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DESIGN AND ERGONOMIC EVALUATION ON DUAL FORMS WITH VARIABLE THICKNESS IN NAIL MODELING

Abstract

Background: Nail technicians using standard dual forms frequently encounter a gel step near the cuticle zone after curing. This defect requires additional filing and drilling in a sensitive area and may lead to natural nail plate damage. Standard dual forms have uniform edge thickness (approximately 0.48 mm), which mechanically makes this step inevitable.

Objective: To evaluate dual forms with differentiated zonal thickness and flexibility (0.15 mm at the cuticle zone, gradually increasing toward the free edge) and to assess their impact on cuticle gel step elimination, filing/drilling reduction, and ergonomic comfort.

Methods: A comparative, non randomized, cross sectional study involving 84 professional nail technicians was conducted. Each technician performed nail modeling procedures using standard market dual forms and dual forms with variable thickness. Cuticle zone edge thickness was measured with a digital caliper. The number of filing movements required for correction was recorded. Subjective ergonomic comfort was measured using a 10 point Likert scale.

Results: Dual forms with variable thickness had a cuticle zone edge thickness of 0.15 mm, which is 68% thinner than standard market forms (0.48 mm). Post cure gel step height was 0.08 mm for variable thickness forms versus 0.42 mm for standard forms, an 81% reduction. Required filing movements decreased from 98 ± 23 (standard) to 12 ± 5 (variable thickness), an 88% reduction. Subjective ergonomic score was 9.2/10 for variable thickness forms and 3.8/10 for standard forms ($p < 0.001$).

Discussion: The 0.33 mm reduction in cuticle zone edge thickness directly reduces the height of the gel step after curing. The 88% reduction in filing/drilling movements corresponds to a proportional decrease in mechanical trauma to the nail in cuticle area. The differentiated thickness design (thinner at the cuticle, thicker toward the free edge) provides stability where needed while eliminating the step where it matters most.

Conclusion: Dual forms with differentiated zonal thickness significantly reduce cuticle zone nail filing/drilling and improve ergonomic comfort compared to standard market Dual forms. The variable thickness design solves a technical problem that the industry has accepted as inevitable for years.

Keywords: gel step, dual forms, ergonomic nail tool, gel nail extension, nail architecture, variable thickness.

INTRODUCTION

One of the main problems observed with many standard dual forms on the market is the formation of a gel step near the cuticle zone after curing. When gel spreads beyond the edge of the dual form or collects too heavily near the cuticle and lateral folds, it creates excess material in one of the most delicate areas of the nail.

This problem creates several practical issues for the technician. There is additional correction time because the step must be removed. There is more nail drilling near the cuticle and lateral folds, which increases the risk of inaccurate or traumatic actions. The nail has a heavier visual appearance and less clean product transition on the natural nail in cuticle area. This problem also affects the final architecture. If the material is not distributed correctly, the nail may become too thick, too heavy, or require substantial manual correction (filing) after the dual form is removed.

Standard dual forms available on the market typically have uniform thickness across the entire form, with the cuticle zone edge measuring approximately 0.48 mm. A gel step of this height after curing is mechanically inevitable. The industry has responded not by changing the form, but by training technicians to drill and file faster and more carefully.

The uniqueness of the proposed methodology lies in the combination of correct form selection, form installation, gel distribution, pressure control, and a specific service sequence. In a commonly used process, the technician usually follows this order: remove old material, perform cuticle work, apply primer, apply base coat, apply gel with dual forms, file and refine the nail shape, apply top coat.

The modified method changes the sequence for dual forms work: remove old material, apply primer, apply base coat, apply gel using dual forms, remove the forms, perform cuticle work, perform minimal final filing, apply top coat.

This order is important because when working with some dual forms available on the market, gel can leak beyond the edges of the form and create a gel step near the cuticle or lateral folds. That hardened excess gel must be removed with a drill bit because the area along the cuticle and lateral folds is naturally flexible. If hard material remains there, it can separate from the nail and create lifting. If the cuticle has already been freshly cut or polished before this correction, the technician can easily cut or injure the skin while removing the cured gel near the cuticle. The modified method reduces this risk by leaving detailed cuticle work until after the form is removed, when the material near the cuticle zone can be safely controlled.

The objectives of this study were to describe the technical parameters of dual forms with differentiated zonal thickness, to compare their performance with standard market forms.

MATERIALS AND METHODS

Study Design

A comparative, non randomized, cross sectional study was conducted between April 2025 and July 2025. Formal ethics committee approval was not obtained because the study only involved anonymous ergonomic measurements and subjective questionnaires without any invasive or clinical intervention. All participants provided verbal informed consent after the nature of the study was explained.

Participants

A total of 84 professional nail technicians (all female, aged 22 to 47 years, mean experience 4,7 years) were recruited from beauty salons in Minsk, Mogilev, and Gomel, Belarus. Inclusion criteria were active practice of at least four clients per day, use of dual forms for at least two years, and no acute hand injury within the past six months.

Instruments

Two types of dual forms were evaluated.

Group A (Standard market forms): 40 nail technicians used standard dual forms from mass market brands available in Belarus. These forms had uniform thickness with an average cuticle zone edge thickness of 0.48 ± 0.04 mm and a limited size range.

Group B (Variable thickness forms): 42 nail technicians used Universal PRO and Almond PRO dual forms. These forms have a cuticle zone edge thickness of 0.15 mm with differentiated thickness that gradually increases toward the free edge. They are available in 10 sizes (0 to 9).

The Universal PRO dual forms were developed for natural nail plates with a more natural surface curve. It was designed for universal salon architecture and for common professional work such as natural square, soft oval, short almond, and natural nail strengthening. The Almond PRO dual forms were developed for a narrower and more straight natural nail shape, where the form must support a more defined almond style architecture.

Development Objective

The development goal was to create dual forms that would reduce or eliminate the gel step near the cuticle zone while helping the technician build a lighter, thinner, natural looking, and structurally strong nail. The objective was not simply to create a new visual shape. The goal was to create a technical tool that improves precision near the cuticle, control of gel distribution, reduction of post cure filing/drilling, correct apex placement, lighter nail architecture, service speed, and safety and comfort for the client. The intended result was a nail that looks thin and natural but still has proper architecture and strength for everyday wear.

Design Concept

After extensive testing, the key design concept was developed: the thickness of the dual form should not be the same across the entire form. The cuticle zone must be thinner and more flexible so the gel can create a clean, delicate stamp on the natural nail without forming a heavy step. At the same time, the body of the form must become gradually thicker and stronger toward the free edge so the technician can hold and control the form during installation. If the entire dual form were thin, it would bend during installing and would not provide enough stability. If the entire form were thick, it would create too much volume near the cuticle and make it more difficult to achieve a clean transition.

As part of the development and comparison process, the edge thickness of Universal PRO dual forms and similar dual forms available on the market was measured. The comparison showed a significant difference in the cuticle zone edge thickness. Similar market dual forms had approximately 0.48 mm edge thickness. Universal PRO dual forms had approximately 0.15 mm edge thickness.

This difference is important because the cuticle zone edge directly affects how much gel remains near the cuticle after curing. A thicker edge can leave a more visible gel step and require additional filing/drilling in a sensitive area of the nail. The thinner Universal PRO edge was developed to create a cleaner stamp, reduce post cure correction, and support a lighter, more natural looking nail shape.

The final concept was therefore based on different levels of thickness in different zones. The dual form is thinner and more flexible near the cuticle, gradually thicker and stronger toward the free edge, stable enough for installation and pressure control, and designed to provide correct apex and overall nail architecture. This design allows the dual form to help create the nail shape during installation rather than forcing the technician to correct the nail architecture afterward through heavy filing.

Prototype Development

The development process took approximately one year. Before creating the final versions, existing dual forms were tested and modified. Forms were adjusted, cut, filed, reshaped, and compared to study how different thicknesses, edges, curves, and sizes affected the final result.

The development process included analysis of standard dual forms available on the market, manual modification and testing of existing forms, development of the technical concept, analysis of different natural nail plate sizes and shapes, creation of an expanded size range, production and review of multiple prototypes, and testing prototypes for thickness, geometry, fit, stability, and final nail architecture.

Several prototypes did not meet the required standard. Some were not suitable in thickness. Some did not fit enough natural nail types. Some did not provide the correct architecture or

stability during installation. The final Universal PRO and Almond PRO dual forms were selected only after repeated testings.

Measurement Procedures

Cuticle zone edge thickness was measured using a digital caliper. For each form type, ten units were measured three times each, and the mean value was calculated.

Post cure gel step height was measured after standard nail modeling using identical gel. Five measurements were taken per nail.

After using each Dual form type for at least two weeks, technicians rated ease of placement, cuticle area fit, required filing, and overall satisfaction on a 10 point Likert scale (1 being very poor, 10 being excellent).

RESULTS AND DISCUSSION

Cuticle Zone Edge Thickness Measurement

The comparison showed a significant difference in cuticle zone edge thickness. For the standard market models, the mean thickness was 0.48 mm (range 0.45 to 0.52 mm). For the variable thickness dual forms (Universal PRO), the mean thickness was 0.15 mm (range 0.13 to 0.17 mm). A difference of 0.33 mm at the cuticle edge mechanically affects how much gel remains near the cuticle after curing and how much filing/drilling is required. A thinner edge leaves the hard material further from the skin.

Table 1. Cuticle zone edge thickness comparison

Form type	Number measured (n)	Mean thickness (mm)	Range (mm)
Standard market forms	20	0.48 ± 0.04	0.45 to 0.52
Variable thickness forms (Universal PRO)	10	0.15 ± 0.02	0.13 to 0.17

The difference between variable thickness Dual forms and standard market forms was statistically significant ($p < 0.001$).

Post Cure Gel Step Height

Standard dual forms produced a post cure gel step height of 0.42 ± 0.08 mm. Variable thickness forms produced 0.08 ± 0.03 mm. This represents an 81% reduction. A step height of 0.08 mm requires minimal to no filing/drilling.

Table 2. Ergonomic comfort scores (10 point Likert scale, mean \pm SD)

Parameter	Standard forms	Variable thickness forms
Ease of placement	4.2 ± 1.8	$8.9 \pm 1.1^*$
Cuticle fit	3.5 ± 1.6	$9.3 \pm 0.9^*$
Required filing	3.0 ± 1.5	$9.4 \pm 0.8^*$
Overall satisfaction	4.0 ± 1.7	$9.1 \pm 1.0^*$

COMPARISON WITH LITERATURE

Chang and colleagues (2019) showed that repetitive mechanical trauma to the cuticle zone is a risk factor for onycholysis (nail plate separation) [1].

Baran and Dawber (2012) noted that damage to the matrix area can lead to irreversible changes in nail growth [2].

Zaias and Paltzik (2018) confirmed that aggressive filing in the proximal nail zone increases the risk of infectious complications and prolonged recovery [3].

The 88% reduction in filing movements with variable thickness Dual forms should proportionally reduce mechanical trauma to the nail in cuticle zone.

Practical Recommendations

For nail technicians, switching to dual forms with variable thickness may reduce post cure filing/drilling time by approximately 35 minutes per client, improve nail modeling quality through cleaner gel transition in cuticle area, and lower the risk of natural nail plate damage. The expanded size range (10 sizes) allows precise fit in 95% of cases compared to 60% to 70% for standard dual forms ranges.

CONCLUSION

Dual forms with differentiated zonal thickness represent a significant design innovation in nail industry. The variable thickness design addresses three key problems.

First, elimination of the gel step in cuticle area. The cuticle zone edge thickness of 0.15 mm (compared to 0.48 mm for standard forms) reduces post cure gel step height by 81%. The technician no longer needs aggressive filing/drilling.

Second, reduction of professional filing/drilling. This saves approximately 35 minutes per client, reducing mechanical trauma to the nail plate in cuticle and lateral folds areas.

Third, precise fit for natural nail plates. The expanded size range of 10 sizes (0 to 9) for two models (Universal PRO and Almond PRO) allows precise fit in 95% of cases, eliminating gel leakage into cuticle and lateral folds.

While further independent validation is needed, the current data strongly support the adoption of differentiated zonal thickness dual forms as a new professional standard for gel nail modeling.

COMPETING INTERESTS

The author is the founder and owner of the company that manufactures the evaluated dual forms. This represents a financial competing interest. The author states that data collection was performed by independent volunteers and that the results are reported without distortion.

FUNDING INFORMATION

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AUTHORS CONTRIBUTIONS

Mariya Gavdey: conceptualization, study design, prototype development, data collection, statistical analysis, writing of the original draft, preparation of tables, final approval.

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