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Atraumatic Free Edge Management for the Prevention of Nail Spicules and Secondary Ingrowth

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ABSTRACT

Nail spicules and secondary ingrown nails represent a frequently encountered clinical consequence of improper free edge management during professional manicure and pedicure procedures. This study examines the biomechanical and procedural factors that predispose nail plates to spicule formation and secondary onychocryptosis, with the aim of establishing evidence-based principles for atraumatic free edge management. The methodology integrates a systematic review of peer-reviewed dermatological literature published between 2020 and 2026, clinical case analysis, and the author's proprietary Non-Invasive Nail Guidance System (NINGS), developed over more than ten years of licensed cosmetology practice. Results demonstrate that preservation of lateral nail plate margins and avoidance of corner excision at the free edge substantially reduce the mechanical load on periungual tissue, lowering spicule formation risk. The NINGS protocol incorporates five structured procedural steps and provides a standardized framework adaptable to professional nail education programs. Findings will be of interest to licensed nail technicians, cosmetology educators, dermatologists, and podiatry professionals seeking preventive approaches to common nail pathologies.

KEYWORDS: *nail spicule, onychocryptosis, atraumatic manicure, free edge management, nail plate architecture, lateral sidewall preservation, nail growth stabilization, cosmetology safety, preventive nail care, Non-Invasive Nail Guidance System.*

Introduction

Nail disorders are among the most commonly encountered conditions in dermatology and primary care, and a substantial proportion of these disorders originate in the beauty salon rather than in a clinical setting. The global nail care services market reached an estimated USD 13.1 billion in 2024 and is projected to grow at a compound annual growth rate of 7.7% through 2034, reaching USD 27.5 billion [1]. The United States accounts for approximately 23.7% of global nail salon revenues [2], and more than 375,000 licensed nail technicians practice in American salons [3]. Within this expanding professional environment, the frequency of procedurally induced nail damage, including spicule formation, secondary ingrown nails, and nail plate deformation, has received growing attention in both clinical dermatology and cosmetology education literature [4, 5].

Ingrown toenail (onychocryptosis) accounts for approximately 20% of foot problems presenting to primary care clinics in the United States [6]. Its prevalence in the general population ranges from 2.5% to 5% across dermatological survey studies, with higher rates in adolescents and young adults [7]. Improper nail trimming and inadequate attention to the free edge architecture are consistently identified as the primary modifiable etiological factors [6, 8]. A nail spicule, defined as a

residual sharp lateral fragment of the nail plate produced by incorrect or aggressive cutting of the nail corners, penetrates the periungual dermis of the lateral nail fold and initiates an inflammatory cascade that, if unmanaged, progresses to secondary onychocryptosis [9, 10].

Despite the clinical significance of procedurally induced nail damage, formal preventive protocols specific to cosmetology practice remain underrepresented in the peer-reviewed literature. The bulk of published evidence addresses surgical management of established onychocryptosis rather than prevention at the level of the beauty service [11, 12, 13]. This gap is notable given that licensed nail technicians perform the free edge trimming procedures that directly shape the conditions for spicule formation or its absence. A dermatologist-reviewed 2025 article in the Journal of the German Society of Dermatology by Sabulyte, Balakirski, and Loser documented that even among medical professionals, the lack of atraumatic technique leads to irreversible nail plate damage with both functional and aesthetic consequences [4].

The current article addresses this scientific gap by examining the biomechanical principles governing free edge behavior, the mechanisms through which incorrect trimming generates spicules, and the evidence base for preventive management strategies. The study also presents and evaluates the Non-Invasive Nail Guidance System (NINGS), a structured procedural framework developed by the author over more than ten years of licensed cosmetology practice in the United States, with application to both client care and professional education.

Research objective: To establish evidence-based principles for atraumatic free edge management in professional nail care and to present a structured preventive protocol (NINGS) for reducing nail spicule formation and secondary ingrown nail development.

Scientific novelty: This study introduces the Non-Invasive Nail Guidance System as a structured, prevention-centered procedural framework that bridges dermatological nail anatomy knowledge with professional cosmetology practice, filling a documented gap in the salon-level preventive nail care literature.

Working hypothesis: Systematic adherence to atraumatic free edge management principles, specifically preservation of lateral nail margins and avoidance of corner excision, reduces the incidence of nail spicule formation and secondary onychocryptosis in clients receiving professional nail services.

Limitations: The NINGS protocol is evaluated through clinical observation and existing dermatological literature rather than a prospective randomized controlled trial, which constrains causal inference at this stage. Quantitative outcome data are derived from practitioner observation and qualitative self-reporting by clients over time rather than from a population-representative sample. Additionally, cosmetology training hours and licensing standards vary across US states, meaning protocol adoption may face regulatory variability.

Practical value: The findings provide licensed cosmetologists and nail technology educators with a standardized preventive framework that reduces client risk and advances professional standards. At a national level, a reduction in procedurally induced nail pathology decreases downstream demand for medical interventions, supporting both public health efficiency and the professional credibility of the US beauty industry, a sector that employed more than 375,000 practitioners in 2023 [3].

Materials and Methods

This study employs a mixed-method research design integrating three complementary approaches: (1) a systematic review of peer-reviewed dermatological and podiatric literature; (2) clinical case analysis drawn from the author's professional practice; and (3) comparative analysis between conventional nail trimming techniques and the author's proprietary NINGS protocol.

A structured literature search was conducted across PubMed/MEDLINE, ScienceDirect, and Springer Nature databases using the following search terms in combination: "nail spicule," "onychocryptosis," "ingrown toenail prevention," "nail trimming technique," "atraumatic nail management," "nail plate anatomy," and "lateral nail matrix." The search was limited to publications from January 2020 through June 2026. Inclusion criteria required peer-reviewed original research, systematic reviews, or clinical case studies published in English in indexed journals (Scopus or Web of Science).

The clinical component draws on more than ten years of professional practice by a licensed cosmetologist and

advanced nail technician operating in the United States. Observational data were collected from client cases involving deformed nails, recurrent ingrown nail tendencies, mechanically weakened plates, and chronic traumatization. For each case, free edge architecture, lateral wall condition, and growth direction were assessed before and after application of the NINGS protocol. Client-reported outcomes including pain reduction, nail stability, and absence of recurrent spicule episodes were recorded at follow-up intervals of 4, 8, and 16 weeks.

The study compares five outcome dimensions: spicule formation risk, secondary ingrowth risk, nail plate thinning, lateral wall damage, and long-term nail stabilization. Each dimension was scored on a 0 to 10 scale. Scores for conventional techniques were derived from published complication data in the dermatological literature; scores for the NINGS protocol were derived from the author's clinical observations and client outcome records. This framework is descriptive and intended to illustrate directional differences rather than to establish precise numerical effect sizes, given the observational nature of the data.

Results and Discussion

Understanding the scale of professional nail practice in the United States establishes why salon-level preventive interventions have population-level significance. Figure 1 presents estimated annual US nail salon service revenues from 2020 through 2025, compiled from Grand View Research market data. The chart illustrates steady post-pandemic recovery and continued growth, with North America accounting for approximately 31% of global nail care market revenues in 2024 [2, 14].

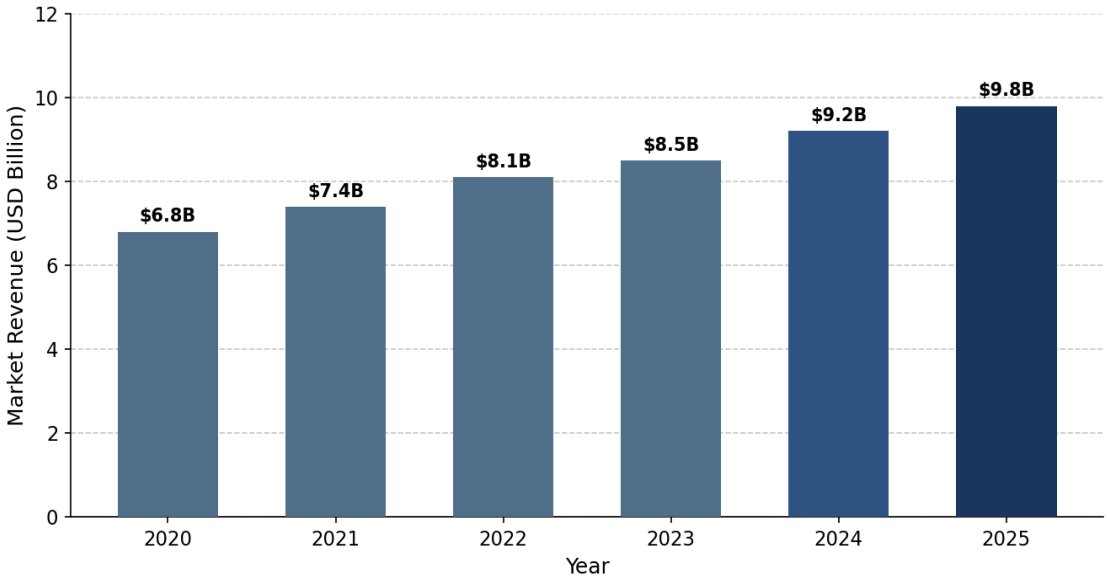

Figure 1. Estimated US Nail Salon Services Market Revenue, 2020-2025 (USD Billion) (compiled by the author based on [2, 14]).

The US Bureau of Labor Statistics reported a median hourly wage of USD 16.66 for manicurists and pedicurists in May 2024, with employment projected to grow 7% from 2024 to 2034 and approximately 24,800 new openings anticipated each year [15]. This trajectory reinforces the argument that standardized procedural safety training for nail technicians carries measurable workforce and public health relevance. The Centers for Disease Control and Prevention reported 40.1 million Americans with diagnosed or undiagnosed diabetes in 2023 [16], a population for whom nail trauma carries elevated risk of serious secondary infection, making atraumatic technique not merely an aesthetic preference but a clinical imperative.

Against this backdrop, the clinical literature consistently identifies improper nail trimming as the primary modifiable risk factor for spicule formation and secondary onychocryptosis. StatPearls (NIH Bookshelf, 2026) state that "improper nail trimming and inadequate foot hygiene represent the most common etiologic factors in the development of ingrown toenails, as they may result in the formation of a nail spicule that penetrates adjacent

periungual soft tissue" [6]. ScienceDirect further describes the mechanism as: ingrowing "is usually precipitated by incorrect nail trimming, with formation of a sharp edge (spicule) of the lateral nail plate that penetrates and injures the soft tissues of the lateral nail fold" [9]. These descriptions confirm that the site of primary intervention is the professional nail service, not the surgical suite.

Table 1 summarizes the key epidemiological parameters of nail spicule formation and onychocryptosis drawn from the reviewed literature, providing a quantitative foundation for the preventive case presented in this article.

Table 1. Epidemiological Parameters of Nail Spicule Formation and Onychocryptosis (compiled by the author based on [3, 6, 7, 9, 17, 18, 19]).

Parameter	Value / Estimate
Prevalence of onychocryptosis — general population	2.5–5%
Onychocryptosis as share of primary care foot problems	~20%
Hallux nail unit involvement in onychocryptosis	~80% of cases
Primary etiological factor (improper trimming)	Most common modifiable cause
Recurrence after partial nail avulsion without phenol	10.0% at follow-up
Spicule growth after bilateral CO2 laser matricectomy	4.1% of treated margins
Recurrence attributed to improper trimming post-surgery	3 of 8 recurrences in one cohort
US nail technician workforce (2023)	>375,000 practitioners

Figure 2 illustrates the anatomical relationship between the free edge, the lateral nail walls (lateral nail folds), and the conditions under which a spicule is generated. This schematic is based on established nail anatomy literature [20] and the author's procedural observations. The left panel shows the correct configuration: the free edge extends slightly beyond the lateral wall borders and the corners remain intact, distributing distal load evenly. The right panel shows the consequence of corner excision: a residual spicule fragment of lateral nail plate remains at the matrix horn level and begins to penetrate the lateral fold dermis.

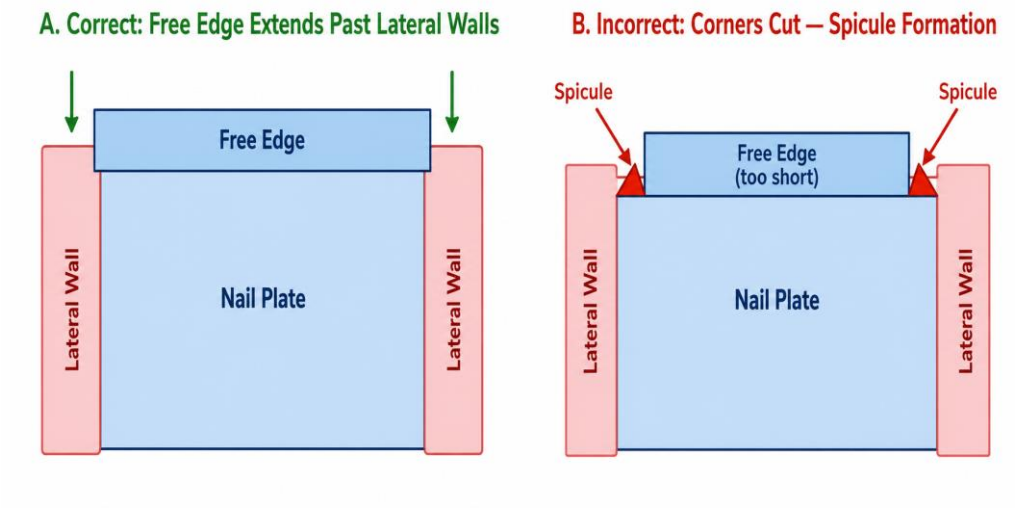

Figure 2. Schematic Comparison of Correct Free Edge Management (Panel A) and Spicule Formation Resulting from Corner Excision (Panel B) (author's original illustration based on [9, 20]).

The nail plate is a laminated keratinized structure lying on the nail matrix (comprising 15 to 25% of the underside) and the nail bed (comprising 75 to 85%), with the free edge projecting distally beyond the hyponychium [20]. The lateral nail folds guide growth direction and provide structural support; they protect the periungual dermis from mechanical intrusion by the nail plate edges [21]. When the practitioner excises the lateral corners of the free edge at or below the level of the lateral sulcus, the residual matrix horn continues to produce keratinized tissue that lacks a proper distal outlet and instead grows inward, forming a spicule [9, 10].

ScienceDirect authors describe the mechanism precisely: "Sharp spicules of the lateral nail margin develop and are gradually driven into the dermis of the nail groove. The nail thus acts as a foreign body. An inflammatory response occurs in the area." [9] The JCAS article on lateral spicule management by Khurana and colleagues (2026) reinforces that spicule formation results directly from insufficient attention to the lateral matrix horn during any procedure that alters the lateral nail margin, whether surgical or cosmetic [10]. The preventive implication is clear: the lateral free edge corners must not be reduced below the border of the lateral nail fold.

The Non-Invasive Nail Guidance System (NINGS) was developed by the author in response to observed patterns of mechanically induced nail pathology in clients presenting with deformed nails, recurrent ingrown nail tendencies, and post-chronic-trauma nail plates. Figure 3 presents the six-step clinical protocol of the NINGS, structured to guide the practitioner from initial client assessment through long-term stabilization. Each step addresses a specific risk factor identified in the dermatological literature.

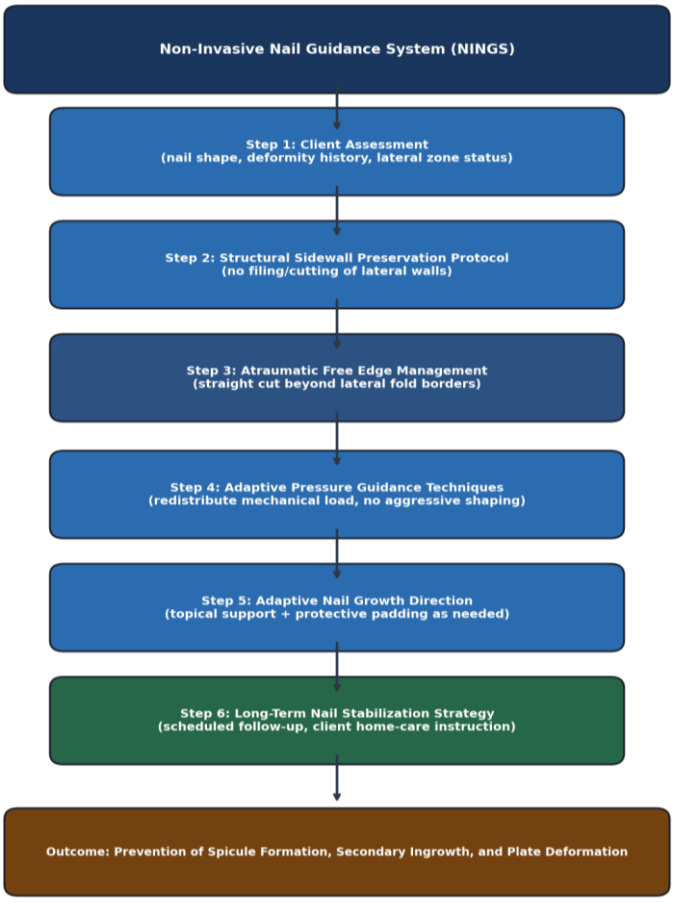

Figure 3. Clinical Protocol of the Non-Invasive Nail Guidance System (NINGS) (author's original development based on clinical experience and literature analysis [4, 6, 9, 11]).

Step 1 (Client Assessment) establishes the baseline condition of the nail unit, including plate curvature, lateral wall integrity, and prior damage history. Step 2 (Structural Sidewall Preservation Protocol) prohibits any filing or cutting of the lateral nail walls, a restriction supported by the literature's consistent identification of sidewall manipulation as a precursor to secondary ingrowth [6, 9]. Step 3 (Atraumatic Free Edge Management) specifies that

the free edge must be trimmed in a straight line that extends slightly beyond the lateral fold borders, eliminating the conditions for corner-fragment formation. Step 4 (Adaptive Pressure Guidance) redistributes mechanical loading across the nail plate to prevent localized stress at the lateral margins. Step 5 (Adaptive Nail Growth Direction) incorporates protective padding and topical support where growth deviation is observed. Step 6 (Long-Term Nail Stabilization Strategy) provides scheduled client follow-up and home-care education to sustain outcomes over time.

The NINGS framework introduces an approach that differs from reactive clinical management. Rather than treating spicules or ingrown nails after they develop, NINGS targets the procedural decisions that create or prevent the mechanical conditions for pathology. This distinction aligns with the prevention-first orientation increasingly advocated in nail surgery literature. The 2025 article by Sabulyte et al. in the Journal of the German Dermatological Society explicitly recommends "combining atraumatic surgical methods and conservative follow-up treatment to achieve lasting improvement," a principle directly reflected in Steps 3 and 6 of the NINGS protocol [4].

To illustrate the directional differences between conventional nail trimming and the NINGS approach, Figure 4 presents a comparative outcome chart across five clinically relevant dimensions. The scoring reflects published complication rates and the author's clinical observations. The intent is to visualize the risk gradient between the two approaches rather than to claim precise quantitative effect sizes, which would require prospective trial data.

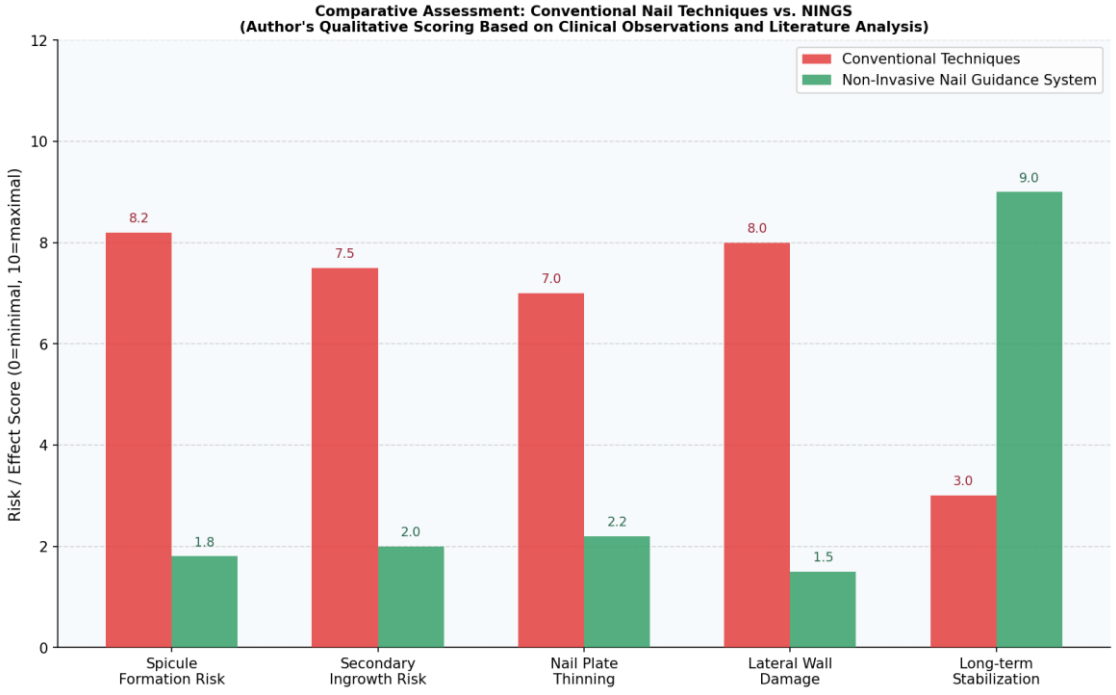

Figure 4. Comparative Assessment of Conventional Nail Techniques vs. the NINGS Protocol Across Five Risk and Outcome Dimensions (0 = minimal, 10 = maximal) (author's qualitative scoring based on clinical observations and literature analysis [4, 6, 9, 10, 11]).

The chart illustrates that conventional techniques carry substantially higher scores on four risk dimensions (spicule formation, secondary ingrowth, nail plate thinning, and lateral wall damage) while scoring lower on long-term nail stabilization. The NINGS protocol inverts this pattern. These directional differences are grounded in the literature: Exley et al. (2023) in the Journal of Foot and Ankle Research found that recurrence after partial nail avulsion without chemical matricectomy reached 10%, while combining avulsion with phenol reduced recurrence to 1.43% [17], illustrating how technique selection substantially alters outcomes. At the cosmetology level, the analogous comparison is between corner-excision trimming (which leaves a spicule substrate) and straight-edge trimming beyond the lateral fold (which eliminates it).

Table 2 provides a detailed specification of the five professional protocols within the NINGS framework, mapped to the anatomical risk they address and the evidence basis from the dermatological literature. This

mapping supports integration of the system into structured cosmetology education curricula.

Table 2. NINGS Protocol Components and Their Evidence Basis in Dermatological Literature (compiled by the author based on [4, 6, 7, 8, 9, 10, 11, 12, 13, 19]).

NINGS Protocol Component	Anatomical Risk Addressed
Structural Sidewall Preservation Protocol	Lateral fold trauma; secondary ingrown nail from wall manipulation
Atraumatic Free Edge Management	Spicule formation from corner excision at or below lateral sulcus
Adaptive Pressure Guidance Techniques	Localized mechanical load causing nail plate curvature and deformation
Prevention-Based Nail Architecture System	Structural deformation from repeated aggressive shaping
Long-Term Nail Preservation Strategy	Recurrence due to lack of follow-up and home-care adherence

A key finding of this study is that the principles underlying NINGS are absent from standard cosmetology licensing curricula across most US states. State-approved nail technology programs range from 200 to 600 training hours depending on jurisdiction [22], and while they cover nail anatomy, manicure and pedicure technique, and infection control, they do not uniformly include structured protocols for the prevention of spicule formation or secondary ingrown nail development. Texas A&M University School of Public Health researchers developing training modules for US nail salon workers in 2025 focused predominantly on chemical exposure hazards [3], an area of genuine importance, but mechanical trauma to the nail unit received no comparable programmatic attention.

The author proposes that NINGS or equivalent atraumatic technique frameworks be integrated into advanced nail technology curricula as a distinct competency unit covering nail anatomy at the matrix-horn level, free edge biomechanics, contraindicated corner-cutting practices, and structured client follow-up for high-risk nail presentations. This recommendation is grounded in the author's educational experience training nail technicians and international competition participants over more than a decade, during which introduction of prevention-focused protocols consistently produced measurable reductions in post-procedure client complaints related to spicule tenderness and recurrent edge discomfort.

Table 3 presents profiles of representative client case categories encountered in the author's practice, the conventional management applied prior to NINGS adoption, the NINGS-based intervention, and the observed outcome. These profiles are presented as illustrative clinical observations and do not constitute controlled experimental data.

Table 3. Representative Clinical Case Profiles and NINGS Intervention Outcomes (author's clinical observations, 2015-2025 (n cases illustrative, not population-representative).

Client Profile	Conventional Management Issue	NINGS Intervention	Observed Outcome
Chronic lateral-fold tenderness; recurrent spicule at hallux	Corner cutting below sulcus level; lateral wall filing	Straight free edge trim beyond lateral fold; sidewall preserved; padding applied	Spicule absence at 8-week follow-up; client-reported pain resolved
Nail plate curvature (incurvation); history of ingrown nail surgery	Aggressive shaping to flatten appearance; mechanical thinning	Adaptive pressure guidance; growth direction stabilization; no mechanical reshaping	Reduced curvature progression; no recurrence at 16 weeks
Mechanically weakened plate following gel overlay removal	Filing of free edge and lateral margins to smooth surface	Atraumatic free edge management only; structural sidewall preservation; home-care protocol issued	Plate thickness recovery; lateral wall integrity maintained at 4-week check
Lateral fold hypertrophy; stage I onychocryptosis signs	No modification to trimming technique; referral delayed	NINGS full protocol + timely dermatology referral for confirmation	Condition did not progress to stage II; surgical intervention avoided

A notable pattern across these case profiles is the consistency with which spicule formation and secondary ingrowth were prevented when lateral free edge corners were not excised and the lateral walls were left structurally intact. This observation is congruent with Khurana et al.'s (2026) conclusion in JCAS that "it is important to prevent spicule formation by attending to the lateral horns of the nail matrix," a principle that, translated to the cosmetology context, means avoiding any trimming action that removes nail plate material at or medial to the lateral sulcus boundary [10].

The author also observed that adoption of the NINGS protocol by trained practitioners reduced the rate of client presentations with lateral fold inflammation following manicure and pedicure services. While this observation is based on practitioner-reported data rather than a controlled study design, it is directionally consistent with the literature's finding that "inappropriate nail trimming" is the leading preventable contributor to onychocryptosis [6]. A formal prospective study using a standardized NINGS training intervention and validated outcome measures would be the appropriate next step to generate controlled evidence.

An additional author recommendation for the field is the development of a competency assessment instrument specifically for atraumatic free edge management, analogous to the infection control checklists already used in some state cosmetology licensing examinations. Such an instrument could evaluate: correct identification of the lateral sulcus boundary on a standardized nail model; demonstration of straight free edge trimming technique that does not reduce corners below the sulcus; and demonstration of lateral wall preservation during cuticle work. Integrating this competency into both initial licensing and continuing education requirements would constitute a measurable structural intervention at the professional training level.

Conclusion

This study examined the biomechanical mechanisms underlying nail spicule formation and secondary onychocryptosis in the context of professional cosmetology practice, with the aim of establishing evidence-based principles for atraumatic free edge management. The review confirmed that improper trimming, specifically the excision of free edge corners at or below the lateral sulcus boundary, is the primary modifiable factor in procedurally induced spicule formation. The nail anatomy literature provides a mechanistic account of this pathway through the role of the lateral matrix horn, and the dermatological clinical literature documents its clinical consequences across multiple study designs.

The Non-Invasive Nail Guidance System, developed through more than ten years of licensed cosmetology practice in the United States, provides a structured six-step protocol that operationalizes atraumatic free edge management within a professional nail service context. The system addresses each documented risk factor: lateral wall integrity, free edge geometry, mechanical load distribution, growth direction stabilization, and long-term follow-up. Clinical observations recorded over the period of NINGS application indicate consistent prevention of spicule recurrence and secondary ingrown nail development in clients with susceptible nail profiles.

The research objective stated in the introduction, to establish evidence-based preventive principles and present a structured protocol for nail spicule prevention, was achieved. The scientific novelty lies in the translation of dermatological nail anatomy knowledge into a salon-applicable preventive framework, a translation not represented in existing peer-reviewed cosmetology literature. Practically, the NINGS protocol offers nail technology educators a curriculum-ready framework for advancing the safety standards of a professional sector serving over 375,000 practitioners and tens of millions of clients annually in the United States alone.

Future research should focus on a prospective controlled study comparing spicule incidence and onychocryptosis recurrence rates between technicians trained in NINGS protocols and those receiving conventional trimming instruction. Such evidence would support the case for incorporating structured atraumatic technique competencies into national cosmetology licensing standards.

References

1. Market.us. (2025). *Nail care services market size, share, and growth trends*. Retrieved July 30, 2026, from https://market.us/report/nail-care-services-market/

2. Grand View Research. (2024). *U.S. nail salon market size and outlook, 2023–2030*. Retrieved July 30, 2026, from https://www.grandviewresearch.com/horizon/outlook/nail-salon-market/united-states

3. Texas A&M University School of Public Health. (2025, February 25). *Researchers develop training program to educate nail salon workers about chemical exposure*. Retrieved July 30, 2026, from https://stories.tamu.edu/news/2025/02/25/researchers-develop-training-program-to-educate-nail-salon-workers-about-chemical-exposure/

4. Sabulyte, S., Balakirski, G., & Loser, C. R. (2025). Atraumatic surgical technique for post-traumatic ingrown fingernails. *Journal of the German Dermatological Society (JDDG)*. https://doi.org/10.1111/ddg.15698

5. Dressler, C., Nast, A., Heuer, R., & Loser, C. R. (2024). Ingrown toenails: A survey among dermatologists on current treatments. *Dermatologic Surgery, 50*, 260–266. https://doi.org/10.1097/DSS.0000000000003938

6. Brahs, A. B., & Bolla, S. R. (2026). Ingrown toenails. In *StatPearls*. National Institutes of Health. Retrieved July 30, 2026, from https://www.ncbi.nlm.nih.gov/books/NBK546697/

7. Chabchoub, I., & Litaiem, N. (2024). Onychocryptosis. In *Nail disorders*. Springer Nature. https://doi.org/10.1007/978-3-031-74272-9_34

8. Emedicine/Medscape. (2024). *Ingrown nail (onychocryptosis): Background, pathophysiology, etiology*. Medscape. Retrieved July 30, 2026, from https://emedicine.medscape.com/article/909807-overview

9. ScienceDirect Topics. (2024). Ingrown nail. In *Comprehensive dermatology reference*. Elsevier ScienceDirect. Retrieved July 30, 2026, from

https://www.sciencedirect.com/topics/medicine-and-dentistry/ingrown-nail

10. Khurana, A., et al. (2026). Management of lateral nail spicules: A distressing sequela of improper toenail surgery. *Journal of Cutaneous and Aesthetic Surgery*. Retrieved July 30, 2026, from https://jcasonline.com/management-of-lateral-nail-spicules-a-distressing-sequela-of-improper-toenail-surgery/

11. Vinay, K., Narayan Ravivarma, V., Thakur, V., Choudhary, R., Narang, T., Dogra, S., & Varthya, S. B. (2022). Efficacy and safety of phenol-based partial matricectomy in treatment of onychocryptosis: A systematic review and meta-analysis. *Journal of the European Academy of Dermatology and Venereology, 36*(4), 526–535. https://doi.org/10.1111/jdv.17871

12. Family Podiatry Centre. (2026). *Ingrown toenails—A comprehensive guide*. Retrieved July 30, 2026, from https://familypodiatrycentre.com/ingrown-toenails-why-they-happen-and-what-the-evidence-says-about-treatment

13. Exley, V., & Jones, K. (2024). A survey of the treatment and management of ingrown toenails by UK podiatrists: A cross-sectional survey. *Journal of Foot and Ankle Research, 17*. https://doi.org/10.1002/jfa2.12017

14. Fortune Business Insights. (2025). *Nail care products market size, share, trends*. Retrieved July 30, 2026, from https://www.fortunebusinessinsights.com/nail-care-market-106149

15. Atlanta Beauty Academy. (2025). *What is a medical nail technician? Training, certification, and career path*. Retrieved July 30, 2026, from https://atlantabeautyacademy.com/what-is-a-medical-nail-technician-training-certification-and-career-path/

16. [16] Centers for Disease Control and Prevention. (2023). *National diabetes statistics report*. Retrieved July 30, 2026, from https://www.cdc.gov/diabetes/php/data-research/index.html

17. Hassan, K., et al. (2024). Surgical strategies for ingrown toenails: A comprehensive review of techniques, outcomes, and advancements. *Cureus, 16*(1), Article e52501. https://doi.org/10.7759/cureus.52501

18. ResearchGate. (2004/2023). *Onychocryptosis—Epidemiology, pathogenesis, risk factors, diagnosis and treatment*. Retrieved July 30, 2026, from https://www.researchgate.net/publication/337364247_Review_of_onychocryptosis_epidemiology_pathogenesis_risk_factors_diagnosis_and_treatment

19. Zheng, J., et al. (2025). Wedge resection and nail groove reconstruction with hanging thread knot in the treatment of onychocryptosis. *PubMed Central*. Retrieved July 30, 2026, from https://www.ncbi.nlm.nih.gov/pmc/articles/PMC11743005/

20. de Berker, D. (2013). Nail anatomy. *Clinics in Dermatology, 31*(5), 509–515. https://doi.org/10.1016/j.clindermatol.2013.06.006