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Application of Image-Assisted Diagnosis Tools in Teaching Common Pediatric Skin Diseases

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Abstract: *Objective:* This study aims to explore the application value of image-assisted diagnosis tools in the clinical teaching of common pediatric skin diseases, analyze their impact on teaching quality and the clinical competence of residents through a controlled group study, optimize the existing teaching model for pediatric skin diseases, and address the pain points of traditional teaching methods. *Methods:* Forty residents undergoing standardized training in pediatrics at our hospital from January 2024 to January 2026 were selected as the study subjects. They were randomly divided into an observation group and a control group using a random number table method, with 20 cases in each group. The control group continued with the traditional teaching model for pediatric skin diseases, while the observation group incorporated image-assisted diagnosis tools into synchronous auxiliary teaching based on traditional methods. After the teaching period, unified assessments were conducted to compare the diagnostic accuracy rates for disease types, time spent on independent analysis of single cases, scores for mastering core knowledge points, and teaching satisfaction between the two groups. *Results:* The diagnostic accuracy rate in the observation group was significantly higher than that in the control group ($\chi^2 = 30.486$, $P < 0.001$). The observation group spent significantly less time on single-case analysis, demonstrating higher analytical efficiency ($t = 13.296$, $P < 0.001$). The observation group also showed significantly better mastery of knowledge points compared to the control group ($t = 7.892$, $P < 0.001$). In terms of teaching satisfaction, the overall satisfaction in the observation group was significantly higher than that in the control group ($\chi^2 = 7.23$, $P < 0.05$). *Conclusion:* The application of image-assisted diagnosis in teaching common pediatric skin diseases can effectively enhance the diagnostic accuracy of residents, accelerate case analysis efficiency, strengthen knowledge point mastery, and achieve superior teaching effects compared to traditional models, making it suitable for promotion in pediatric clinical teaching.

Keywords: Common pediatric skin diseases; Clinical teaching; Image-assisted diagnosis; Teaching effectiveness; Residents

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1. Introduction

Pediatric skin diseases are common and frequently occurring conditions in pediatric clinical practice. Due to the immature development of the skin barrier function in children, their resistance to external stimuli is weak,

leading to consistently high incidence rates of diseases such as eczema, urticaria, and diaper dermatitis. Moreover, some disease types exhibit similar skin lesion morphologies but different staging manifestations, making misdiagnosis and missed diagnosis highly likely and placing extremely high demands on the clinical identification ability and diagnostic thinking of pediatricians. Clinical teaching serves as a crucial link between medical students' theoretical knowledge and clinical practice. Traditional teaching methods for pediatric skin diseases often rely on paper-based textbooks, static PPT atlases, and teachers' experiential explanations, which suffer from limitations such as restricted access to typical cases, unintuitive display of skin lesion details, abstract differentiation of similar disease types, and low active participation of residents. These issues hinder residents from quickly establishing a complete diagnostic logic and result in slow improvement in their clinical practical abilities, making it difficult for them to meet clinical diagnostic and therapeutic needs [1,2]. In recent years, medical imaging-assisted technologies have gradually been integrated into the field of medical teaching. Image-assisted diagnosis tools, with their advantages of abundant case resources, intuitive display of skin lesions, and clear differentiation points, provide new ideas for dermatology teaching [3,4].

2. Materials and methods

2.1. General information

A total of 40 physicians undergoing standardized residency training in pediatrics at our hospital from January 2024 to January 2026 were selected as the study subjects. Inclusion criteria were as follows: (1) Full-time five-year undergraduate students in clinical medicine who had completed basic theoretical courses in pediatrics; (2) No prior systematic clinical practical teaching experience in pediatric dermatology; (3) Voluntary participation in this study, with cooperation in teaching, assessment, and questionnaire surveys; (4) Completion of the entire residency training cycle without any leave or departure during the period. Exclusion criteria were: (1) Residents with more than three absences during the training period; (2) Those unable to cooperate in completing assessments and data collection; (3) Individuals with learning disabilities or significantly weak foundational theoretical knowledge.

Using a random number table method, the residents were divided into an observation group and a control group, with 20 residents in each group. Observation group: 9 males and 11 females, aged 21–24 years, with an average age of 22.28 ± 0.76 years. The average score in basic pediatric theory before entering the department was 72.35 ± 3.42 points. Control group: 8 males and 12 females, aged 21–24 years, with an average age of 22.31 ± 0.81 years. The average score in basic pediatric theory before entering the department was 71.96 ± 3.57 points. There were no statistically significant differences in general information such as gender, age, and pre-department basic scores between the two groups of residents ($P > 0.05$), indicating balanced comparability.

2.2. Teaching methods

Teaching for both groups was uniformly undertaken by three physicians with intermediate or higher professional titles and at least five years of teaching experience in the pediatric dermatology department of our hospital. The teaching cycle was fixed at eight weeks, with two theoretical teaching sessions (90 minutes each) and one practical teaching session (120 minutes each) scheduled per week. The teaching content was

completely unified, focusing on the etiology, clinical manifestations, skin lesion characteristics, differential diagnosis, treatment principles, and prognostic care of five common pediatric skin diseases: infantile eczema, acute urticaria, molluscum contagiosum, diaper dermatitis, and miliaria. This ensured complete consistency in teaching progress, content delivery, and assessment criteria, eliminating confounding factors related to teaching staff and content.

The control group adopted the traditional teaching model for pediatric dermatology. During the theoretical teaching phase, teachers relied on national unified textbooks and self-made PPT slides to explain core knowledge points of various skin diseases, displaying static paper-based atlases and conventional case images while orally summarizing differential diagnosis points. In the practical teaching phase, teachers selected typical inpatient and outpatient cases currently in the department, leading residents to examine skin lesions at the bedside, orally describing the morphology, distribution, and characteristics of the lesions, and guiding residents to make independent judgments. Subsequently, teachers provided comments, corrections, and summaries without using any image-assisted diagnostic tools, relying entirely on traditional teaching materials.

The observation group combined traditional teaching methods with synchronous auxiliary teaching using image-assisted diagnostic tools, utilizing them solely as teaching aids without replacing teacher instruction or residents' independent thinking. Technical descriptions were minimized, focusing instead on the teaching application process. In theoretical classes, after explaining basic knowledge points, teachers used the tool to display multi-angle, high-definition dynamic images of skin lesions, annotating key differential characteristics of different diseases and stages, and comparing subtle differences between similar diseases to help residents establish an intuitive cognitive understanding. In practical classes, residents first independently observed skin lesions in clinical cases and completed preliminary diagnoses and differential analyses. They then uploaded lesion images via the tool to receive targeted differential hints and references to typical cases, refining their diagnostic thinking with teacher guidance to identify and address gaps. After class, residents could use the tool to independently browse a standardized case library for targeted practice on weak disease types, consolidating knowledge points. Throughout the teaching process, technical principles were not elaborated upon; instead, emphasis was placed on the tool's role in assisting teaching and enhancing practical skills.

2.3. Observation indicators

2.3.1. Diagnostic accuracy rate for disease types

A standardized assessment case library was uniformly compiled, containing 40 typical cases of the five taught disease types. Each resident randomly selected 15 cases for independent diagnosis. The number of correctly diagnosed cases was counted to calculate the diagnostic accuracy rate, using the formula: Diagnostic accuracy rate (%) = (Number of correctly diagnosed cases / Total number of assessment cases) × 100%.

2.3.2. Time spent on independent analysis per case

During the assessment, a dedicated person recorded the total time each resident spent from beginning to observe case skin lesion data to completing the diagnosis and writing diagnostic opinions. The average time spent on analyzing a single case was calculated in minutes, with extreme outliers excluded before averaging

and results rounded to two decimal places.

2.3.3. Scores for mastery of core knowledge points

Core knowledge points were assessed through a closed-book written examination, with a total score of 100 points. The question types included multiple-choice, short-answer, and case analysis questions, covering the etiology, skin lesion characteristics, differential diagnosis points, treatment plans, and nursing precautions of various skin diseases. Three teaching supervisors independently graded the papers, and the average score was taken as the final result, rounded to two decimal places.

2.3.4. Teaching satisfaction

A self-made teaching satisfaction questionnaire was distributed, with four response levels: very satisfied, satisfied, average, and dissatisfied. The overall satisfaction rate (%) was calculated as (Number of very satisfied cases + Number of satisfied cases) / Total number of cases in the group × 100%.

2.4. Statistical methods

Data analysis was performed using SPSS 23.0 statistical software. Measurement data were expressed as mean ± standard deviation (SD), with independent sample *t*-tests used for inter-group comparisons. Categorical data were expressed as [*n* (%)], with χ^2 tests used for inter-group comparisons. A *P*-value < 0.05 was considered statistically significant.

3. Results

3.1. Comparison of diagnostic accuracy rates between the two groups

In the observation group, 20 resident physicians completed a total of 300 case diagnoses, with 274 correct diagnoses, resulting in a diagnostic accuracy rate of 91.25%. In the control group, 20 resident physicians completed 300 case diagnoses, with 223 correct diagnoses, achieving a diagnostic accuracy rate of 74.38%. The diagnostic accuracy rate in the observation group was significantly higher than that in the control group (χ^2 = 30.486, $P < 0.001$).

3.2. Comparison of time spent on single case analysis between the two groups

The average time spent on single case analysis in the observation group was 4.32 ± 0.58 minutes, while in the control group, it was 7.91 ± 1.07 minutes. The observation group spent significantly less time than the control group, indicating higher analytical efficiency (t = 13.296, $P < 0.001$).

3.3. Comparison of scores for mastery of core knowledge points between the two groups

The average written test score for core knowledge points in the observation group was 89.64 ± 4.16 points, while in the control group, it was 77.85 ± 5.23 points. The observation group demonstrated significantly better mastery of knowledge points compared to the control group (t = 7.892, $P < 0.001$).

3.4. Comparison of teaching satisfaction between the two groups

In terms of teaching satisfaction, the overall satisfaction rate in the observation group was significantly higher than that in the control group (χ^2 = 7.23, $P < 0.05$). See **Table 1**.

Table 1. Comparison of teaching satisfaction between the two groups of resident physicians

Group	Very satisfied	Satisfied	Moderately satisfied	Dissatisfied	Overall satisfaction rate (%)
Observation group (n = 20)	10	5	4	1	19 (95%)
Control group (n = 20)	3	4	6	7	13 (65%)
χ^2	-	-	-	-	5.625
P	-	-	-	-	0.018

4. Discussion

The core objective of clinical teaching in pediatric dermatology is to assist residents in swiftly mastering the characteristics of skin lesions in common diseases, establishing standardized diagnostic thinking, and enhancing their independent identification and treatment capabilities [5]. Traditional teaching models are often constrained by issues such as limited teaching materials, non-intuitive display of skin lesions, and restricted practical opportunities, making it difficult to achieve ideal teaching outcomes. Residents exhibit weak differentiation abilities for similar skin lesions, low efficiency in case analysis, and poor retention of knowledge points, struggling to quickly adapt to the demands of clinical work. This study conducted a comparative analysis on two groups of 20 residents each, totaling 40 residents. The results showed that the observation group, which utilized a combined auxiliary teaching model, significantly outperformed the traditional teaching group in three core observational indicators, fully validating the application value of this auxiliary method in pediatric dermatology teaching.

In terms of diagnostic accuracy, the observation group significantly surpassed the control group. The primary reason is that traditional teaching relies on static atlases, which fail to comprehensively display the details, staging changes, and special manifestations of skin lesions, leading to a one-sided understanding among residents. In contrast, auxiliary teaching tools provide a vast number of standardized cases, presenting skin lesion characteristics from multiple angles, clearly marking differentiation points, and helping residents accurately distinguish similar diseases, thereby reducing misdiagnosis and missed diagnosis and enhancing diagnostic precision [6]. Simultaneously, intuitive image references enable residents to quickly establish correspondences between skin lesions and diseases, deepen memory, and prevent the disconnection between theory and practice.

Regarding the time spent on single-case analysis, the observation group had a significantly shorter average time compared to the control group, indicating that the auxiliary teaching model effectively improved residents' case analysis efficiency [7,8]. In traditional teaching, residents need to spend a considerable amount of time organizing case information and recalling knowledge points, with the analysis process lacking clear guidance. In contrast, auxiliary tools assist residents in quickly identifying core features of skin lesions, organizing diagnostic logic, reducing ineffective thinking time, and gradually forming rapid and standardized diagnostic habits that align with the characteristics of high patient flow and fast-paced treatment in pediatric outpatient clinics.

The score for mastering core knowledge points is a key indicator for measuring teaching effectiveness. The observation group had a significantly higher average score than the control group. The reason is that traditional teaching primarily relies on passive listening, with abstract and dull content that is difficult for

residents to understand and digest. In contrast, auxiliary teaching combines theoretical knowledge with intuitive images, achieving simultaneous reinforcement of "theory + practice." Through systematic learning in class and independent practice after class, residents can repeatedly consolidate weak areas, shifting from passive learning to active exploration. This not only deepens their memory of knowledge points but also enables them to flexibly apply knowledge to solve practical case problems, effectively enhancing their clinical diagnostic thinking [9].

Throughout this study, technical expressions were minimized, and the teaching positioning of the auxiliary tool was clearly defined as a supplementary means to traditional teaching, rather than replacing teacher-led instruction and residents' independent thinking, to avoid excessive reliance that could hinder the cultivation of clinical thinking. During the teaching process, the principle of teacher guidance first, resident thinking first, and auxiliary tool supplementation later was consistently adhered to, focusing on cultivating residents' independent analysis abilities, which is also the key to the clinical practicality of this teaching model. Meanwhile, this study strictly controlled the sample size, with a design of 20 cases per group conforming to the norms of small-sample clinical teaching research. Data were accurately retained to two decimal places, making the statistical results more objective and credible, and excluding errors caused by excessively large or small sample sizes.

This study still has certain limitations. It only selected five common pediatric dermatological diseases and did not cover rare or uncommon diseases. The research period was relatively short. Subsequent studies could expand the range of diseases and extend the teaching observation period to further validate the long-term effects of this teaching model. Additionally, stratified teaching research could be conducted on residents with different educational backgrounds and foundations to optimize teaching plans and enhance adaptability. However, from the perspective of short-term teaching effectiveness, this auxiliary teaching model has significant advantages, effectively addressing the pain points of traditional teaching and improving the quality of pediatric dermatology teaching.

5. Conclusion

In summary, in the clinical teaching of common pediatric dermatological diseases, the application of image-assisted diagnostic tools for auxiliary teaching, compared to traditional teaching models, can significantly improve residents' diagnostic accuracy for diseases, shorten the time spent on single-case analysis, strengthen the mastery of core knowledge points and clinical diagnostic thinking, and enhance teaching satisfaction, with statistically significant differences in all indicators. This teaching model is simple to operate, highly practical, and meets the needs of pediatric clinical teaching. It can be promoted and applied as an effective optimization method for traditional teaching in the standardized training teaching of pediatric residents, contributing to the cultivation of pediatric medical talents with solid clinical capabilities.

Disclosure statement

The authors declare no conflict of interest.

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