

Original Research

Pharmacist-led evaluation of a novel nail-cutting innovation versus conventional trimming in hemiplegic patients: A Randomized controlled trial

Janyut Srihirun , Sudarat Isaravisavakul, Prayuth Poowaruttanawiwit 

Received (first version): 11-Jul-2025

Accepted: 20-Aug-2025

Published online: 06-Jan-2026

Abstract

Background: Hemiplegic patients often have trouble maintaining nail hygiene due to unilateral hand dysfunction, increasing the risk of perionychial injury, infection, and reduced quality of life. Assistive devices enabling safe, independent nail trimming may address these challenges while supporting preventive health strategies. **Objective:** To evaluate the efficacy and safety of a novel one-handed, electrically powered nail-cutting device compared with conventional manual clippers in hemiplegic patients. **Methods:** A randomized controlled trial was conducted at Naresuan University Hospital in two phases: preliminary testing in healthy volunteers (n=10) and clinical evaluation in hemiplegic patients (n=20). Participants were randomized to use either the novel device or conventional clippers. Primary outcomes were trimming quality (shape uniformity, smoothness of edges) and safety (incidence of perionychial injury, pain scores). Secondary outcomes included user satisfaction and completion time. Randomization, independent allocation, standardized training, and blinded outcome assessment were employed to enhance internal validity. **Results:** In hemiplegic patients, the novel device achieved smoother nail edges, preserved nail integrity, and significantly reduced pain compared with conventional clippers (mean difference in pain score: -0.68; 95% CI: -1.28 to -0.08). No perionychial injuries occurred in the intervention group. Satisfaction scores were consistently high, with participants reporting enhanced self-esteem and perceived safety. Similar performance and safety were observed in healthy volunteers. **Conclusion:** The novel one-handed electric nail-cutting device demonstrated superior efficacy, safety, and user satisfaction compared with conventional clippers in hemiplegic patients. While findings are promising, larger multi-center trials with longer follow-up are warranted to confirm these results and assess cost-effectiveness and long-term adherence.

Keywords: hemiplegia, assistive device, nail trimming, randomized controlled trial, patient independence

INTRODUCTION

In hemiplegic patients, maintaining hygiene is of paramount importance due to their inability to fully care for themselves owing to limitations in mobility and use of certain body parts¹. A review of literature indicates that medical observational evidence consistently underscores the inferior health status of hemiplegic patients compared to those with normal bodily functions²⁻⁴. Additionally, reports of diseases or wounds occurring in hemiplegic patients due to inadequate healthcare maintenance, such as irregular nail trimming, are prevalent⁵⁻⁷. Evidence suggests that if hemiplegic patients allow their nails to grow long, it may result in skin abrasions, inflammation, or infections, predisposing them to unwanted future events⁷. Furthermore, upon considering self-healthcare abilities, particularly regarding nail trimming, it is highly unlikely that

hemiplegic patients, especially those with unilateral hemiplegia, can independently trim nails on both hands. Patients often rely on others for nail trimming, a dependency that medical evidence indicates correlates with worsened mental states and increased susceptibility to neurological disorders such as depression.

Therefore, the introduction of tools or innovations enabling self-assistance in nail trimming for these patients, resulting in shorter nails, smoother edges, and the prevention of perionychial injuries, would significantly reduce the likelihood of undesired events as previously discussed. Ultimately, this would lead to heightened self-awareness, improved mental health, and ultimately, a better quality of life.

From a broader healthcare perspective, the clinical significance of this innovation extends beyond rehabilitation into the intersecting domains of Pharmacy Practice and public health⁷. Within Pharmacy Practice, pharmacists are increasingly recognized as integral members of multidisciplinary care teams, contributing not only to the optimization of pharmacotherapy but also to the prevention of secondary complications in vulnerable populations⁸. In hemiplegic patients, poor nail hygiene can precipitate skin breaks, localized inflammation, and microbial colonization, serving as portals of entry for pathogens and potentially leading to cellulitis or systemic infection^{9,10}. Such events frequently necessitate pharmacologic intervention, including analgesics, topical or systemic antimicrobials, and, in severe cases, surgical management, thereby increasing

Janyut Srihirun. Department of Art and Design, Faculty of Architecture Art and Design Naresuan University
Sudarat Isaravisavakul. Occupational Therapy and Prosthetics & Orthotics Unit, Naresuan University Hospital, Phitsanulok, Thailand.

Prayuth Poowaruttanawiwit*. Department of Pharmacy Practice, Faculty of Pharmaceutical Sciences, Naresuan University, Phitsanulok, 65000, Thailand.
Medical & Pharmacy Innovation Research & Development Unit, Faculty of Pharmaceutical Sciences, Naresuan University, Phitsanulok, 65000, Thailand. yuth_pu@hotmail.com



drug utilization, healthcare costs, and the risk of antimicrobial resistance. The incorporation of a safe, self-administered nail-cutting innovation into routine care pathways offers a preventive strategy that aligns with antimicrobial stewardship objectives by reducing the incidence of avoidable infections and subsequent medication use.

From a public health standpoint, this approach addresses multiple social and functional determinants of health, including personal hygiene, independence in activities of daily living, and psychological well-being. By enabling hemiplegic patients to maintain nail care autonomously, the device may reduce caregiver dependency, alleviate caregiver burden, and improve patient self-esteem, factors known to correlate with enhanced mental health outcomes¹¹. In resource-limited healthcare settings, where access to regular rehabilitation or grooming services is often constrained, such an innovation represents a low-cost, high-impact intervention with the potential to reduce the prevalence of preventable complications and their downstream effects on healthcare systems. Collectively, these outcomes illustrate the potential for integrating this device into clinical practice guidelines, where it can serve as an example of how rehabilitation technology, pharmacy practice, and public health policy can converge to deliver holistic, patient-centered, and cost-effective care.

Srihirun and colleagues have designed and developed a novel nail cutting device with key features that allow patients to utilize it independently, even in cases of hemiplegia or unilateral hand impairment. They have successfully filed for a patent with the Thai Intellectual Property Department. Initial trials conducted on a small group of patients have shown promising results, warranting further investigation into its potential application in a larger patient cohort. Motivated by these findings, the researchers are undertaking this study with the objective of evaluating the efficacy and safety of the innovative nail cutting device compared to conventional methods in hemiplegic patients.

RESEARCH METHODOLOGY

Aim

The primary objective of this study was to evaluate the efficacy and safety of a novel electric automatic nail-cutting device, specifically designed for one-handed operation, compared with conventional nail-clipping methods in hemiplegic patients.

Study Design and Setting

A randomized controlled trial (RCT) was conducted at Naresuan University Hospital, Phitsanulok, Thailand. The study comprised two sequential phases: a preliminary feasibility phase and the main clinical trial phase.

Ethical approval was obtained from the Institutional Review Board of Naresuan University Hospital and Naresuan University (IRB No. P3-0057/2566), and the study adhered to the principles of the Declaration of Helsinki.

Participants

The preliminary phase enrolled 10 healthy adult volunteers

to assess device feasibility, operational ergonomics, and procedural reliability. Inclusion criteria required participants to have normal bilateral hand function, the ability to follow instructions, and comparable educational backgrounds to ensure uniformity in device handling.

The main phase recruited 20 individuals with unilateral hand function impairment, defined as having one functional hand while the contralateral hand exhibited markedly reduced or absent functionality secondary to neurological or musculoskeletal conditions.

Sample Size Calculation

A target sample size of 20 participants per group was calculated using standard formulas based on a two-tailed hypothesis test, 80% statistical power, and a significance level (α) of 0.05. An effect size of 1.33, derived from previous comparable studies, was used to ensure both statistical rigor and feasibility.

Randomization and Allocation Concealment

Participants were allocated to either the intervention group (novel device) or control group (conventional clippers) using a computer-generated randomization sequence. Allocation was performed by an independent researcher to prevent selection bias.

Blinding

Due to the open-label nature of the trial, blinding of participants was not feasible. However, to minimize detection and measurement bias, objective outcome assessments were performed by independent evaluators who were not involved in device training or patient allocation.

Interventions

The intervention group used the electric automatic nail clipper, ergonomically designed for one-handed use and featuring a fully enclosed cutting mechanism for safety and comfort. The comparator group used standard manual nail clippers.

Training and Data Collection

All participants received standardized training and hands-on practice with their assigned device before evaluation. Nail shape and trimming quality were documented through standardized, high-resolution photographic procedures. Data was recorded using a structured Case Record Form and a validated satisfaction questionnaire.

Outcome Measures

Primary outcomes included trimming quality (shape uniformity, smoothness of edges) and safety (incidence of perionychial injury). Secondary outcomes included user satisfaction scores and completion time.

Pharmacist Integration to Enhance Methodological Rigor and Internal Validity

To strengthen internal validity, pharmacist involvement was explicitly integrated into the study protocol. Pharmacists contributed to participant recruitment via structured



medication therapy management (MTM) programs, ensuring eligibility criteria were applied consistently and reducing selection bias. Standardized, pharmacist-led device training emphasized hygiene and infection prevention, thereby minimizing variability in intervention delivery and reducing the risk of performance bias. Pharmacists also oversaw adverse event monitoring, with particular attention to drug-related events following infections, providing a systematic approach to safety surveillance that mitigated underreporting and enhanced data accuracy. Even in this retrospective context, documenting pharmacist roles ensures procedural consistency, improves fidelity of intervention implementation, and increases the reproducibility of study outcomes.

Statistical Analysis

Descriptive statistics were used to summarize baseline characteristics. Between-group differences for continuous variables were analyzed using independent t-tests or Mann-Whitney U tests, depending on data distribution. Categorical variables were analyzed using chi-square or Fisher's exact tests. Mean differences with 95% confidence intervals (CIs) were calculated. A p-value <0.05 was considered statistically significant.

RESULT

The characteristics of the novel nail clipper and functions

The new nail clipper used in this study displays a triangular-shaped object on one side bearing the emblem of Naresuan University, the affiliated institution of the researchers. The device operates by employing a rotary abrasive burr driven by an electric motor, which abrades the nail surface, resulting in nail shortening. Subsequently, nail debris is collected within the device, which is designed with a receptacle for containing the abraded particles.

The demographic data of the participants

Ten healthy volunteers, comprising an equal number of males and females, participated in this study. Their average age \pm standard deviation was 34.09 ± 4.35 years. All participants were two-handed, proficient in both their left and right hands.

Efficacy

Preliminary study

The objective of this preliminary study is to investigate the potential efficacy and safety of the new nail cutting device when utilized by healthy volunteers. Preliminary findings indicate that the new tool effectively trimmed the nails of the volunteers, as illustrated in Figure 1. Moreover, the results demonstrated safety, as evidenced by the absence of pain reported in the intervention group compared to the comparator group, a statistically significant difference as depicted in figure 2. The mean difference between the two groups is 2.60 and 95% confidence interval is [1.75, 3.44]. Figure 4 displays the novel nail clipper and the characteristics of nails on the index and middle fingers, trimmed with the new device, in a group of

healthy volunteers (n=10).

As depicted in Figure 3, healthy volunteers exhibit a strong inclination towards utilizing the new nail cutting tool, as evidenced by their responses closely resembling an interrogative tone. The score ratings across all evaluated aspects hover around 5, indicating near-maximum satisfaction levels among participants. This suggests that individuals involved in this phase of the study are content with the novel innovation and underscore its potential for further investigation in subsequent phases involving real patients.

Experimental study

In this phase of the study, 20 hemiplegic patients were allocated to either the intervention or comparator group, after which significant outcomes were measured. The findings indicated that the efficacy of the novel innovation surpassed that of the comparator, as illustrated in Figure 4. Furthermore, the utilization of the new cutting instrument demonstrated safety, as evidenced by the maintenance of the nail's good shape and absence of sharp edges. Furthermore, the results showcased its safety profile, substantiated by the lack of reported pain in the intervention group compared to the comparator group, which exhibited a statistically significant difference, the mean difference of pain comparing with intervention and comparator group is 0.68, 95%CI [-1.28, -0.08].

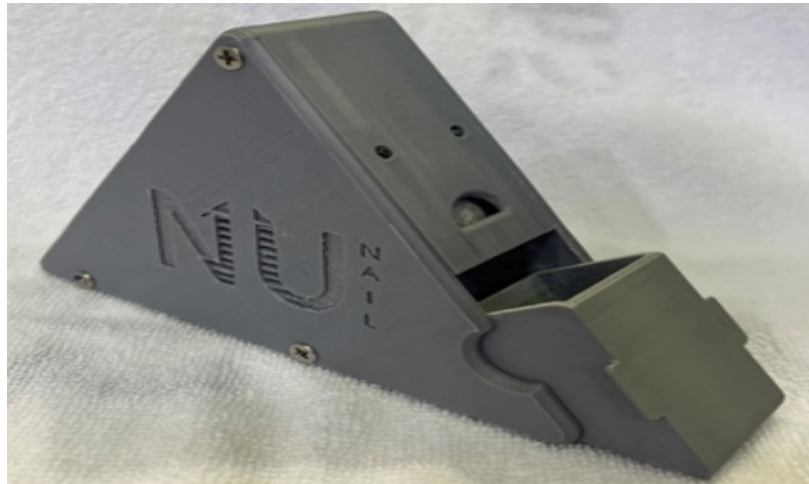
As depicted in Figure 5, patients in the experimental group expressed favorable opinions towards the novel instrument regarding its design, which contributed to enhancing both self-esteem, safety, and durability. In real medical practice, this statement suggests that patients who used the new instrument in the experimental group had positive perceptions about its design. This positive perception of the design contributed to an increase in both their self-esteem and their sense of safety while using the instrument. Essentially, it implies that not only did the new instrument function effectively, but its design also had psychological and practical benefits for the patients, making them feel more confident and secure during its use. The findings were corroborated through in-depth interviews conducted with each participant, eliciting their individual perspectives on the efficiency, safety, and satisfaction aspects of the intervention as shown in Table 1.

DISCUSSION

The preliminary findings of this study aimed to evaluate the potential efficacy and safety of a novel nail cutting device utilized by healthy volunteers. The results revealed that the new tool effectively trimmed the nails of the volunteers, as depicted in Figure 1. Furthermore, the safety profile of the device was demonstrated through the absence of pain reported in the intervention group compared to the comparator group, indicating a statistically significant difference, as shown in Figure 2.

These initial observations suggest promising prospects for the new nail cutting device in terms of both efficacy and safety. Further research involving larger sample sizes and diverse





A

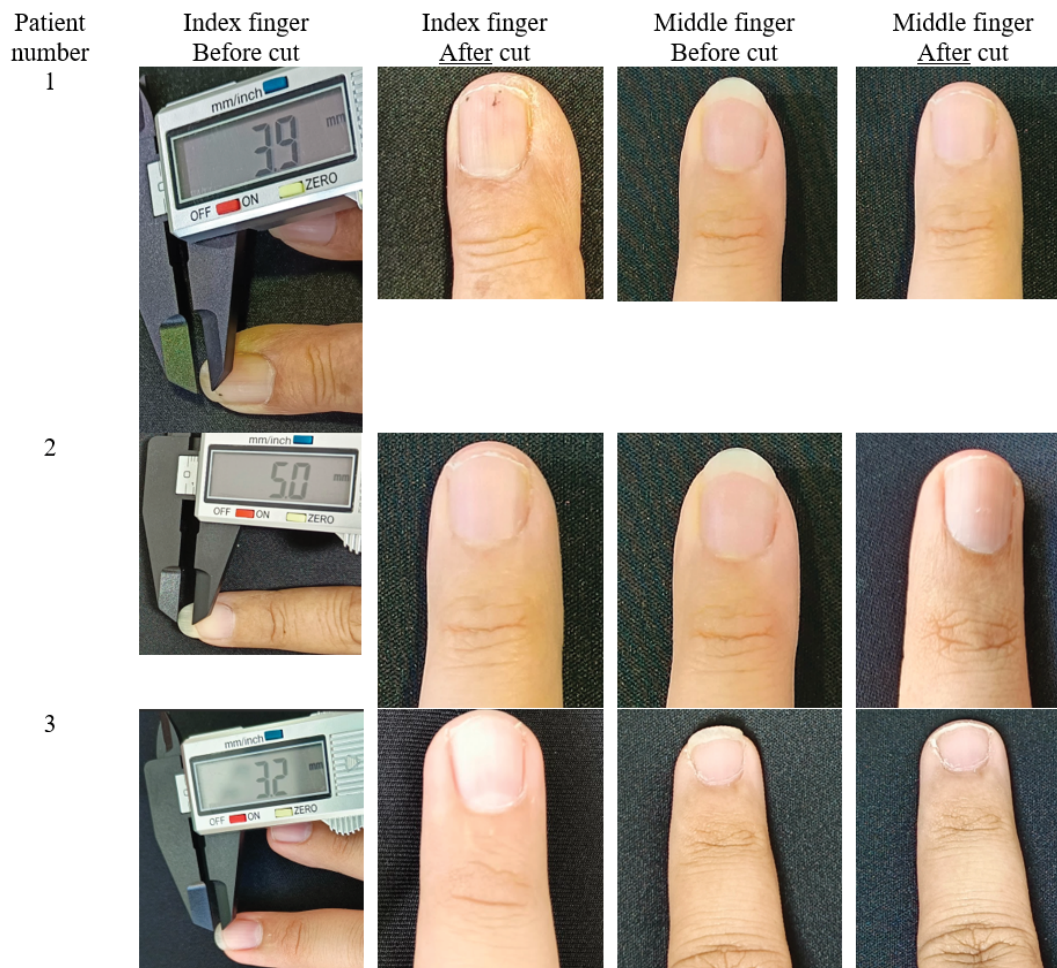


Figure 1. The example of characteristics of the nails on the index and middle fingers that were trimmed using the new device in healthy volunteers (n=10).

Note: A = the novel nail clipper, B = nails before and after using the nail clipper

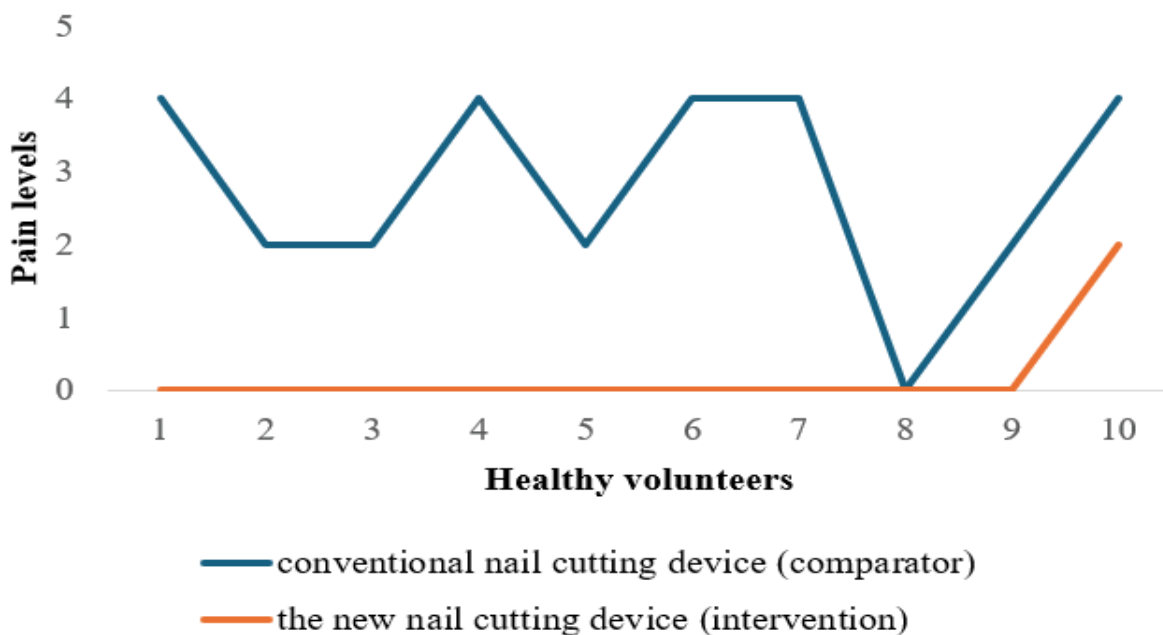


Figure 2. The pain comparison between nail trimming using the conventional nail cutting device and the new nail cutting device in health volunteers

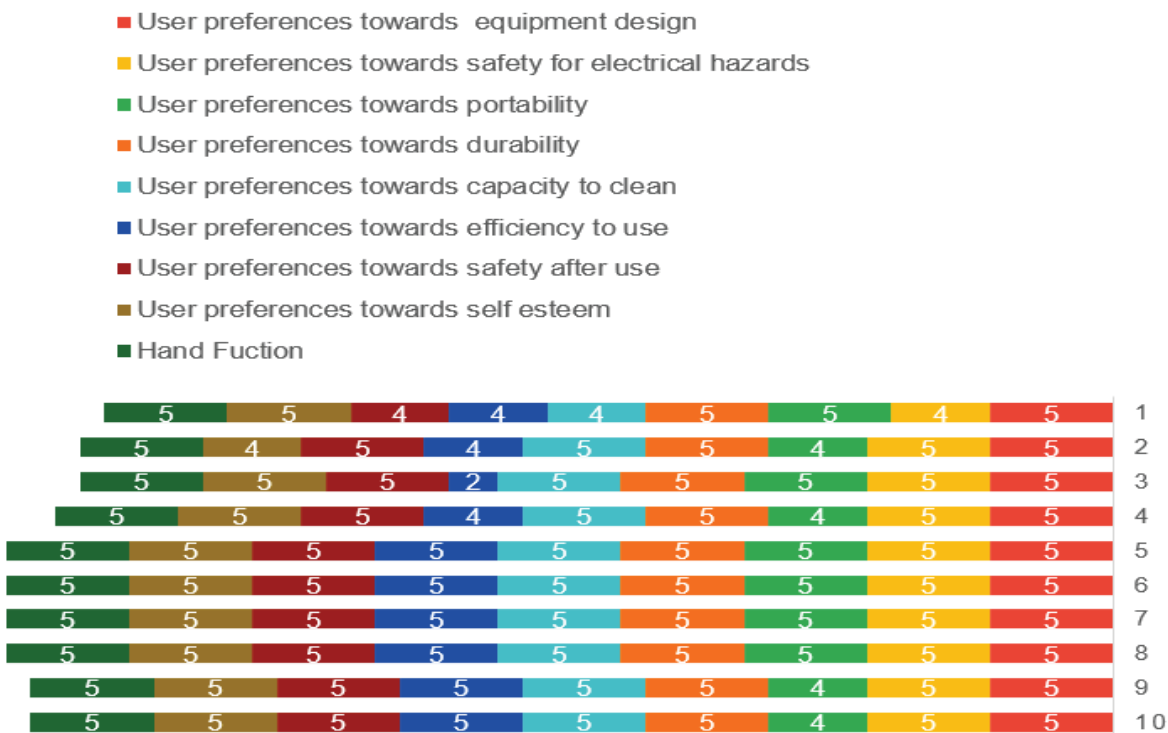


Figure 3. The feelings and opinions of healthy volunteers regarding the use of the new nail cutting device vary across different aspects

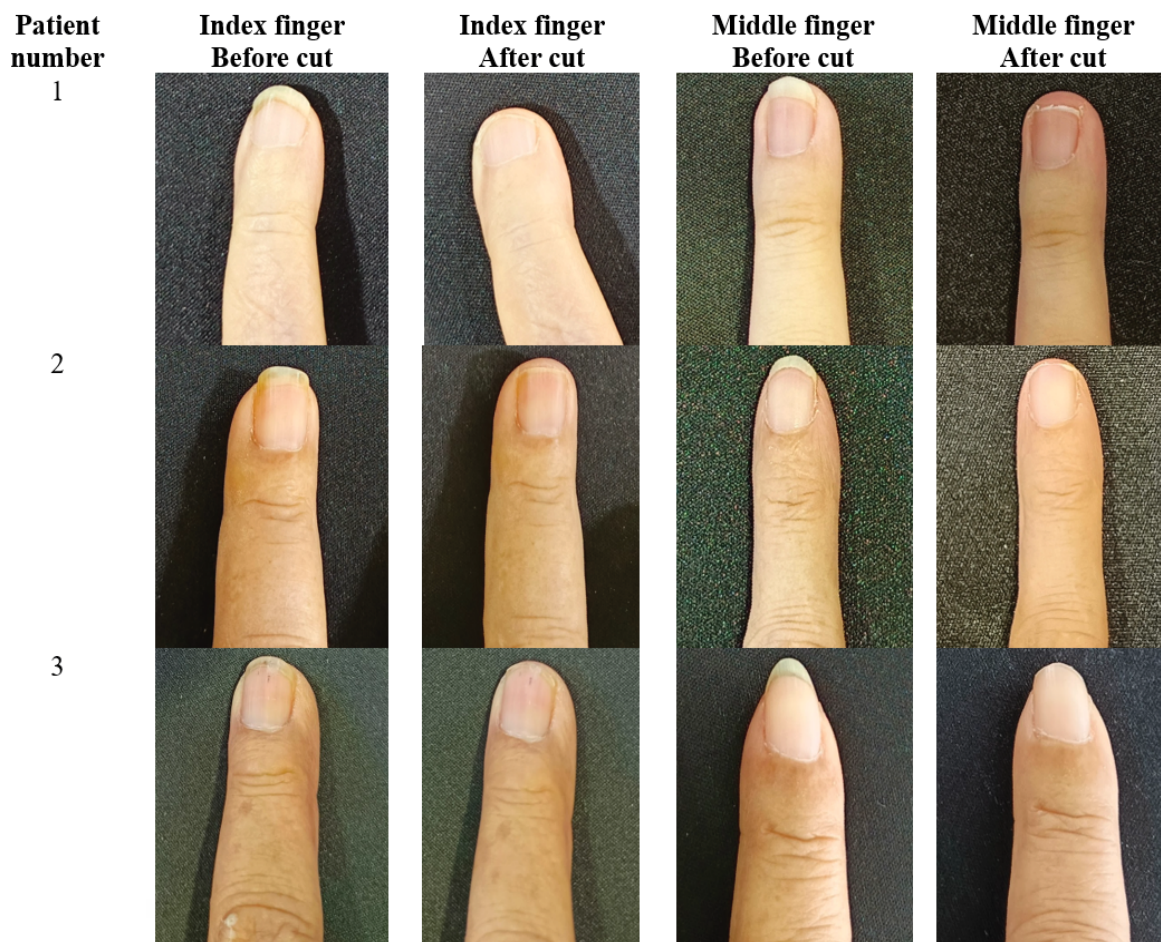


Figure 4. The example of characteristics of the nails on the index and middle fingers that were trimmed using the new device in hemiplegic patients (n=10).

Table 1. The Summary of Efficiency, Safety, and Satisfaction in Nail Clipper Usage among Participants		
	The concluding remarks concern	Clinical implications
Efficiency	The results underscore the efficacy of nail clippers, with particular emphasis on the newer model's ability to maintain nail health. Insights into maintenance needs and user satisfaction provide valuable information regarding their effectiveness. Additionally, patient feedback and assessments offer valuable insights into the overall efficiency and convenience of nail clippers, encompassing considerations of durability.	The findings emphasize the importance of selecting nail clippers that prioritize nail health preservation, user satisfaction, and durability, particularly highlighting the efficacy of newer models in meeting these criteria.
Safety	The analysis underscores the paramount importance of safety in the utilization of nail clippers, especially when comparing older and newer models. Discussions encompass concerns regarding potential injuries and discomfort, particularly noting patients' reluctance towards nail trimming. Considerations extend to the inherent risks associated with both types of devices, emphasizing the critical need for safety measures. Further inquiries into injuries and discomfort highlight safety implications, emphasizing the utmost importance of prioritizing safety in nail clipper design and application to safeguard user well-being.	Prioritizing safety in nail clipper design and application is paramount, particularly when considering the inherent risks associated with both older and newer models. This emphasis is crucial to address patients' reluctance towards nail trimming and safeguard their well-being.
Satisfaction	The study extensively examines user satisfaction regarding nail clipper usage, shedding light on individual preferences and experiences. One participant articulated a preference for the traditional nail clipper, attributing it to familiarity and effectiveness. Furthermore, the investigation delved into participants' attitudes towards newer nail clipper designs, uncovering factors that influence their preferences. Overall, the study offers valuable insights into varying perspectives on nail clipper types and the levels of user satisfaction associated with them.	Tailoring nail clipper options to accommodate individual preferences and experiences can enhance overall user satisfaction and optimize nail care outcomes.

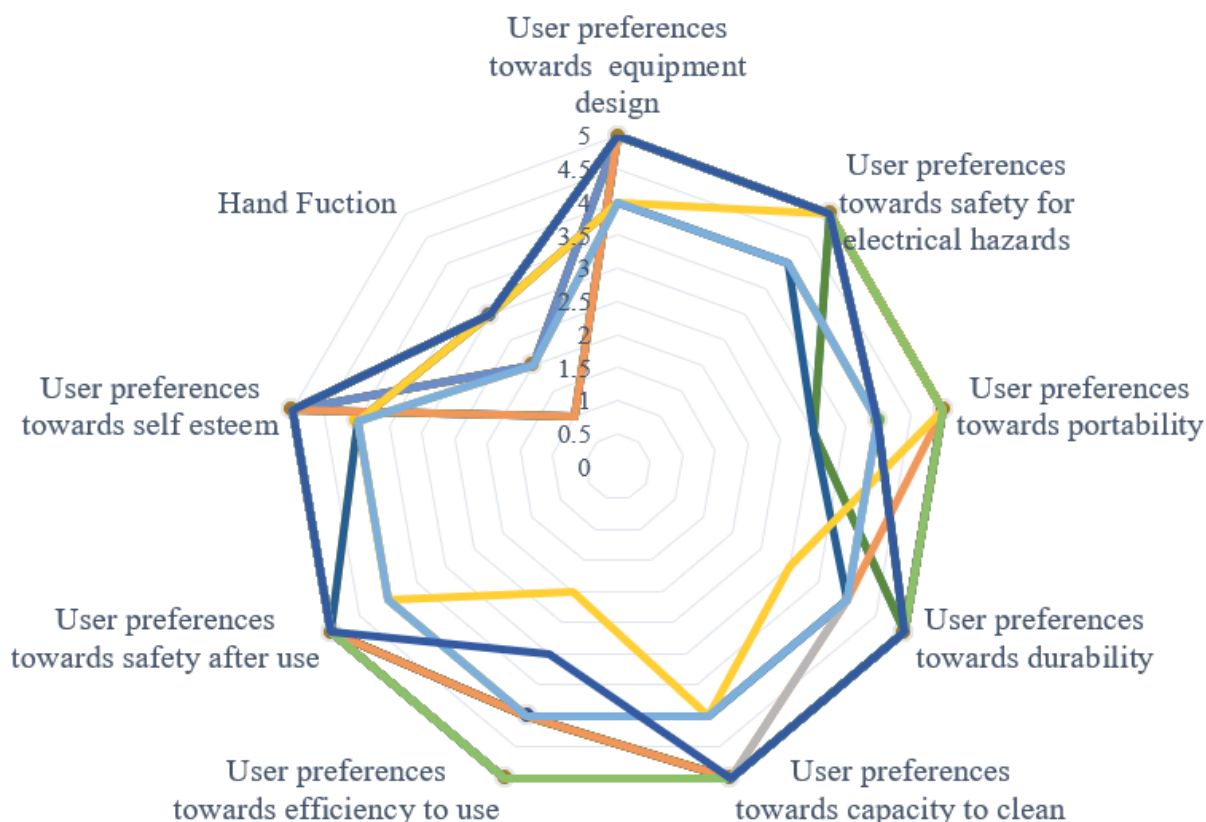


Figure 5. The feelings and opinions of patients regarding the use of the new nail cutting device vary across different aspects (n=0).

patient populations is warranted to validate these preliminary findings and ascertain the broader clinical implications of the novel device. As illustrated in Figure 3, healthy volunteers demonstrate a marked preference for using the new nail cutting tool, reflected in their responses which closely resemble an interrogative tone. The score ratings across all evaluated aspects consistently hover around 5, indicative of nearly maximum levels of satisfaction among participants. This suggests that individuals participating in this phase of the study are highly content with the novel innovation and emphasize its potential for further investigation in subsequent phases involving real patients.

In this phase of the study, 20 hemiplegic patients were assigned to either the intervention or comparator group, following which significant outcomes were assessed. The results indicated that the efficacy of the novel innovation exceeded that of the comparator, as depicted in Figure 4. Moreover, the use of the new cutting instrument demonstrated safety, supported by the preservation of the nail's integrity and the absence of sharp edges. Additionally, the findings highlighted its safety profile, substantiated by the notable absence of reported pain in the intervention group compared to the comparator group. This difference in pain perception between the intervention and comparator groups was statistically significant, with a mean difference of 0.68, 95%CI [-1.280, -0.080]. These findings

suggest the potential for the novel nail cutting innovation to be implemented in real clinical care settings. The demonstrated efficacy and safety of the new cutting instrument, particularly in hemiplegic patients, indicates its suitability for practical use. Moreover, the statistically significant difference in pain perception between the intervention and comparator groups further supports the viability of integrating this innovation into clinical practice. Overall, these results imply that the novel nail cutting device holds promise for improving nail care outcomes and enhancing patient comfort in real-world clinical settings.

The analysis of patient feedback, as illustrated in Figure 5, demonstrates the experimental group's favorable opinions regarding the design of the novel instrument, which significantly contributed to the enhancement of both self-esteem and perceptions of safety and durability. This indicates that patients who utilized the new instrument in the experimental group had positive perceptions regarding its design, resulting in increased confidence and a sense of security during its use. These findings suggest that the new instrument not only effectively functioned but also provided psychological and practical benefits to patients, improving their overall experience. Moreover, the results were reinforced through comprehensive in-depth interviews conducted with each participant, further elucidating individual perspectives on the intervention's efficiency, safety, and satisfaction aspects, as depicted in Table 2.

In comparison to the Step 'n Snip¹², a mechanically actuated, foot-pedal-controlled nail clipper designed to assist stroke survivors through ergonomic positioning and a clipping collection system, the present study's device offers a distinctly different technological and clinical profile. While the Step 'n Snip report emphasizes engineering design and intended benefits, it does not provide quantitative clinical outcome data. In contrast, the novel electric, one-handed rotary burr clipper evaluated in this randomized controlled trial underwent systematic clinical testing in both healthy volunteers and hemiplegic patients. The results demonstrated superior trimming quality, preservation of nail integrity, significant pain reduction, and consistently high patient satisfaction compared with conventional clippers, alongside psychological benefits such as enhanced self-esteem and perceived safety. Both devices share the goal of restoring independence, reducing caregiver burden, and preventing perionychial injury and infection, aligning with antimicrobial stewardship objectives. However, the Step 'n Snip's low-tech, mechanically actuated design may be advantageous in resource-limited or non-electrified settings, whereas the electrically powered device in this study may be particularly suited for individuals with greater motor impairment, requiring minimal physical exertion or dexterity. Together, these innovations broaden the range of assistive solutions available to stroke survivors, and future comparative effectiveness studies could determine the most appropriate device selection for specific patient populations and care contexts¹².

This randomized controlled trial demonstrated that the novel one-handed nail-cutting device was superior to conventional clippers in hemiplegic patients, as evidenced by smoother nail edges, preservation of nail integrity, and a statistically significant reduction in pain perception. These objective findings were complemented by consistently high patient satisfaction scores and positive perceptions of safety, ergonomic design, and ease of use. Importantly, participants in the intervention group reported heightened self-esteem and a greater sense of independence, suggesting that the device not only addresses a functional need but also delivers meaningful psychological benefits. Such psychosocial effects are particularly relevant in hemiplegic populations, in whom reduced autonomy and dependency on caregivers are frequently associated with lower quality of life and higher rates of depressive symptoms¹³. From a Pharmacy Practice perspective, the clinical relevance of this innovation extends beyond the scope of assistive device engineering. Poor nail hygiene in patients with unilateral functional limitation increases the risk of perionychial injury, which can serve as a portal of entry for bacterial or fungal pathogens¹⁴⁻¹⁶. This may lead to secondary skin infections requiring pharmacologic interventions—commonly topical or systemic antimicrobials—thereby contributing to increased medication use, healthcare costs, and, in the long term, the burden of antimicrobial resistance¹⁴⁻¹⁶. By enabling safe, independent nail care, the novel device aligns with preventive health strategies and antimicrobial stewardship principles, reducing the incidence of potentially avoidable prescriptions. Furthermore, pharmacists are uniquely positioned to integrate

such innovations into patient care pathways by providing training, monitoring for complications, and reinforcing hygiene practices during routine clinical encounters, especially in community and home-care settings.

The internal validity of this trial was strengthened through multiple methodological safeguards, including computer-generated randomization, independent allocation, and the use of objective outcome measures to minimize selection and measurement bias. Standardized training protocols were implemented, and assessments were conducted by personnel independent of device allocation, further enhancing methodological rigor. The open-label design, however, precluded participant blinding and may have introduced performance bias. Although objective indicators such as nail smoothness and structural integrity were utilized, certain endpoints—most notably patient satisfaction, were inherently subjective and potentially susceptible to response bias. The relatively short follow-up period also limited the evaluation of long-term safety, device durability, and sustained adherence.

Infection-related healthcare utilization was systematically documented to ensure comprehensive outcome data and reduce detection bias. This included recording emergency department visits or physician consultations for skin or nail infections, as well as prescription changes involving antimicrobial therapy. These measures improved the accuracy of adverse event attribution, informed safety assessments, and provided important clinical context for interpreting the findings.

The generalizability of the results is constrained by the modest sample size, single-center setting, and focus on a specific population—hemiplegic individuals with unilateral functional limitation. While this population homogeneity allowed for tighter control of confounding variables, it may not fully represent the diversity of broader patient groups, such as those with different neurological or musculoskeletal impairments, varying cultural approaches to self-care, or limited access to assistive technologies.

Future trials should incorporate medication-use endpoints as key secondary outcomes to capture broader clinical and economic implications. Systematic collection and analysis of drug utilization data, particularly antimicrobial prescriptions for skin or nail infections, would enable evaluation of prescribing patterns and potential cost savings. Integrating cost-effectiveness analyses from a pharmacy system perspective could further inform resource allocation and scalability. Pharmacist involvement should also be explicitly examined, as pharmacists are well positioned to identify at-risk individuals during medication reviews, provide targeted device training, and monitor for early signs of infection—potentially reducing the need for physician visits and antimicrobial use. Including medication utilization metrics, such as antimicrobial, analgesic, and topical agents both before and after device introduction, would enhance understanding of the intervention's impact on pharmacotherapy.

Despite the noted limitations, this trial provides strong



preliminary evidence supporting the device's integration into clinical and community care. Larger, multi-center randomized trials with longer follow-up are warranted to assess durability, maintenance needs, and cost-effectiveness. Comparative effectiveness studies in diverse patient populations and care environments will further clarify external validity, while real-world implementation research will be critical to evaluating health system readiness, training feasibility, patient adherence, and overall economic impact. Such evidence will be essential to guide policy decisions and to ensure that the intervention achieves sustained clinical, economic, and public health benefits.

CONCLUSION

In this randomized controlled trial, the one-handed electric nail-cutting device demonstrated measurable benefits over conventional clippers in hemiplegic patients, including smoother nail edges, preserved nail integrity, reduced pain, and favorable user-reported outcomes. Methodological rigor was supported by computer-generated randomization, independent allocation, standardized training, and objective outcome measures. However, the study's interpretation is limited by its modest sample size, single-center design, open-label nature, and short follow-up period, which restricts the evaluation of long-term safety, device durability, and broader applicability. The findings indicate potential for this device to contribute to preventive care and patient self-management, but confirmation through larger, multi-center trials with extended follow-up is required. Future studies should also incorporate cost-effectiveness analysis and assess integration into diverse clinical and community settings to inform evidence-based implementation.

ACKNOWLEDGEMENT

- Naresuan University Hospital, Phitsanulok, Thailand
- Faculty of Pharmaceutical Sciences, Naresuan University,

Phitsanulok, 65000, Thailand

- Medical & Pharmacy Innovation Research & Development Unit, Faculty of Pharmaceutical Sciences, Naresuan University, Phitsanulok, 65000, Thailand

CONFLICT OF INTEREST

None to declare.

AUTHORS' CONTRIBUTIONS

Janyut Srihirun conceived the study concept and design, conducted the comprehensive literature search and study selection process, synthesized key findings, led the drafting of all manuscript sections, coordinated team communication, and ensured adherence to project timelines.

Sudarat Isaravisavakul coordinated data collection and team communication, supported methodological organization, prepared essential documentation, maintained communication with the research setting, and assisted in managing operational aspects of the study implementation.

Prayuth Poowaruttanawiwit (Corresponding Author) provided strategic leadership and overall supervision of the project from conceptual development to final dissemination. He guided the research framework, ensured methodological rigor and alignment with international academic standards, and offered senior-level oversight on study design, data interpretation, and theoretical integration. He critically reviewed and substantively revised all manuscript drafts to enhance scientific coherence, analytical depth, and academic clarity. In addition, he ensured ethical integrity, compliance with reporting guidelines, and consistency with journal requirements. As the corresponding author, he assumed full responsibility for the final approval of the manuscript, managed the submission process, responded to peer-review feedback, and maintained all communications with the journal throughout the editorial and publication process.

References

1. Poomalai G, Prabhakar S, Sirala Jagadesh N. Functional Ability and Health Problems of Stroke Survivors: An Explorative Study. *Cureus*. 2023 Jan 4;15(1):e33375. doi: 10.7759/cureus.33375. PMID: 36751244; PMCID: PMC9898797.
2. Coleman ER, Moudgal R, Lang K, Hyacinth HI, Awosika OO, Kissela BM, Feng W. Early Rehabilitation After Stroke: a Narrative Review. *Curr Atheroscler Rep*. 2017 Nov 7;19(12):59. doi: 10.1007/s11883-017-0686-6. PMID: 29116473; PMCID: PMC5802378.
3. Zhou H, Han Y, Xie D, Zheng K, Zhou Z, Zhu H, Ji Y. Predictors and clinical implications of post-stroke cognitive impairment: a retrospective study. *Sci Rep*. 2025 Jul 7;15(1):24198. doi: 10.1038/s41598-025-08048-5. PMID: 40624177; PMCID: PMC12234689.
4. Lee HS, Sohn MK, Lee J, Kim DY, Shin YI, Oh GJ, Lee YS, Joo MC, Lee SY, Song MK, Han J, Ahn J, Lee YH, Kim DH, Kim YT, Kim YH, Chang WH. Long-term functional outcomes in patients with isolated cerebellar infarction: the KOSCO study. *Front Neurol*. 2025 Mar 10;16:1541245. doi: 10.3389/fneur.2025.1541245. PMID: 40129865; PMCID: PMC11930828.
5. Siragusa M, Schepis C, Cosentino FI, Spada RS, Toscano G, Ferri R. Nail pathology in patients with hemiplegia. *Br J Dermatol*. 2001 Mar;144(3):557-60. doi: 10.1046/j.1365-2133.2001.04083.x. PMID: 11260014.
6. Gül U, Cakmak SK, Ozel S, Bingöl P, Kaya K. Skin disorders in patients with hemiplegia and papaplegia. *J Rehabil Med*. 2009 Jul;41(8):681-3. doi: 10.2340/16501977-0394. PMID: 19565163.
7. Xiong J, Wang JT, Lin S, Xie BY. Advances in hemiplegia rehabilitation: modern therapeutic interventions to enhance activities of daily living. *Front Neurol*. 2025 Mar 28;16:1555990. doi: 10.3389/fneur.2025.1555990. PMID: 40224310; PMCID:



PMC11985468.

8. Taberna M, Gil Moncayo F, Jané-Salas E, Antonio M, Arribas L, Vilajosana E, Peralvez Torres E, Mesía R. The Multidisciplinary Team (MDT) Approach and Quality of Care. *Front Oncol*. 2020 Mar 20;10:85. doi: 10.3389/fonc.2020.00085. PMID: 32266126; PMCID: PMC7100151.
9. Ki V, Rotstein C. Bacterial skin and soft tissue infections in adults: A review of their epidemiology, pathogenesis, diagnosis, treatment and site of care. *Can J Infect Dis Med Microbiol*. 2008 Mar;19(2):173-84. doi: 10.1155/2008/846453. PMID: 19352449; PMCID: PMC2605859.
10. Abdullah L, Abbas O. Common nail changes and disorders in older people: Diagnosis and management. *Can Fam Physician*. 2011 Feb;57(2):173-81. PMID: 21321168; PMCID: PMC3038811.
11. Stepanian N, Larsen MH, Mendelsohn JB, Mariussen KL, Heggdal K. Empowerment interventions designed for persons living with chronic disease - a systematic review and meta-analysis of the components and efficacy of format on patient-reported outcomes. *BMC Health Serv Res*. 2023 Aug 25;23(1):911. doi: 10.1186/s12913-023-09895-6. PMID: 37626346; PMCID: PMC10463815.
12. Carhart C, Ciechowski R, Groat D, Stevans A. Development of a one-handed nail clipper for stroke survivors. *Top Stroke Rehabil*. 2008 Mar-Apr;15(2):156-9. doi: 10.1310/tsr1502-156. PMID: 18430684.
13. Cheong MJ, Kang Y, Kang HW. Psychosocial Factors Related to Stroke Patients' Rehabilitation Motivation: A Scoping Review and Meta-Analysis Focused on South Korea. *Healthcare (Basel)*. 2021 Sep 14;9(9):1211. doi: 10.3390/healthcare9091211. PMID: 34574985; PMCID: PMC8471222.
14. Lee DK, Lipner SR. Optimal diagnosis and management of common nail disorders. *Ann Med*. 2022 Dec;54(1):694-712. doi: 10.1080/07853890.2022.2044511. PMID: 35238267; PMCID: PMC8896184.
15. Reinecke JK, Hinshaw MA. Nail health in women. *Int J Womens Dermatol*. 2020 Feb 5;6(2):73-79. doi: 10.1016/j.ijwd.2020.01.006. PMID: 32258335; PMCID: PMC7105659.
16. Tanacan E, Erdogan FG. Effect of Nail Disorders on Quality of Life Scale Scores: A Prospective, Cross-sectional Study from a Tertiary Referral Center. *J Am Podiatr Med Assoc*. 2024 May-Jun;114(3):21-208. doi: 10.7547/21-208. PMID: 39058639.

