

Artificial Intelligence in Orthopaedics: Current Applications in Diagnosis, Treatment, Rehabilitation, and Resident Training - A Narrative Review**Sourav Diasi¹, Tarun Agrawal², Mahendra Singh Dhakar³, Maneesh Verma⁴,
Tribhuwan Narayan Singh Gaur⁵**¹Senior Resident, Department of Orthopedics, Government Medical College, Datia, Madhya Pradesh, India²Junior Resident, Department of Orthopedics, Government Medical College, Datia, Madhya Pradesh, India³Junior Resident, Department of Orthopedics, Government Medical College, Datia, Madhya Pradesh, India⁴Assistant Professor, Department of Orthopedics, Government Medical College, Datia, Madhya Pradesh, India⁵Professor and HOD, Department of Orthopedics, Government Medical College, Datia, Madhya Pradesh, India

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Corresponding author: Dr. Sourav Diasi

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Abstract**Aim & Background:** Artificial intelligence (AI) is increasingly transforming orthopaedic practice through advancements in machine learning, deep learning, computer vision, and natural language processing. AI applications now support fracture detection, imaging interpretation, surgical planning, robotic-assisted surgery, rehabilitation monitoring, and resident training. This narrative review summarizes the current applications of AI in orthopaedic along with its future potential in musculoskeletal healthcare.**Material & Methods:** A literature review was conducted using PubMed, Scopus, and Embase and Google Scholar databases for studies published from January 2020 to March 2026. Keywords included “artificial intelligence,” “machine learning,” “orthopaedics,” “deep learning,” “robotics,” “rehabilitation,” and “resident training.” Peer-reviewed studies, systematic reviews, observational studies, and narrative reviews related to AI in orthopaedics were included.**Result:** AI improved fracture detection, imaging interpretation, osteoarthritis grading, clinical prediction, surgical planning, implant positioning, rehabilitation monitoring, and resident training. However, challenges related to data privacy, algorithmic bias, validation, ethical concerns, and implementation costs remain.**Conclusion:** AI has the potential to significantly improve orthopaedic healthcare and education. However, further validation, ethical regulation, and standardized clinical integration are necessary before widespread adoption.**Keywords:** Artificial Intelligence; Orthopaedics; Machine Learning; Rehabilitation; Resident Training.**DOI:** 10.25258/ijcpr.18.6.85

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Introduction

Artificial intelligence (AI) has emerged as one of the most transformative technological advancements in modern healthcare. AI encompasses machine learning, deep learning, computer vision, and natural language processing techniques that enable the analysis of complex medical data and support clinical decision-making [1,2].

Orthopaedics, with its reliance on imaging, biomechanical assessment, digital health records, and precision-based surgical interventions, is

particularly well suited for AI integration [3]. Over the past decade, AI applications in orthopaedics have expanded considerably. AI-assisted systems have been developed for fracture detection, osteoarthritis grading, implant recognition, surgical planning, robotic-assisted procedures, rehabilitation monitoring, and clinical outcome prediction [4–7].

These technologies aim to improve diagnostic accuracy, optimize treatment planning, enhance surgical precision, and improve patient outcomes. The COVID-19 pandemic accelerated the adoption

of digital healthcare technologies, including telemedicine, remote rehabilitation, and virtual learning platforms [8]. Concurrently, advances in generative AI and large language models have created new opportunities in research, clinical documentation, patient communication, and resident education [9].

Despite these advances, challenges related to data privacy, algorithmic bias, external validation, ethical considerations, and medicolegal accountability remain significant barriers to widespread implementation [10]. A clear understanding of both the opportunities and limitations of AI is therefore essential for its responsible integration into orthopaedic practice.

This narrative review summarizes the current applications of artificial intelligence in orthopaedic diagnosis, treatment, rehabilitation, and resident training, while highlighting its limitations and future prospects.

Machine Learning: Machine learning (ML) is a subset of artificial intelligence that enables computer systems to learn patterns from data and make predictions or decisions without being explicitly programmed for every task. ML algorithms improve their performance by analyzing large datasets and identifying complex relationships among variables.

In orthopaedics, machine learning has been applied to fracture detection, osteoarthritis grading, implant survivorship prediction, postoperative risk assessment, and clinical outcome prediction. By analyzing demographic, clinical, imaging, and surgical data, ML models can support diagnostic decision-making, personalized treatment planning, and predictive analytics [3].

As the availability of digital health records and imaging databases continues to increase, machine learning is expected to play an expanding role in evidence-based orthopaedic practice.

Deep Learning and Neural Networks: Deep learning (DL) is a specialized subset of machine learning that utilizes artificial neural networks with multiple processing layers to learn complex patterns from large datasets. Inspired by the structure of the human brain, neural networks

consist of interconnected nodes (neurons) that process information and adjust their connections through training.

One of the most widely used deep learning architectures in orthopaedics is the convolutional neural network (CNN), which is particularly effective for image analysis. CNNs have demonstrated high accuracy in detecting fractures, classifying osteoarthritis severity, identifying implant types, and interpreting musculoskeletal imaging studies [1,3].

The ability of deep learning algorithms to process large volumes of imaging and clinical data has contributed significantly to the expanding role of artificial intelligence in orthopaedic practice.

Natural Language Processing: Natural language processing (NLP) is a branch of artificial intelligence that enables computers to understand, interpret, and generate human language. NLP combines computational linguistics with machine learning and deep learning techniques to analyze large volumes of unstructured text data.

In orthopaedics, NLP has been used to extract clinically relevant information from electronic health records, operative notes, radiology reports, and research databases. These systems can automate data extraction, identify complications, classify diagnoses, and support clinical documentation, thereby improving workflow efficiency and reducing administrative burden. [1,3].

Generative Adversarial Networks: Generative Adversarial Networks (GANs) are deep learning models composed of a generator and a discriminator that are trained in competition to produce realistic synthetic data. In orthopaedics and medical imaging, GANs are widely used for data augmentation, image synthesis, image enhancement, and noise reduction.

By generating high-quality radiographs, CT, and MRI images, GANs help overcome limited dataset availability, improve model performance, and support the development of robust artificial intelligence applications in clinical practice and research [1,3].

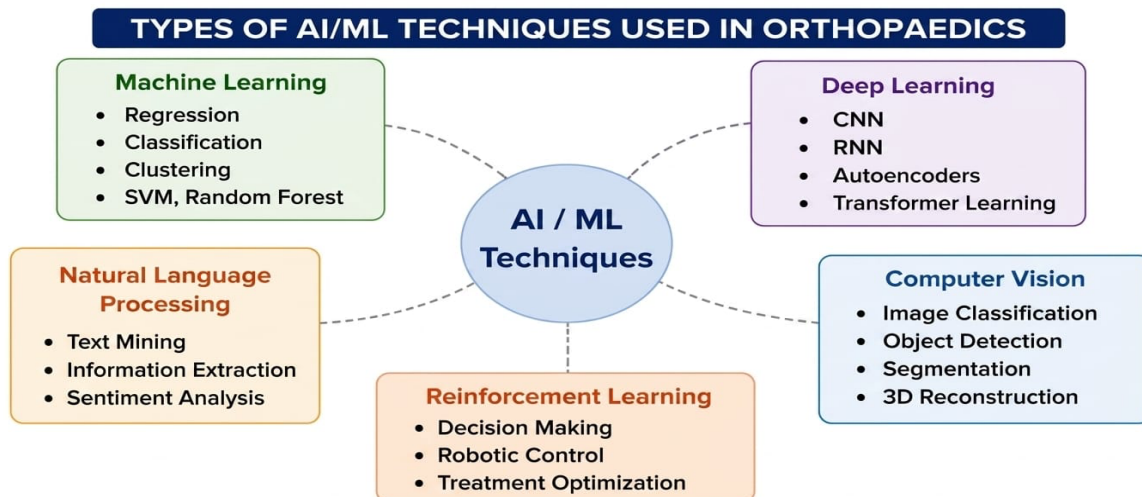


Figure 1: Types of AI/ML. techniques used in orthopaedics

Material & Methods

A narrative review of the literature was performed using PubMed, Scopus, Embase, and Google Scholar databases. Articles published between January 2020 and March 2026 were searched using the terms “Artificial Intelligence,” “Machine Learning,” “Orthopaedic Surgery,” “Deep Learning,” “Rehabilitation,” “Robotic Surgery,” “Virtual Reality,” and “Orthopaedic Education.”

Inclusion Criteria

1. Articles published in English.
2. Studies related to AI applications in orthopaedics.
3. Original research articles, observational studies, clinical studies, systematic reviews, and narrative reviews.
4. Publications focusing on orthopaedic diagnosis, treatment, rehabilitation, or education.

Exclusion Criteria

1. Non-English studies.
2. Articles unrelated to musculoskeletal healthcare.
3. Editorials without scientific evidence.

After screening abstracts and removing duplicate articles, 40 relevant studies were included for analysis.

Results

AI in Orthopaedic Diagnosis: Artificial intelligence assisted diagnostic systems have

shown promising performance in musculoskeletal imaging. Deep learning algorithms, especially convolutional neural networks (CNNs), have demonstrated high accuracy in fracture detection involving the wrist, hip, ankle, humerus, and vertebral column [10-13]. Several studies have shown that AI systems can identify fractures on radiographs with sensitivity levels comparable to experienced clinicians [14,34,35]. AI has also improved the evaluation of degenerative joint diseases. Automated osteoarthritis grading systems based on radiographic analysis can classify disease severity using the Kellgren–Lawrence scale [15]. MRI-based AI models can identify cartilage degeneration, meniscal injuries, and ligament pathology at earlier stages than conventional assessment methods [16].

In spine surgery, AI-based software assists in vertebral segmentation, spinal alignment analysis, pedicle screw trajectory planning, and deformity assessment [17]. Implant recognition algorithms are increasingly used during revision arthroplasty planning to identify prosthesis types from radiographs [18]. Natural language processing technologies can extract clinically relevant information from radiology reports and electronic medical records, thereby reducing administrative burden and improving workflow efficiency [19]. AI systems are also being investigated for trauma triage, oncology screening, and sports injury assessment [20].

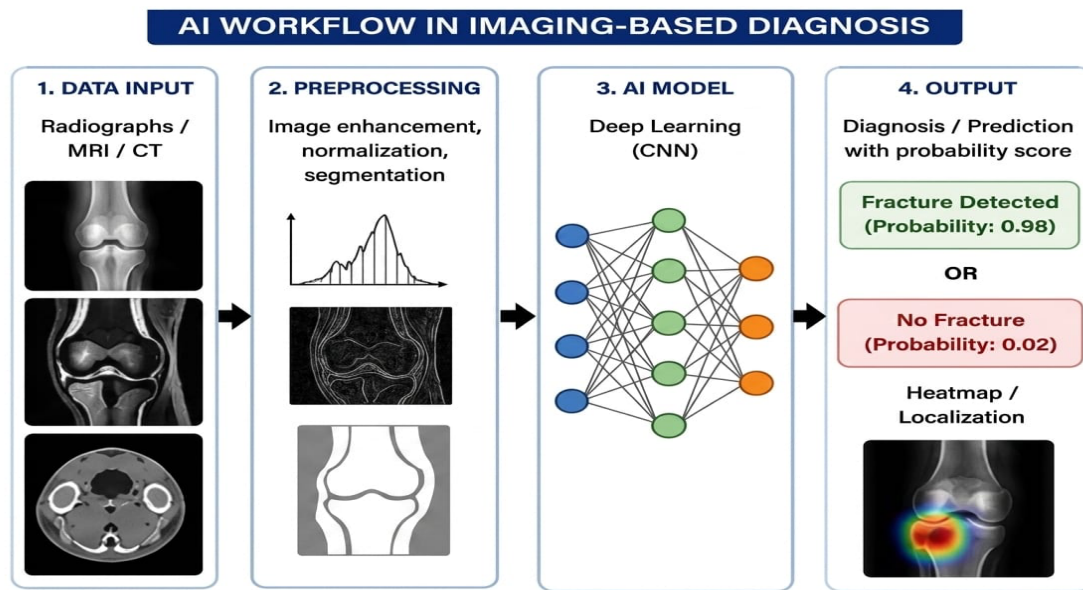


Figure 2: AI workflow in imaging-based diagnosis

AI in Orthopaedic Treatment: AI has become increasingly important in surgical planning and perioperative management. Predictive analytics models can estimate postoperative complications, length of hospital stay, implant survivorship, and readmission risk using patient-specific clinical data [21]. These tools support individualized treatment planning and may improve healthcare resource utilization. Robotic-assisted orthopaedic surgery has expanded considerably in total knee arthroplasty and total hip arthroplasty [22]. AI-integrated robotic systems help surgeons achieve accurate implant positioning, soft tissue balancing, and precise bone preparation [23]. Such technologies may improve implant longevity and functional outcomes. Three-dimensional AI-

assisted planning systems are also used for deformity correction and complex trauma surgery [24,38]. Patient-specific instrumentation and navigation technologies reduce intraoperative variability and enhance surgical reproducibility [25]. Machine learning models can predict postoperative complications such as infection, venous thromboembolism, and implant failure [26]. Predictive algorithms may therefore assist surgeons in risk stratification and perioperative optimization.

Generative AI tools and large language models are increasingly being explored for clinical documentation, operative note generation, and patient communication [27]. However, concerns remain regarding misinformation, legal liability, and overdependence on automated systems [28].

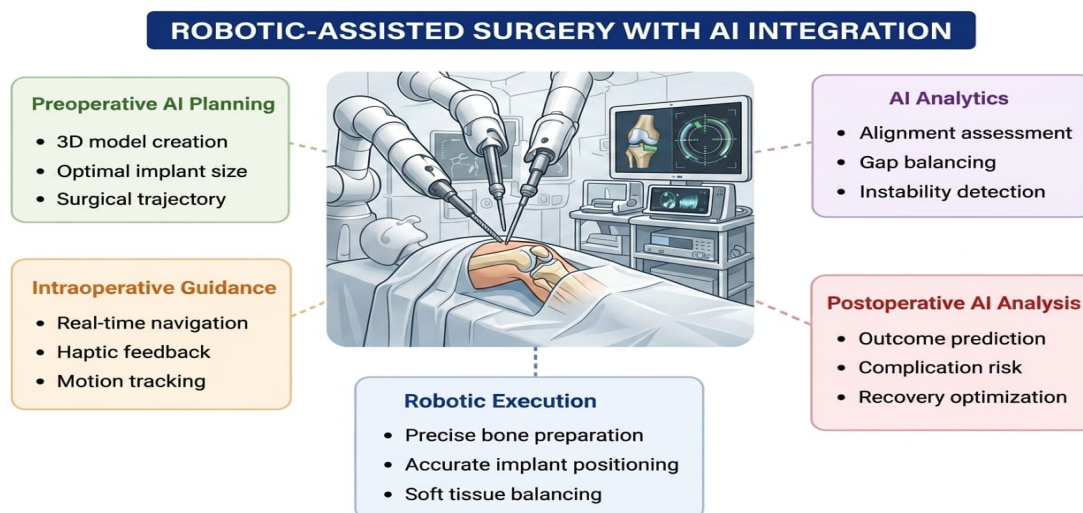


Figure 3: Robotic-assisted surgery with AI integration

AI in Orthopaedic Rehabilitation: Postoperative rehabilitation is another important area of AI application. Wearable sensors and computer vision systems allow continuous monitoring of patient movement and recovery [29]. AI-driven rehabilitation platforms can assess gait patterns, range of motion, balance, and muscle activity with objective precision [30,36].

Tele-rehabilitation systems gained popularity during and after the COVID-19 pandemic because they reduced the need for repeated hospital visits [31]. Mobile applications powered by AI can provide individualized exercise programs, monitor compliance, and deliver real-time feedback to patients recovering from surgery [32].

Motion-analysis algorithms can identify deviations in rehabilitation exercises and assist clinicians in monitoring recovery remotely [33,37]. These systems are especially useful following arthroplasty, ligament reconstruction, fracture fixation, and spine surgery.

AI-assisted prosthetic and orthotic technologies have also improved gait adaptation and biomechanical efficiency [34].

Intelligent exoskeleton systems are increasingly being used in patients with neurological deficits and spinal cord injuries [35]. Despite these developments, challenges related to patient privacy, affordability, accessibility, and validation continue to limit widespread implementation [36].

AI in Resident Training and Orthopaedic Education: Orthopaedic education has evolved significantly with the introduction of AI-based learning technologies [37]. Traditional apprenticeship-based teaching is increasingly being supplemented with simulation platforms, virtual reality (VR), and augmented reality (AR) systems [38]. VR simulators enable residents to practice arthroscopy, fracture fixation, and joint replacement procedures in a controlled environment without patient risk [39,40]. AI algorithms can objectively evaluate surgical performance by analyzing hand motion, procedural timing, instrument handling, and technical accuracy [40]. Adaptive educational systems personalize learning content according to trainee performance and learning speed [23]. AI-powered platforms can generate clinical scenarios, examination questions, and educational summaries for residents. Large language models are also increasingly being used for manuscript preparation, literature review support, and academic research assistance [27]. However, educators must ensure ethical use of AI to prevent misinformation, plagiarism, and excessive reliance on automated tools [31]. Simulation-based training has demonstrated improvements in procedural confidence, psychomotor skill development, and resident satisfaction [37-40]. Nevertheless, further research is required to determine the long-term impact of simulation training on real operative performance.

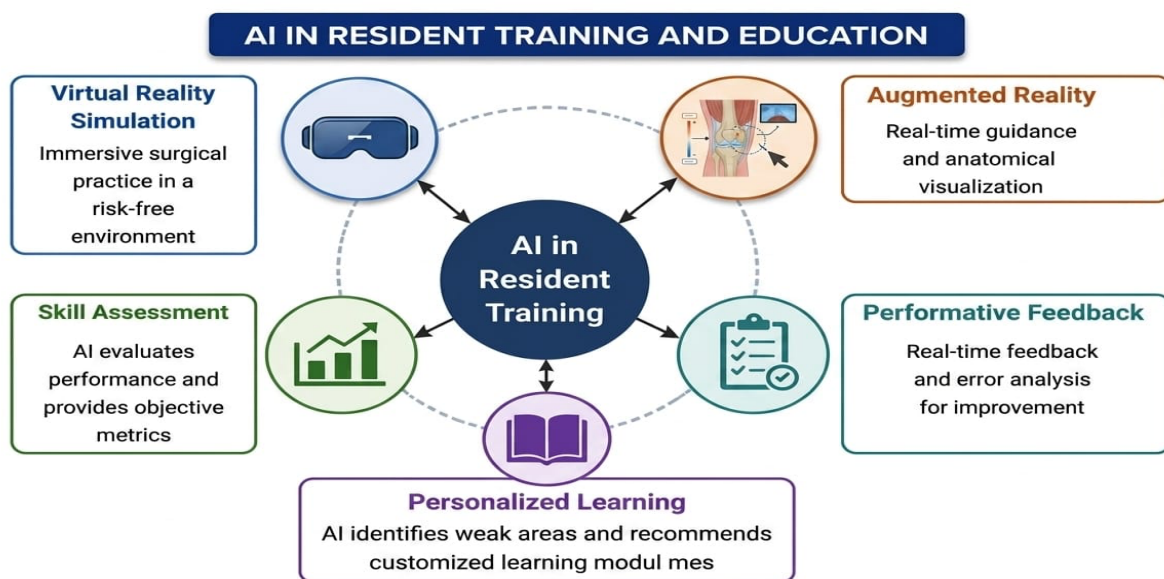


Figure 4: AI in resident training and education

Discussion

Artificial intelligence is increasingly influencing orthopaedic practice by enhancing diagnostic accuracy, supporting treatment planning, improving rehabilitation, and facilitating resident education [1–5]. The ability of AI algorithms to analyze large volumes of clinical and imaging data offers opportunities for earlier diagnosis, improved decision-making, and more personalized patient care.

In musculoskeletal imaging, deep learning models have demonstrated diagnostic performance comparable to experienced clinicians for selected conditions, particularly fracture detection and osteoarthritis grading [10–15]. While these systems have the potential to improve efficiency and reduce reporting delays, their performance may vary across institutions and patient populations.

Consequently, AI should currently be viewed as a decision-support tool rather than a replacement for clinical judgment.

The integration of AI into surgical planning and robotic-assisted procedures represents another important advancement. Improved implant positioning, surgical precision, and procedural reproducibility have been reported in arthroplasty and complex reconstructive procedures [22–25]. Furthermore, predictive analytics may assist in risk stratification and perioperative optimization, contributing to improved patient outcomes and more efficient resource utilization.

AI-driven rehabilitation platforms have expanded opportunities for remote monitoring and personalized recovery programs, particularly following arthroplasty, ligament reconstruction, and fracture fixation [29–33]. Similarly, virtual reality simulation and adaptive learning systems have enhanced orthopaedic education by providing objective performance assessment and risk-free procedural training [37–40].

Despite these promising developments, several barriers continue to limit widespread implementation. Concerns regarding data privacy, algorithmic bias, transparency, medicolegal responsibility, implementation costs, and inadequate external validation remain significant challenges [31–35]. Addressing these issues will require multidisciplinary collaboration among clinicians, researchers, engineers, and policymakers. Future developments may include more sophisticated predictive models, wearable-integrated monitoring systems, advanced robotic platforms, and personalized AI-driven treatment pathways. As evidence continues to evolve, responsible integration of AI has the potential to

improve the quality, efficiency, and accessibility of orthopaedic care.

Conclusion

Artificial intelligence is rapidly reshaping orthopaedic healthcare and education. Applications in imaging, surgical planning, robotic surgery, rehabilitation, and resident training have demonstrated encouraging outcomes. AI technologies may improve diagnostic accuracy, operative precision, patient monitoring, and educational efficiency.

However, challenges involving ethical regulation, data security, implementation costs, and validation must be addressed before widespread clinical adoption. At present, AI should serve as a tool to augment, rather than replace, clinical expertise. Continued research, validation, and responsible integration will be essential to fully realize the benefits of AI in orthopaedic practice.

Clinical Message: Artificial intelligence has emerged as a valuable tool in orthopaedics by improving diagnostic support, refining surgical precision, enhancing rehabilitation monitoring, and advancing resident education. AI should complement not replace clinical judgment. Careful validation and ethical implementation are essential for its successful integration into practice.

References

1. Rosen J, Russell J, Kartik P, Vella-Baldacchino M. Artificial intelligence algorithms in orthopaedics: A narrative review of methods and clinical applications. *J Exp Orthop*. 2025;12(4):e70549. doi:10.1002/jeo2.70549.
2. Banskota, B., Bhusal, R., Yadav, P.K. et al. Artificial intelligence in orthopaedic education, training and research: a systematic review. *BMC Med Educ* 25, 1594 (2025). <https://doi.org/10.1186/s12909-025-08162-y>.
3. Han F, Huang X, Wang X, Chen YF, Lu C, Li S, et al. Artificial intelligence in orthopedic surgery: Current applications, challenges, and future directions. *MedComm*. 2025;6:e70260. doi:10.1002/mco2.70260.
4. Mohamed A, Elasad A, Fuad U, et al. (September 14, 2025) Artificial Intelligence in Trauma and Orthopaedic Surgery: A Comprehensive Review from Diagnosis to Rehabilitation. *Cureus* 17(9): e92280. DOI 10.7759/cureus.92280
5. Szatkowski JP, Druten E, Soni C, O'Neill DC. Artificial intelligence in orthopaedic education: a narrative review. *Ann Jt* 2025;10:34.doi: 10.21037/aoj-25-7.
6. Leal, Jaime Andrés MD, MHPE. Artificial Intelligence in Orthopaedic and Trauma Surgery Education: Applications, Ethics, and

- Future Perspectives. *JAAOS: Global Research and Reviews* 9(9):e25.00174, September 2025. | DOI: 10.5435/JAAOSGlobal-D-25-00174
7. Glinkowski WM, Spalińska A, Wołk A, Wołk K. Artificial intelligence in orthopaedics: Clinical performance, limitations, and translational readiness—A review. *J Clin Med*. 2026;15(5):1751. doi:10.3390/jcm15051751.
 8. Vaishya R, Sibal A, Kar S, Reddy S. Integrating artificial intelligence into orthopedics: Opportunities, challenges, and future directions. *J Hand Microsurg*. 2025;17:100257. doi:10.1016/j.jham.2025.100257.
 9. Baghbani, S., Mehrabi, Y., Movahedinia, M. et al. The revolutionary impact of artificial intelligence in orthopedics: comprehensive review of current benefits and challenges. *J Robotic Surg* 19, 511 (2025). <https://doi.org/10.1007/s11701-025-02561-5>
 10. Lisacek-Kiosoglous AB, Powling AS, Fontalis A, Gabr A, Mazomenos E, Haddad FS. Artificial intelligence in orthopaedic surgery. *Bone Joint Res*. 2023;12(7):447-454. doi:10.1302/2046-3758.127.BJR-2023-0111.R1
 11. Giorgino R, Alessandri-Bonetti M, Luca A, Migliorini F, Rossi N, Peretti GM, Mangiavini L. ChatGPT in orthopedics: a narrative review exploring the potential of artificial intelligence in orthopedic practice. *Front Surg*. 2023 Nov 1;10:1284015. doi: 10.3389/fsurg.2023.1284015. PMID: 38026475; PMCID: PMC10654618.
 12. Wang J, Bi H, Wang Y, Song Y, Xu H, Zhong S, He Q and Zhang Q (2026) Application of artificial intelligence in postoperative orthopedic rehabilitation: a scoping review. *Front. Digit. Health* 7:1746552. doi: 10.3389/fgdth.2025.1746552
 13. Sporn K, Kumar R, Paladugu P, Ong J, Sekhar T, Vaja S, et al. Artificial Intelligence in Orthopedic Medical Education: A Comprehensive Review of Emerging Technologies and Their Applications. *International Medical Education [Internet]*. 2025Apr;4:14. Available from: <http://dx.doi.org/10.3390/ime4020014>
 14. Ebrahimpour, A., Dolikhani, M., Shakibamaram, G. Artificial Intelligence (AI) as a Catalyst for Orthopedic Residency Training. *The Archives of Bone and Joint Surgery*, 2025; 13(12): 773-775. doi: 10.22038/abjs.2025.91626.4155
 15. Walters C, Young P. Artificial intelligence in orthopedic trauma: A narrative review. *Cureus*. 2026;18(4):e107574. doi:10.7759/cureus.107574.
 16. Bartkowski J, Zerdka J, Brasse P, Piszka M, Kwapien E, Staszkiwicz K, et al. Artificial intelligence in medicine with emphasis on orthopedic practice. *Cureus*. 2025;17(3):e98306. doi:10.7759/cureus.98306.
 17. Zsidai B, Hilkert AS, Kaarre J, Narup E, Senorski EH, Grassi A, et al. A practical guide to the implementation of AI in orthopaedic research-Part 1: Opportunities in clinical application and overcoming existing challenges. *J Exp Orthop*. 2023;10(1):117. doi: 10.1186/s40634-023-00683-z.
 18. Yang W, Gao T, Liu X, Shen K, Lin F, Weng Y, et al. Clinical application of artificial intelligence-assisted three-dimensional planning in direct anterior approach hip arthroplasty. *Int Orthop*. 2024;48(3):773-783. doi:10.1007/s00264-023-06029-9.
 19. Jackson P, Ponath Sukumaran G, Babu C, Tony MC, Jack DS, Reshma VR, et al. Artificial intelligence in medical education: Perception among medical students. *BMC Med Educ*. 2024;24(1):804. doi:10.1186/s12909-024-05760-0.
 20. Nagi F, Salih R, Alzubaidi M, Shah H, Alam T, Shah Z, et al. Applications of artificial intelligence (AI) in medical education: A scoping review. *Stud Health Technol Inform*. 2023;305:648-651. doi:10.3233/SHTI230581.
 21. Jeyaraman M, Ramasubramanian S, Balaji S, Jeyaraman N, Nallakumarasamy A, Sharma S. ChatGPT in action: Harnessing artificial intelligence potential and addressing ethical challenges in medicine, education, and scientific research. *World J Methodol*. 2023;13(4):170-178. doi:10.5662/wjm.v13.i4.170.
 22. Adegbesan A, Shittu O, Akinyemi A, Bello A, Yusuf M, Okafor C, et al. From scalpels to algorithms: The risk of dependence on artificial intelligence in surgery. *Glob Med*. 2024;2:100140. doi:10.1016/j.gmedi.2024.100140.
 23. Moldt JA, Festl-Wietek T, Madany Mamlouk A, Nieselt K, Fuhl W, Herrmann-Werner A. Chatbots for future docs: Exploring medical students' attitudes and knowledge towards artificial intelligence and medical chatbots. *Med Educ Online*. 2023;28(1):2182659. doi:10.1080/10872981.2023.2182659.
 24. Mir MM, Mir GM, Raina NT, Mir SM, Miskeen E, Alharthi MH, et al. Application of artificial intelligence in medical education: Current scenario and future perspectives. *J Adv Med Educ Prof*. 2023;11(3):133-140. doi:10.30476/JAMP.2023.98655.1803.
 25. Pandurangam, Gayathri; Gurajala, Swathi; Nagajyothi, Dandul. Artificial Intelligence in Anatomy Teaching and Learning: A Literature Review. *National Journal of Clinical Anatomy* 13(3):p 158-163, Jul-Sep 2024. | DOI: 10.4103/NJCA.NJCA_103_24
 26. Al-Zahrani AM. Unveiling the shadows: Beyond the hype of AI in education. *Heliyon*. 2024;10(9):e30696. doi:10.1016/j.heliyon.2024.e30696.

27. Levingston H, Anderson MC, Roni MA. From theory to practice: Artificial intelligence (AI) literacy course for first-year medical students. *Cureus*. 2024;16(10):e70706. doi:10.7759/cureus.70706.
28. Bakkum MJ, Hartjes MG, Piët JD, et al. Using artificial intelligence to create diverse and inclusive medical case vignettes for education. *Br J Clin Pharmacol*. 2024;90(3):640-648. doi:10.1111/bcp.15977
29. An Z, Zhang Y, Zhu K, Zhao R. Advances in the application of artificial intelligence in continuing education for trauma orthopedics. *Art Int Surg*. 2025;5:505-520. doi:10.20517/ais.2025.34.
30. Liao Y, Vakanski A, Xian M, Paul D, Baker R. A review of computational approaches for evaluation of rehabilitation exercises. *ComputBiol Med*. 2020;119:103687. doi:10.1016/j.combiomed.2020.103687.
31. Anisuzzaman DM, Wang C, Rostami B, Gopalakrishnan S, Niezgoda J, Yu Z. Image-based artificial intelligence in wound assessment: A systematic review. *Adv Wound Care (New Rochelle)*. 2022;11(6):247-279. doi:10.1089/wound.2021.0091.
32. Ghorashi N, Ismail A, Ghosh P, Sidawy A, Javan R. AI-powered chatbots in medical education: Potential applications and implications. *Cureus*. 2023;15(8):e43271. doi:10.7759/cureus.43271.
33. Nowroozi A, Salehi MA, Shobeiri P, Agahi S, Momtazmanesh S, Kaviani P, et al. Artificial intelligence diagnostic accuracy in fracture detection from plain radiographs and comparing it with clinicians: A systematic review and meta-analysis. *Clin Radiol*. 2024;79(8):579-588. doi:10.1016/j.crad.2024.04.009.
34. Jung J, Dai J, Liu B, Wu Q. Artificial intelligence in fracture detection with different image modalities and data types: A systematic review and meta-analysis. *PLOS Digit Health*. 2024;3(1):e0000438. doi:10.1371/journal.pdig.0000438.
35. Kuo RYL, Harrison C, Curran TA, Jones B, Freethy A, Cussons D, et al. Artificial intelligence in fracture detection: A systematic review and meta-analysis. *Radiology*. 2022;304(1):50-62. doi:10.1148/radiol.211785.
36. Liao Y, Vakanski A, Xian M. A deep learning framework for assessing physical rehabilitation exercises. *IEEE Trans Neural Syst Rehabil Eng*. 2020;28(2):468-477. doi:10.1109/TNSRE.2020.2966249.
37. Chen MY, Cao MQ, Xu TY. Progress in the application of artificial intelligence in skin wound assessment and prediction of healing time. *Am J Transl Res*. 2024;16(7):3064-3078.
38. Anwar A, Wu Y, Zhang Y, et al. Artificial intelligence technology improves the accuracy of three-dimensional preoperative planning in primary cementless total hip arthroplasty. *Asian J Surg*. 2024. doi:10.1016/j.asjsur.2024.04.186.
39. Kuhn AW, Rossy WH, Schwarzkopf R, et al. Virtual reality and surgical simulation training for orthopaedic residents: Current applications, perceptions, and future directions. *J Bone Joint Surg Am*. 2024;106(6):e24. doi:10.2106/JBJS.23.00987.
40. Bartlett JD, Lawrence JE, Stewart ME, Nakano N, Khanduja V. Does virtual reality simulation have a role in training trauma and orthopaedic surgeons? *Bone Joint J*. 2021;103-B(3):559-565. doi:10.1302/0301-620X.103B3.BJJ-2020-1508.R1.