINAL ARTICLE**
Appl. Sci. 2020, 10, 2336

## ABSTRACT

With reference to bone regeneration, tissue engineering demonstrated to offer promising approaches especially using biomaterials that provide specific environments able to promote bone formation.
Among other biomaterials, collagen membranes (3D-COL) and polylactide (PLA) have been successfully used for bone repair. As in previous studies, the Authors already showed that mesenchymal stem cells (MSCs) and their derivatives, such as conditioned medium (CM) and extracellular vesicles (EV), when seeded on collagen membranes (COL) or polylactide (PLA) biomaterials, are able to favor bone tissue regeneration, they focused the present study on the investigation of whether the enrichment of a rat calvary defect site with CM, EVs and polyethylenimine (PEI)-engineered EVs could substantially modify the bone remodelling kinetics during defect healing. With the aid of synchrotron radiation-based high-resolution tomography, they analyzed the the bone mass density distribution. As scaffolds, they used a collagen membrane (COL) obtained from equine mesenchymal tissue (OsteoBiol® *Evolution*, Tecnoss®, Giaveno, Italy) and a polylactide scaffold (PLA) of commercial origin (Kaytech srl, Ancona, Italy). In particular, Evolution membrane (COL) is dense in fibers, ensuring easy suitability to nearby tissues and protecting underlying grafts. For the purpose of the study, COL scaffold was seeded with human PDLSCs (hPDLSCs) and hPDLSCs-derived CM or hPDLSCs-derived EVs or hPDLSCs-derived PEI-EVs; and PLA scaffold was enriched with human GMSCs (hGMSCs) and hGMSCs-derived CM or hGMSCs-derived EVs or hGMSCs-derived PEI-EVs. Male Wistar rats were used for this experiment and, after the scraping of their cortical calvaria bone tissue, the rats were randomly distributed into 10 groups of study, each of them grafted with different combinations of biomaterials, stem cells and their derivatives. Six weeks later, under anaesthesia the animals were euthanized and their calvariae were excised and prepared for synchrotron-based high resolution tomographic (microCT) analysis.
The mineralized bone density distribution analysis with synchrotron-based microCT showed increased mineralization in COL/hPDLSCs/PEI-EVs compared to other groups based on the same biomaterial and stem cells. PLA/hGMSCs/PEI-EVs showed the presence of lower mineralization levels and a wider density distribution variance than in the control sites. However, PLA/hGMSCs/CM samples were shown to reach levels of mineralization higher than the controls, with higher mean and variability values.

## CONCLUSIONS

Based on the results, the Authors concluded that "*the enrichment of a defect site with CM, EVs and PEI-EVs substantially modifies, often accelerating, bone remodelling kinetics and the related mineralization process during defect healing. Moreover, different biomaterials (COL or PLA) in combination with stem cells of different origin (namely, human periodontal ligament stem cells-hPDLSCs and human gingival mesenchymal stem cells-hGMSCs) and their own CM, EVs and PEI-EVs products were shown to exhibit different mineralization kinetics*".

*Abstract author: Cristina Rodighiero, dental journalist, free publication, not for resale. Printed by Tecnoss® Dental s.r.l.*

**Grafted with**

MEMBRANE
**OsteoBiol® *Evolution***