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Assessment of Osteogenic Efficacy of Demineralised Dentin Matrix Hydrogel

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Objectives The use of a demineralized dentin matrix (DDM) has garnered substantial importance in dentistry. This study was carried out to evaluate the osteoinductive performance of DDM hydrogel (DDMH) in comparison to nano-hydroxyapatite hydrogel (NHH) on critical-sized calvarial bone defect (CSDs).

Methods Human extracted teeth were minced into particles and partially demineralized to produce DDM particles. DDM and n-HA particles were added to the sodium alginate (SA) then, dripped into calcium chloride solution to obtain DDMH or NHH. The formulated hydrogels were characterized, and cell viability was evaluated by MTT assay. Alkaline phosphatase (ALP) activity was assessed to test the hydrogel's osteogenic potential on bone marrow mesenchymal stem cells (BMMSCs). Then, two CSDs were bilaterally trephined in the calvarium of sixteen healthy rabbits, then were categorized into four groups: group 1, the defect was left empty; group 2, defects were filled with SA hydrogel; group 3, defects were treated with NHH; group 4, defects were treated using DDMH. Histological and immunohistochemical analyses were carried out to evaluate the areas of newly formed bone after 4 and 8 weeks.

Results characterization of the tested hydrogels revealed that they had negative values of zeta potential and showed a porous microstructure under SEM. The viability results revealed that BMMSCs were able to grow and proliferate in the presence of either DDMH or NHH. ALP level was significantly increased in the groups treated with 50% DDMH compared to 50% NHH after 21 days in culture. In vivo, DDMH showed newly formed woven bone bridged the defect area. Osteocalcin immune expression was significantly higher in the DDMH group in comparison to in the NHH or SA groups after 8 weeks.

Conclusions The results showed that adding DDM to SA-hydrogel improved the osteogenesis process in rabbit CSDs. The DDMH showed noticeably higher levels of new bone formation and showed great promise for accelerating the healing process.