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Transforming Orthopedic Decision-Making and Patient Care Through Artificial Intelligence

Yapay Zekâ ile Ortopedik Klinik Karar Verme ve Hasta Yönetiminin Dönüşümü

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Dear Editor,

Orthopedic medicine is undergoing a profound transformation, driven by the accelerated integration of artificial intelligence (AI) technologies into diagnostic and therapeutic processes. While traditionally lagging behind specialties like radiology and cardiology in AI adoption, recent developments have demonstrated that orthopedics is rapidly catching up, particularly in trauma diagnostics, joint arthroplasty planning, and regenerative applications (1). Given the growing body of evidence, we believe AI deserves more deliberate incorporation into orthopedic clinical workflows and training curricula.

Fracture diagnosis remains a significant diagnostic challenge, particularly in emergency departments, where time pressure and variable expertise often lead to frequent misinterpretations. Radiographic misdiagnoses of fractures are estimated to occur in 3–10% of cases, with error rates inversely related to clinician experience. Furthermore, the increasing volume of imaging continues to exceed the capacity of radiology services in many countries, highlighting the urgent need for scalable solutions. In this context, AI has shown considerable promise. A meta-analysis including over 55,000 images reported that AI and clinicians demonstrated comparable diagnostic performance in fracture detection, with pooled sensitivities and specificities exceeding 90% in both internal and external validations (2).

The field of regenerative orthopedics is also beginning to benefit from AI integration. AI-supported analysis of genomic and cellular data has accelerated the design of scaffolds and the optimization of stem cell therapies, laying the groundwork for personalized musculoskeletal regeneration strategies. Tools such as KeyGene and CellNet exemplify how AI can aid in interpreting complex biological signals and guide therapeutic decisions, especially in tissue engineering applications where conventional analytics fall short (3).

Convolutional neural networks (CNNs) in particular have exhibited high accuracy in image-based fracture detection, sometimes exceeding that of non-specialist clinicians. For instance, AI tools achieved a sensitivity of 98.6% for distal radius fractures and 92.2% for ulnar styloid fractures in a study employing bi-planar radiographs. Similarly, for femoral neck fractures, CNNs demonstrated an overall accuracy of 92.3% and outperformed clinicians in classifying displaced fractures (1).

Despite these advancements, several barriers hinder the full-scale adoption of AI in orthopedics. These include data heterogeneity, model generalizability across diverse patient populations, and the lack of prospective clinical trials validating AI applications in real-time settings (2,4). Furthermore, skepticism persists among clinicians regarding the safety, interpretability, and ethical use of AI, as reflected in recent surveys (5). Educational initiatives and interdisciplinary collaborations are necessary to enhance AI literacy among orthopedic surgeons and promote confidence in AI-assisted decision-making.

In conclusion, AI is no longer a peripheral innovation but a central component of future-ready orthopedic practice. Its diagnostic capabilities are well-validated, and its potential in surgical planning and regenerative medicine is rapidly expanding. We urge orthopedic communities, educational institutions, and policymakers to proactively integrate AI into clinical pathways and training frameworks, ensuring the safe, equitable, and effective implementation of this technology.

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