Journal of Composites and Compounds 5 (2023) 1-2

Available Online at www.jourcc.com

Journal homepage: www.JOURCC.com

Journal of Composites and Compounds

Artificial intelligence to discover and create innovative biocomposites for tissue engineering applications

Mehdi Mohabbatkhah [a], ***Darya Nejadkoorki*** [b*]

[a] *Department of Artificial Intelligence, Istinye University, İstanbul, Turkey*

[b] *M Kurs at Studienkolleg of the Frankfurt Goethe University, Frankfurt, Germany*

Commentary

ARTICLEINFORMATION

Article History:
Received: September 20 2023
Received in Revised form: November 31 2023
Accepted: December 25 2023

Keywords:
Artificial Intelligence (AI)
Tissue Engineering
Biomedical Engineering
Biocomposites

Abstract

In this commentary, we explore the role artificial intelligence (AI) can play in the development of innovative biocomposites for tissue engineering, emphasizing its ability to enhance material design and streamline production. Using artificial intelligence, biomaterials can be customized for individual patients, improving outcomes. AI-driven biocomposites are poised to transform tissue repair and regeneration, with personalized materials becoming standard by 2030 despite data quality and regulatory issues.

Peer review under responsibility of UGPH.

Introduction

The integration of Artificial Intelligence (AI) in the discovery and development of innovative biocomposites for tissue engineering applications marks an important advancement in the field of biomedical engineering [1]. Tissue engineering aims to restore or replace damaged tissues using biomaterials, cells, and biochemical factors. However, the complexity of designing functional three-dimensional structures presents substantial challenges [2]. AI boosts these processes by utilizing machine learning (ML) and deep learning (DL) algorithms to analyze extensive datasets, predict material behaviors, and optimize properties, thereby accelerating the improvement of effective biocomposites [3]. Fig. 1 shows the number of articles related to using AI for developing innovative tissue engineering composites from recent years with a forecast extended to 2030 based on google scholar. This commentary not only emphasizes the novelty of AI-driven biocomposites in transforming tissue engineering but also predicts a future where personalized, AI-optimized biomaterials will become the norm, significantly optimizing patient outcomes and transforming the field by 2030.

Contributions of AI in Material Discovery

AI plays a pivotal role in facilitating material discovery and design within tissue engineering [4]. By employing predictive modeling techniques, researchers can rapidly identify and develop new biomaterials that exhibit desirable characteristics for various applications, such as bone, heart, nerve, skin, and cartilage repair. This capability meaningfully reduces the time and resources typically required for traditional material testing and validation [5]. Furthermore, AI can raise the physical and biological properties of biocomposites, ensuring they meet stringent standards for biocompatibility and functionality essential for successful incorporation into biological systems [6].

* *Corresponding author: Darya Nejadkoorki.* E-mail: *daryanejad2004@gmail.com*
https://doi.org/10.61186/jcc.5.4.2

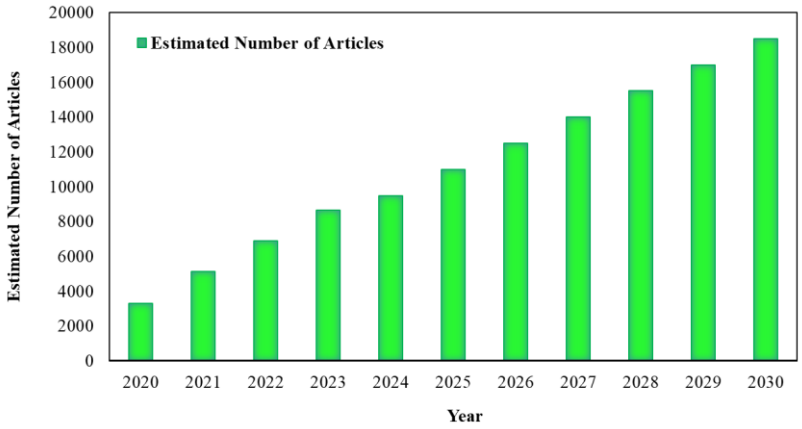

Fig. 1. Projected number of articles on AI-driven biocomposites for tissue engineering.

Streamlining Production and Personalization

In addition to optimizing material properties, AI streamlines production processes associated with creating biocomposites. Automation driven by AI technologies enriches manufacturing efficiency while simultaneously reducing costs [7]. Moreover, AI's capacity to analyze patient-specific data allows for the customization of biocomposites tailored to individual needs. This personalization is crucial for improving patient outcomes and minimizing complications following implantation, as it confirms that the materials used are ideally suited to each patient's unique biological context. The ability to predict how different materials will interact with biological systems further increases the potential for successful tissue regeneration [8].

Challenges and Future Directions

Despite these promising advancements, several experiments remain in fully integrating AI into tissue engineering. Issues related to data quality and availability can hinder the effectiveness of AI models, as inconsistent or insufficient data may lead to inaccurate predictions [9]. Additionally, the inherent complexity of biological systems makes it difficult for AI algorithms to capture all relevant variables accurately [10]. Addressing regulatory hurdles is also essential to guarantee that AI-driven products meet safety and efficacy standards before clinical application. By overcoming these contests through ongoing research and progress, AI has the potential to revolutionize tissue repair and regeneration, leading to improved health outcomes for patients worldwide [11].

Authors' contribution

Mehdi Mohabbatkhah: Writing—Original Draft Preparation, Writing—Review and Editing, **Darya Nejadkoorki**: Interpretation, Writing—Original Draft Preparation, Writing—Review and Editing.

Data availability

No data was used for the article.

Declaration of competing interest

The authors have no conflicts of interest to disclose.

Funding

None.

References

[1] Monfared, V., Application of Artificial Intelligence (Machine Learning) in Additive Manufacturing, Bio-Systems, Bio-Medicine, and Composites, in Additive Manufacturing for Biocomposites and Synthetic Composites. 2023, CRC Press. p. 152-203.
[2] Gao, W., et al., The status, challenges, and future of additive manufacturing in engineering. Computer-aided design, 2015. 69: p. 65-89.
[3] Dushyant, K., et al., Utilizing machine learning and deep learning in cybesecurity: an innovative approach. Cyber security and digital forensics, 2022: p. 271-293.
[4] Badini, S., S. Regondi, and R. Pugliese, Unleashing the power of artificial intelligence in materials design. Materials, 2023. 16(17): p. 5927.
[5] Kuhn, M., Applied predictive modeling. 2013, Springer.
[6] Al Mahmud, M.Z., Exploring the versatile applications of biocomposites in the medical field. Bioprinting, 2023. 36: p. e00319.
[7] Haleem, A., et al., Hyperautomation for the enhancement of automation in industries. Sensors International, 2021. 2: p. 100124.
[8] Joyce, K., et al., Bioactive potential of natural biomaterials: Identification, retention and assessment of biological properties. Signal transduction and targeted therapy, 2021. 6(1): p. 122.
[9] Al-Kharusi, G., et al., The role of machine learning and design of experiments in the advancement of biomaterial and tissue engineering research. Bioengineering, 2022. 9(10): p. 561.
[10] Neftci, E.O. and B.B. Averbeck, Reinforcement learning in artificial and biological systems. Nature Machine Intelligence, 2019. 1(3): p. 133-143.
[11] Kothuru, S.K., AI-Driven Innovations in Healthcare: Improving Diagnostics and Patient Care. International Journal of Machine Learning and Artificial Intelligence, 2023. 4(4): p. 1-13