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A Comprehensive Approach to Nanocellulose-Based Hydrogel Composites for Tissue Engineering: A Systematic Review

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ABSTRACT

Introduction: Tissue engineering is a promising technique that focuses on tissue regeneration and biological replacement to restore their lost function. Nanocellulose-based hydrogels are based on chemically cross-linked polymers that can be preferred in tissue engineering due to their resistance and longer lifetime than physical types. This study aimed to identify the most preferred type of nanocellulose to provide the most flexibility, biocompatibility, and moldability for tissue engineering in the last decade.

Search strategy: The present study was prepared by searching foreign (PubMed, Scopus, and ScienceDirect) and domestic (SID, Maglran, and IranDoc) databases, according to PRISMA guidelines. The search was carried out using the MeSH terms "tissue engineering", "hydrogel", and "nanocellulose," along with their Persian equivalents during the period of 2014-2024. In the initial search, 943 articles were obtained, and after applying the inclusion criteria and removing duplicate and unrelated items, 18 articles were selected. The inclusion criteria encompassed studies investigating nanocellulose materials for hydrogel fabrication in tissue engineering between January 2014 and April 2024. Peer-reviewed studies and those involving different hydrogel materials or conducted outside the specified timeframe were excluded. The search was concluded on April 2, 2024.

Results: Hydrogels based on nanocellulose should have high flexibility, biocompatibility, moldability, and water retention capacity. Four of the 18 articles studied in this review selected bacterial nanocellulose. They stated their similarity to the extracellular matrix and their degradability and non-toxicity. Two studies investigated cellulose nanocrystals and reported their high crystallinity. Twelve studies preferred cellulose nanofibers and stated them as suitable for hydrogel fabrication with higher polymerization, high water absorption, and high flexibility and structural strength.

Conclusion and Discussion: Cellulose nanofibers, with their extensive physical and chemical properties, are more useful in the fabrication of hydrogels, and with their biocompatibility and biodegradability, they have a unique and promising place in the advancement of tissue engineering science.

Keywords: Hydrogels, Systematic review, Tissue engineering

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