2D meets 3D: graphene-based solutions in bone regeneration

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Graphene is widely regarded as one of the most exceptional materials discovered to date, yet it remains a subject of considerable debate within the scientific community when it comes to biomedical applications. First, graphene has generated considerable interest due to its remarkable mechanical properties and the ability to reinforce any polymer matrix to an extent never seen before. Later studies uncovered new functionalities way beyond that e.g. osteoconductive and osteoinductive capabilities. These findings have elevated graphene to a prominent position in the biomaterials field, underscoring its potential to drive innovation in bone regenerative medicine and opening new horizons for improved and personalized cellular and acellular solutions to address complex challenges such as non-union bone fractures.
The advent of 3D printing technique has further opened new avenues in bone tissue engineering; however, the development of bioinks capable of producing scaffolds with high biocompatibility, effective mineralization, and suitable mechanical strength remains a significant challenge. Graphene-based formulations has emerged as a promising solution being considered highly promising, offering the potential to overcome key limitations of current 3D printing technologies—such as resolution and dimensional accuracy—while simultaneously addressing critical biological requirements like osteoconductivity and osteoinductivity.

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