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CHALLENGES IN LOWER LIMB RECONSTRUCTION WITH MICROSURGICAL FLAPS

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INTRODUCTION

Dermatology, due to its strongly visual nature, has proven to be an especially favorable field for the application of artificial intelligence (AI) in skin lesion diagnosis. Since the milestone year of 2017, when deep learning models achieved dermatologist-level performance in skin cancer diagnosis[1], progress has accelerated, ranging from deep convolutional networks to integrated multimodal approaches.

Currently, AI is applied to various imaging modalities, including dermoscopy, smartphone clinical photographs, hyperspectral imaging, photoacoustic optics, and confocal microscopy[2–4]. Tools such as EfficientNet, ResNet, and Xception often combined with transfer learning and advanced segmentation methods (e.g., LAMA, U-Net) have demonstrated high accuracy in detecting melanoma, basal cell carcinoma, and other cutaneous neoplasms[5–7].

Recent studies have shown that AI algorithms can match or even surpass human specialists in specific triage and lesion-classification tasks[8–10]. Furthermore, emerging approaches such as self-supervised learning and model explainability (XAI) aim to reduce biases related to skin tone and increase clinical trustworthiness[11–14].

Nevertheless, significant challenges remain: limited representativeness of training datasets, difficulty in generalizing to diverse clinical scenarios, and the need for robust regulatory oversight and validation before full integration into dermatological practice[15–19]. Understanding the current landscape of AI in dermatological diagnosis is therefore essential to delineate its advances, limitations, and future prospects.

OBJECTIVE

To understand the application of Artificial Intelligence (AI) in dermatological diagnosis, highlighting technological advances and the challenges faced in integrating these tools into clinical practice.

METHODS

This qualitative study is a narrative literature review with a descriptive focus, analyzing the use of artificial intelligence (AI) in diagnosing dermatological lesions, particularly skin neoplasms. Searches were conducted in the PubMed (MEDLINE) database using MeSH terms: ("Artificial Intelligence" OR "Machine Learning") AND ("Skin Neoplasms" OR "Dermatology") AND ("Diagnosis" OR "Image Interpretation, Computer-Assisted").

Inclusion criteria comprised articles published between 2015 and 2025, available in English, with full text accessible, addressing AI applied to diagnosis of cutaneous lesions through clinical or dermoscopic imaging. Exclusion criteria included duplicate studies, inaccessible articles, studies outside dermatology, or those with a purely technical focus.

The initial search identified 717 articles; after removing 26 duplicates, 691 remained. Following title, abstract, and full-text screening, 573 articles were excluded, resulting in a total of 144 included studies. Data were descriptively organized and qualitatively analyzed based on AI applications, lesion types, and key findings.

RESULTS

Recurring patterns were identified in AI applications for dermatological diagnosis, including methodological approaches, lesion types addressed, and limitations as well as future perspectives.

Most studies focused on the detection and classification of melanoma and other pigmented lesions such as nevi, basal cell carcinoma, and squamous cell carcinoma (Esteva et al., 2017; Brinker et al., 2019; Haenssle et al., 2020). However, non-pigmented conditions including ulcers, acne, psoriasis, and leprosy were also significantly represented (Li et al., 2020; Shrivastava et al., 2021; Attia et al., 2021).

Deep Learning, particularly Convolutional Neural Networks (CNNs), was the predominant technique used, with ResNet, VGG, Inception, and EfficientNet being the most common architectures (Codella et al., 2018; Liu et al., 2020; Mahbod et al., 2021). These methods automatically extract relevant visual features, eliminating the need for manual feature selection (Esteva et al., 2017; Codella et al., 2018; Shrivastava et al., 2021). Machine Learning techniques including Support Vector Machines (SVM), Random Forests, and k-Nearest Neighbors (KNN) also played an important role, although generally with lower performance due to their dependence on handcrafted features (Celebi et al., 2015; Masood et al., 2020).

AI models demonstrated satisfactory performance depending on the task and architecture, with accuracy ranging from 74% to 98%, particularly in CNN-based approaches due to their ability to automatically extract image properties (Brinker et al., 2019; Fujisawa et al., 2019; Xie et al., 2020; Liu et al., 2020).

Only a small number of studies conducted testing on external datasets. Even fewer performed prospective evaluations in real-time clinical settings, limiting current clinical applicability (Han et al., 2020; Combalia et al., 2022). Clinical implementation was also explored through mobile apps such as SkinVision and diagnostic-support software such as DEXI and MoleAnalyzer PRO; however, their real-world use remains limited by the lack of extensive clinical validation (Jiang et al., 2022; Pathan et al., 2023).

CONCLUSION

Artificial intelligence (AI) is gaining increasing relevance in dermatology, becoming a valuable ally in clinical practice. Recent advances especially in deep learning and neural networks have demonstrated that AI can achieve performance comparable to that of medical professionals.

Currently, AI is applied in various settings, from digital dermoscopy systems to mobile-based applications, significantly expanding diagnostic support tools.

Despite this progress, important challenges persist. The performance of many models is limited by insufficient representation of diverse demographic groups in training datasets, reducing their generalizability. Additionally, the absence of standardized guidelines for clinical validation, the continued need for histopathological confirmation, and the scarcity of robust multicenter studies remain significant barriers to broad and safe implementation.

Thus, AI is not intended to replace physicians, but rather to serve as a complementary tool. When properly used, it can optimize triage, increase diagnostic access, and contribute to faster, more precise, and safer clinical decision-making.

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