

Research Article

Efficacy and Safety of Incobotulinumtoxin-A for Nonfacial Aesthetic Indications: A Prospective Case Series on Calf Contouring

Hosung Choi ¹ and Kui Young Park ²

¹PIENA Aesthetic Medical Clinic, Seoul, Republic of Korea

²Department of Dermatology, Chung-Ang University College of Medicine, Seoul, Republic of Korea

Correspondence should be addressed to Kui Young Park; kyky@cauhs.or.kr

Received 3 January 2025; Revised 19 June 2025; Accepted 21 August 2025

Academic Editor: Yung-Tsu Cho

Copyright © 2025 Hosung Choi and Kui Young Park. Dermatologic Therapy published by John Wiley & Sons Ltd. This is an open access article under the terms of the Creative Commons Attribution License, which permits use, distribution and reproduction in any medium, provided the original work is properly cited.

Background: Botulinum toxin-A (BoNT-A) injection is a widely used cosmetic procedure in Korea to improve calf contours; however, a standardized protocol has yet to be established. While other BoNT-A formulations have been studied for calf contouring, the efficacy and safety of Inco-BoNT-A (IncoBoNT-A) specifically for this purpose remain unclear.

Objective: This prospective case series study aimed to evaluate the effectiveness and safety of IncoBoNT-A for calf contouring. **Methods:** Twenty Korean women (mean age: 35.55 ± 7.37) received 75–100 U of IncoBoNT-A per calf muscle (total 150–200 U for both calves), administered intramuscularly using a 30G 0.5-inch needle. Evaluations were conducted at baseline and at 1, 3, and 6 months postprocedure. Changes in muscle size were measured via ultrasound and tape, supplemented by clinical photographs. Observer evaluations (PGAIS, Merz scales for female Asian calf) and participant satisfaction (SGAIS) were assessed at each visit, along with body weight monitoring and daily activity assessments.

Results: Both calf circumference (measured by tape) and muscle thickness (measured by ultrasound) at 2 fixed locations declined over time, with significant reductions at each visit compared to baseline. The PGAIS and SGAIS scores demonstrated consistent clinical improvement and patient satisfaction. The Merz scale indicated a shift from “severe” and “very severe” to “mild” and “moderate” ratings over time. Notably, weight gain was associated with less reduction in calf circumference.

Conclusions: A single dose of 150–200 U IncoBoNT-A is safe and effective for calf contouring. Unlike facial wrinkle treatment, weight management may be essential for achieving optimal results in calf contouring with BoNT-A.

Keywords: botulinum toxin; calf muscle; contouring; Incobotulinumtoxin-A

1. Introduction

Botulinum toxin-A (BoNT-A) has been extensively utilized in the treatment of various neurological, medical, and cosmetic conditions and is well recognized for its efficacy in reducing facial wrinkles. More recently, its application has expanded beyond facial aesthetics to include body contouring procedures, such as calf muscle slimming and reduction of trapezius muscle size, aimed at achieving a more aesthetically pleasing body contour [1, 2].

Body contouring procedures typically necessitate higher doses of BoNT-A compared to facial treatments, raising concerns about the potential development of immunological resistance. Immunological resistance occurs when the body produces neutralizing antibodies (NABs) against BoNT-A, which can gradually diminish or completely negate its clinical effects [3]. Given the potential loss of therapeutic benefits due to immunological resistance, it is imperative to establish appropriate guidelines based on systematic clinical studies and expert recommendations to reduce the risk of

NAB formation [4]. In light of these concerns, selecting a BoNT-A formulation with a lower immunogenic potential is particularly crucial for aesthetic treatments involving larger muscle groups, such as the calves. Recent research indicates that frequent injections of a complexing protein-containing BoNT-A preparation are associated with a significantly higher risk of NAB development compared to injections of a complexing protein-free (CF) Inco-BoNT-A (IncoBoNT-A) preparation administered with the same frequency [5]. IncoBoNT-A is a highly purified form of BoNT-A consisting solely of the 150 kDa core neurotoxin, without any complexing proteins or other bacterial accessory components. Structurally, this 150 kDa protein comprises a 100 kDa heavy chain and a 50 kDa light chain linked via a disulfide bridge. The heavy chain enables specific neuronal targeting and translocation, while the light chain exerts its biological activity by cleaving the synaptosomal-associated protein of 25 kDa (SNAP-25), thereby inhibiting acetylcholine release at neuromuscular junctions. Unlike other BoNT formulations derived from the ~900 kDa progenitor complex, which includes hemagglutinin proteins and nontoxic nonhemagglutinin components, IncoBoNT-A excludes these complexing proteins, which are unnecessary for therapeutic neuromodulation and may increase immunogenicity. The absence of such proteins in IncoBoNT-A reduces the risk of NAB formation and makes it particularly suitable for aesthetic indications requiring high-dose or repeated injections [6]. IncoBoNT-A has been widely studied and approved for the treatment of glabellar lines, crow's feet, and forehead lines, with a well-established safety and efficacy profile. Previous clinical trials have demonstrated that it provides comparable aesthetic outcomes to Ona-BoNT-A, with a similar duration of action and lower antigenic potential [7–9].

Therefore, the present study was conducted to evaluate the efficacy and safety of IncoBoNT-A injections for lower leg contouring.

2. Materials and Methods

The study adhered to the guidelines outlined in the Declaration of Helsinki. The Institutional Review Board approved the study protocols, informed consent forms, and relevant supplementary data (IRB Approval no. 2311-012-578).

2.1. Participants. We recruited 20 healthy adult female participants seeking cosmetic improvement in calf muscle hypertrophy. Exclusion criteria included the following: (1) individuals with a history of calf muscle resection or selective neurotomy for leg slimming; (2) those who had received BoNT-A treatment in the lower legs within the past 12 months; (3) individuals with neuromuscular-affecting diseases such as severe muscular dystrophy, Eaton–Lambert syndrome, amyotrophic lateral sclerosis, or motor neuropathy; (4) those with dermatitis or infectious skin conditions on the lower legs; (5) pregnant or lactating women; and (6) those deemed unfit for the study by the investigator. All participants

voluntarily agreed to participate, provided written informed consent, and were informed of their right to withdraw from the study at any time and for any reason.

2.2. Treatment Protocols. A total of 100 U of IncoBoNT-A (XEOMIN; Merz Pharmaceuticals GmbH, Frankfurt, Germany) was diluted in 4 mL of 0.9% normal saline to achieve a concentration of 2.5 U per 0.1 mL. Each participant received 75–100 U per calf muscle, totaling 150–200 U, depending on calf muscle mass on clinical examination. The treatment was distributed as follows: 40% and 30% of the total dose to the inner and lateral sides of the gastrocnemius (GM), 15% to the peroneus longus, and 10% and 5% to the inner and lateral sides of the soleus (SM), respectively (Figure 1). A total of 75–100 U was injected intramuscularly using a 30 G 0.5-inch needle at 2–3 cm intervals, 5 U (0.2 mL) per injection point.

2.3. Assessment. Participants were assessed on the day of the procedure, as well as at 1, 3, and 6 months postprocedure to evaluate changes in calf muscle size. These changes were quantified using clinical photographs, ultrasound imaging, and tape measurements. Calf circumference was measured with a tape at two fixed surface landmarks: (1) the midpoint of the calf from the popliteal crease to the intermalleolar line and (2) 5 cm above the midpoint (Figure 2). Ultrasound measurements were obtained at the same two anatomical levels using transverse imaging. Muscle thickness was defined as the longest vertical distance between the outer (superficial) and inner (deep) fascia of the medial GM muscle, measured at the visually thickest portion of the muscle along the horizontal plane. At each visit, clinical photographs were rated by a blinded evaluator using the Merz scales for the female Asian calf, at rest and dynamic (4: very severe, 3: severe, 2: moderate, 1: mild, and 0: none) (Figure 3). In addition, observer evaluation with the Physicians' Global Aesthetic Improvement Scale (PGAIS) and participant satisfaction with the Subjects' Global Aesthetic Improvement Scale (SGAIS) were conducted at each follow-up visit in comparison to baseline. The PGAIS and the SGAIS were rated on a 5-point scale: very much improved (4), much improved (3), improved (2), no change (1), and worse (0). Body weight and exercise levels were also monitored. Safety was assessed by documenting all adverse events, including pain, bruising, bleeding, paresthesia, and muscle weakness at each visit.

2.4. Statistical Analysis. Statistical analyses were performed using R language Version 4.2.2 (R Foundation for Statistical Computing, Vienna, Austria) and the TnF program Version 4.0 (YooJin BioSoft, Korea). The Wilcoxon signed-rank test was applied to compare changes in calf size at 1, 3, and 6 months relative to baseline measurements. Bonferroni correction was used for multiple testing. Spearman correlation analysis was conducted to assess the relationship between weight and calf size for each participant across repeated measurements. The influence of baseline

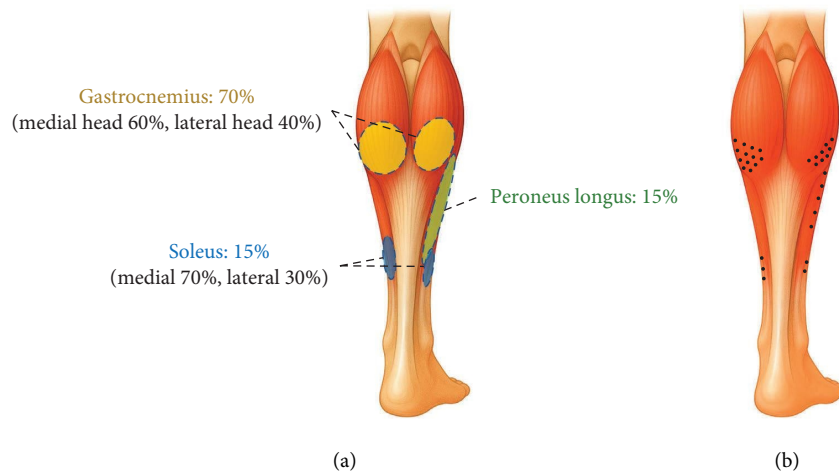


FIGURE 1: Injection sites and dosage distribution of IncoBoNT-A for calf contouring. (a) Schematic diagram showing the proportional distribution of the total injection dose: gastrocnemius (70%; medial head 60%, and lateral head 40%), soleus (15%; medial 70%, and lateral 30%), and peroneus longus (15%). (b) Detailed anatomical representation of intramuscular injection sites (black dots) within the medial and lateral heads of the gastrocnemius, soleus, and peroneus longus muscles. The figure illustrates the typical rows and columns of injection points used to enhance reproducibility. Actual injection sites may vary depending on individual muscle volume and morphology.

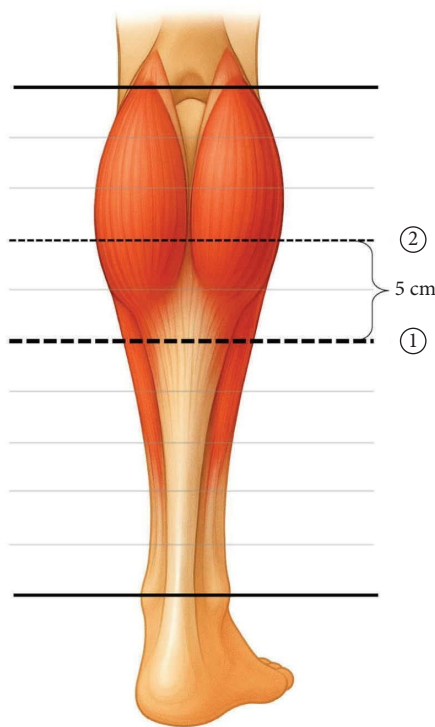


FIGURE 2: Evaluation of calf muscle size at 2 fixed levels. ① Midpoint of calf from the popliteal crease to the intermalleolar line. ② 5 cm above the midpoint.

characteristics, including age, weight, and calf size, on the changes in calf circumference following IncoBoNT-A injection was analyzed using linear regression for the 1-, 3-, and 6-month intervals. A p value of < 0.05 was considered statistically significant for all analyses.

3. Results

All 20 enrolled Korean women, aged 30–40 years (mean age: 35.55 ± 7.37 years), successfully completed the entire study protocol and attended all follow-up visits.

The circumference (cm) measured with a tape 5 cm above and at the midpoint of the calf demonstrated statistically significant reductions postprocedure, as shown in Figure 4. Similarly, muscle thickness at the calf midpoint (inner and outer) and 5 cm above the midpoint at each follow-up visit also exhibited statistically significant decreases postprocedure, as depicted in Figures 5 and 6.

The PGAIS and the SGAIS ratings were collected at every follow-up visit (Table 1). PGAIS scores indicated that 90%–100% of participants were rated 2 or higher (at least “improved”) at 1, 3, and 6 months postprocedure; while 100% of participants scored 2 or higher (at least “improved”) on the SGAIS at all time points, indicating high physician and patient satisfaction with the treatment.

According to blinded evaluation with the Merz scales for female Asian calf, a more pronounced change was observed in the dynamic state compared to the resting state (Table 1). In the dynamic state, the number of participants rated as “mild” increased from 1 at baseline to 6, 7, and 6 at 1, 3, and 6 months, respectively. Conversely, the number of participants rated as “severe” or “very severe” decreased to 5, 4, and 2 at 1, 3, and 6 months, respectively.

To assess whether weight changes during the study period affected calf contouring, correlations between repeatedly measured variables were analyzed using the R package. As highlighted in Table 2, a statistically significant positive correlation was observed, indicating that calf circumference 5 cm above the midpoint measured by tape increased significantly with body weight gain. However, no statistically significant difference was found in calf circumference and muscle thickness compared to baseline,

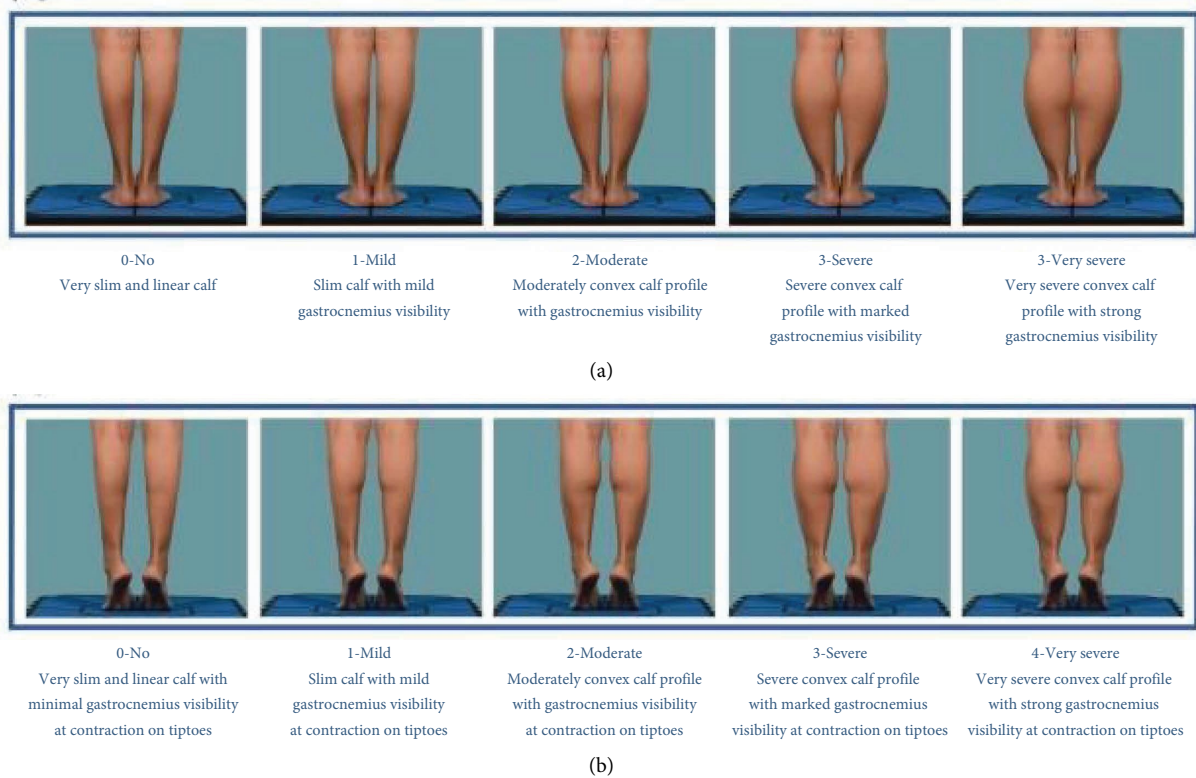


FIGURE 3: MERZ scales for female Asian calf. (a) Calf-at rest. (b) Calf-dynamic.

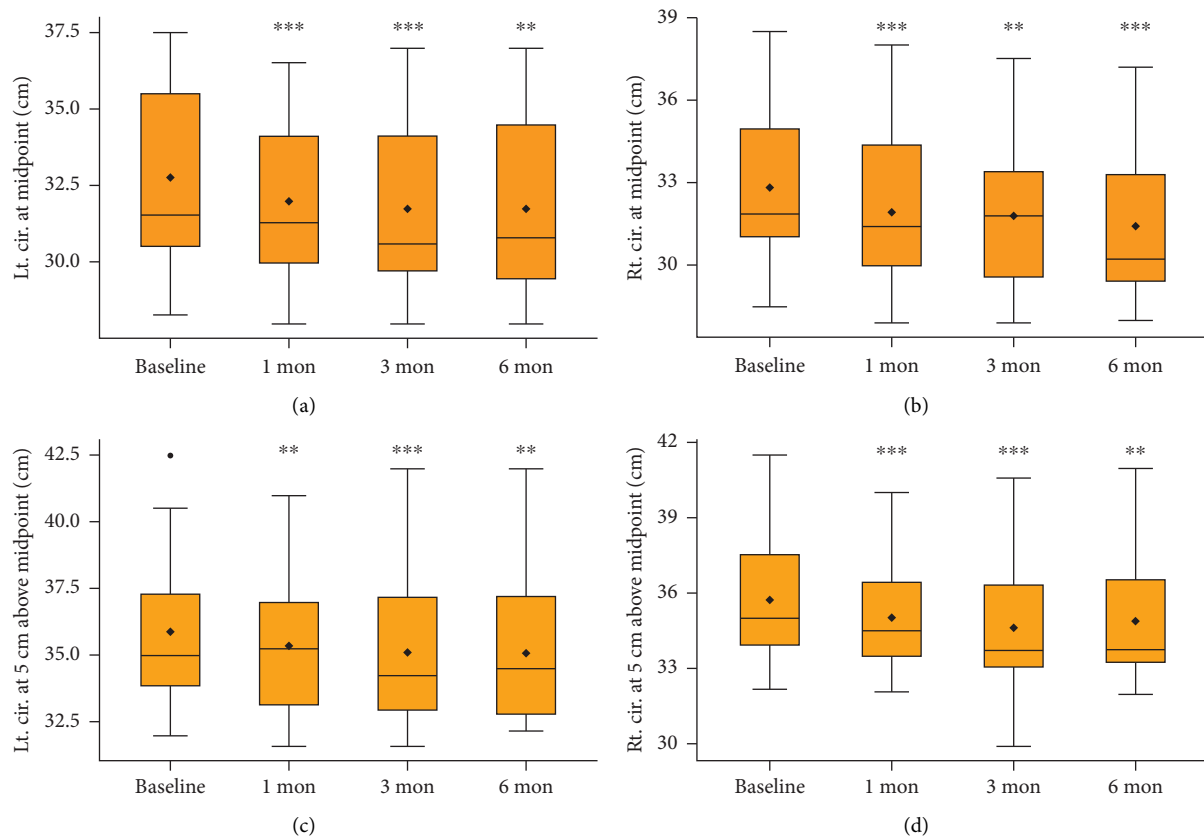


FIGURE 4: Measurement of calf circumference at the midpoint (1/2 of the total length from the popliteal crease to the intermalleolar line) and 5 cm above the midpoint using a tape measure at each visit. The middle box represents the interquartile range, and the inner solid line indicates the median. The inner dot denotes the mean measurement. Statistical significance is indicated as follows: * $p < 0.05$, ** $p < 0.01$, and *** $p < 0.001$, with Bonferroni adjustment for multiple comparisons.

TABLE 1: Distribution of GAIS scores (physicians' and subjects') and Merz scales for female Asian calf (resting and dynamic) over time.

	0 (baseline)	1 month	3 month	6 month
PGAIS	<i>n</i> = 20	0: <i>n</i> = 0	0: <i>n</i> = 0	0: <i>n</i> = 0
		1: <i>n</i> = 2	1: <i>n</i> = 0	1: <i>n</i> = 0
		2: <i>n</i> = 10	2: <i>n</i> = 7	2: <i>n</i> = 8
		3: <i>n</i> = 8	3: <i>n</i> = 12	3: <i>n</i> = 10
		4: <i>n</i> = 0	4: <i>n</i> = 1	4: <i>n</i> = 2
SGAIS	<i>n</i> = 20	0: <i>n</i> = 0	0: <i>n</i> = 0	0: <i>n</i> = 0
		1: <i>n</i> = 0	1: <i>n</i> = 0	1: <i>n</i> = 0
		2: <i>n</i> = 11	2: <i>n</i> = 4	2: <i>n</i> = 8
		3: <i>n</i> = 9	3: <i>n</i> = 15	3: <i>n</i> = 11
		4: <i>n</i> = 0	4: <i>n</i> = 1	4: <i>n</i> = 1
Merz (rest)	0: <i>n</i> = 0 1: <i>n</i> = 1 2: <i>n</i> = 10 3: <i>n</i> = 8 4: <i>n</i> = 1	0: <i>n</i> = 0 1: <i>n</i> = 2 2: <i>n</i> = 11 3: <i>n</i> = 6 4: <i>n</i> = 1	0: <i>n</i> = 0 1: <i>n</i> = 5 2: <i>n</i> = 8 3: <i>n</i> = 6 4: <i>n</i> = 1	0: <i>n</i> = 0 1: <i>n</i> = 4 2: <i>n</i> = 9 3: <i>n</i> = 6 4: <i>n</i> = 1
Merz (dynamic)	0: <i>n</i> = 0 1: <i>n</i> = 1 2: <i>n</i> = 7 3: <i>n</i> = 10 4: <i>n</i> = 2	0: <i>n</i> = 0 1: <i>n</i> = 6 2: <i>n</i> = 9 3: <i>n</i> = 5 4: <i>n</i> = 0	0: <i>n</i> = 0 1: <i>n</i> = 7 2: <i>n</i> = 9 3: <i>n</i> = 4 4: <i>n</i> = 0	0: <i>n</i> = 0 1: <i>n</i> = 6 2: <i>n</i> = 12 3: <i>n</i> = 1 4: <i>n</i> = 1

Note: *n*, number.

Abbreviations: PGAIS, Physicians' Global Aesthetic Improvement Scale; SGAIS, Subjects' Global Aesthetic Improvement Scale.

TABLE 2: Correlation between repeatedly measured weight and calf circumferences among subjects.

	Comparison	Corr.coeff	Lower 95% CI	Upper 95% CI	<i>p</i> value
Weight (kg)	Lt. cir. at the midpoint (cm)	0.205	−0.054	0.438	0.113
	Rt. cir. at the midpoint (cm)	−0.012	−0.267	0.245	0.929
	Lt. cir. at 5 cm above the midpoint (cm)	0.357	0.111	0.562	0.005
	Rt. cir. at 5 cm above the midpoint (cm)	0.338	0.089	0.546	0.008
	Inner lt. thk at the midpoint (mm)	−0.095	−0.342	0.165	0.468
	Inner rt. thk at the midpoint (mm)	−0.135	−0.380	0.128	0.304
	Outer lt. thk at the midpoint (mm)	−0.0040	−0.293	0.218	0.758
	Outer rt. thk at the midpoint (mm)	−0.091	−0.341	0.172	0.491
	Inner lt. at 5 cm above the midpoint (mm)	−0.026	−0.281	0.231	0.840
	Inner rt. at 5 cm above the midpoint (mm)	−0.083	−0.332	0.177	0.524

Note: Corr. coeff, correlation coefficient computed using repeatedly measured weight and circumferential variables. 95% CI, 95% confidence intervals for the correlation coefficient; lt, left; rt, right; cir, circumference; thk, thickness.

regardless of whether participants engaged in exercise following BoNT-A injections.

Representative photographs of a participant are provided in Figure 7. All participants reported experiencing mild to moderate pain during the procedure, but no additional adverse events, such as bruising and muscle weakness, were observed. None of the participants reported any difficulty in walking, running, or performing daily activities during the study period.

4. Discussion

In the present study, participants received 75–100 units of IncoBoNT-A per calf muscle, with a total dose of 150–200 units. The injections were administered intramuscularly using a 30-gauge, 0.5-inch needle. Dosage and injection sites were meticulously calibrated: 40% and 30% of the total dose were delivered to the inner and lateral portions of the GM

muscle, 15% to the peroneus longus, and 10% and 5% to the inner and lateral portions of the SM muscle, respectively. A significant proportion of the dose was targeted at both the inner and lateral heads of the GM muscle to address the primary contributors to calf bulk, improving the contour and appearance of the legs. The inclusion of the peroneus longus and selective dosing of the SM muscle further refined the lower leg's silhouette, achieving a balanced and harmonious aesthetic outcome (Figure 1). This precise and customized approach likely optimized the aesthetic results while minimizing potential side effects, contributing to the high level of patient satisfaction reported.

Various formulations of BoNT-A have been employed in calf contouring, including Ona-BoNT-A (Botox), Pra-BoNT-A (Jeuneau), and Lan-BoNT-A (Hengli). Each brand differs in unit potency, diffusion characteristics, and immunogenicity profile, which necessitates tailored injection planning. Han et al. [10] conducted a randomized, double-

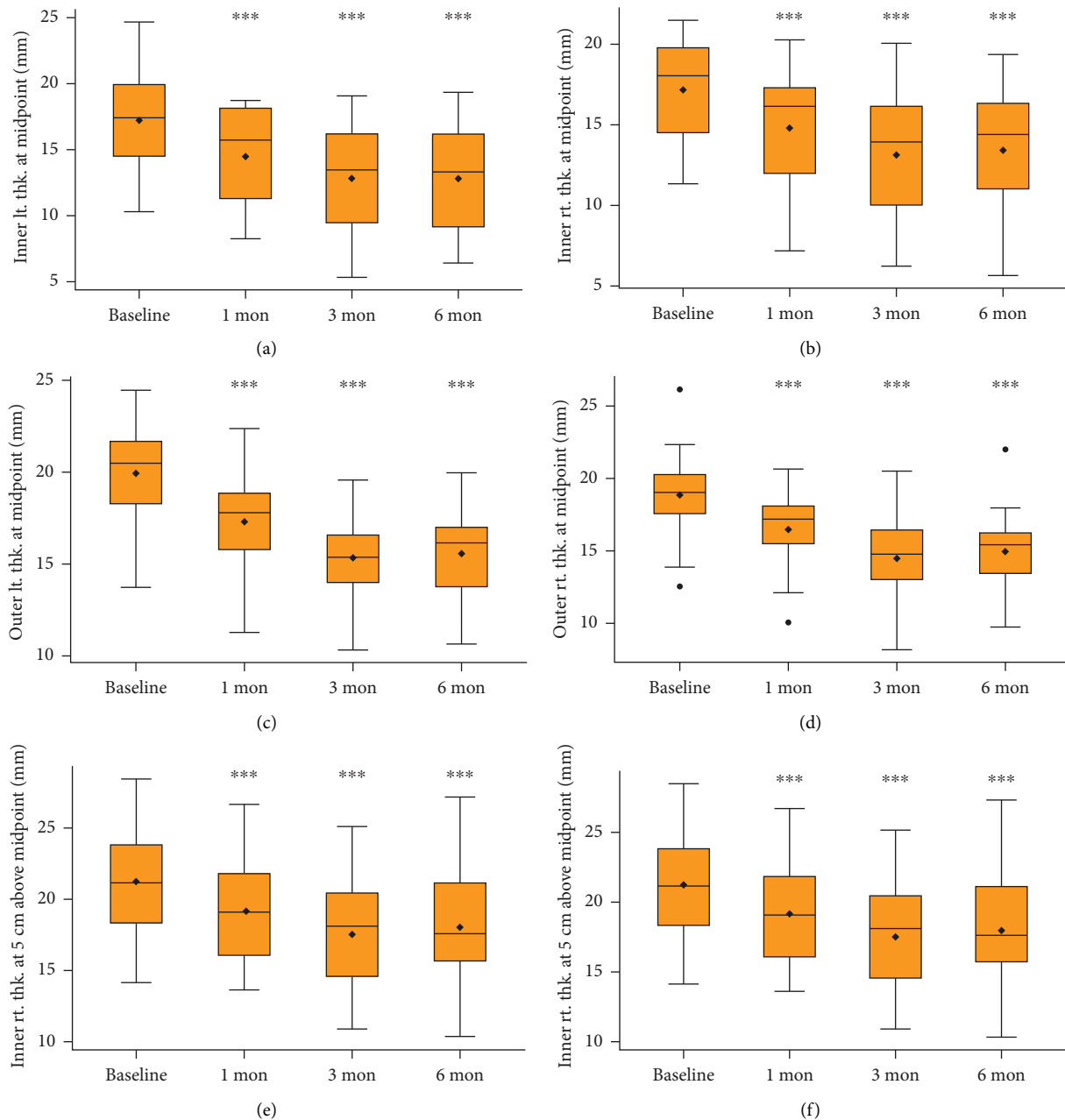


FIGURE 5: Ultrasound-based measurement of calf muscle thickness at the midpoint (1/2 of the total length, both inner and outer) and 5 cm above the midpoint (inner) at the visit. Statistical significance is denoted as $*p < 0.05$, $**p < 0.01$, and $***p < 0.001$.

blinded controlled trial evaluating Ona-BoNT-A for calf contouring, injecting either 60 or 100 units into the GM muscle across 20 injection points per leg. Both dose groups showed a significant reduction in calf circumference at 8 weeks (mean decrease: ~ 0.5 cm), with no significant difference between doses. Li et al. [11] performed a prospective, self-controlled, double-blind study using Lan-BoNT-A to compare two injection protocols: GM-only versus GM plus SM (GM + SM) treatment. Both groups received a total of 150 units per leg, with the GM + SM group using ultrasound-guided dual-depth injections. While both methods significantly improved calf contour and reduced circumference,

long-term compensatory thickening of the SM and subcutaneous tissue was observed in the GM group. The GM + SM protocol mitigated this rebound effect but showed no significant difference in overall patient satisfaction compared to GM alone. Wanitphakdeedecha et al. [12] conducted a randomized, double-blind, split-leg trial comparing Ona-BoNT-A (ONA) and Pra-BoNT-A (PRA) for GM reduction in 22 patients. Each leg received 100 units of either ONA or PRA. Both groups showed significant reductions in calf circumference beginning at 2 weeks and sustained through 6 months, with no significant differences between products in circumference, ultrasound

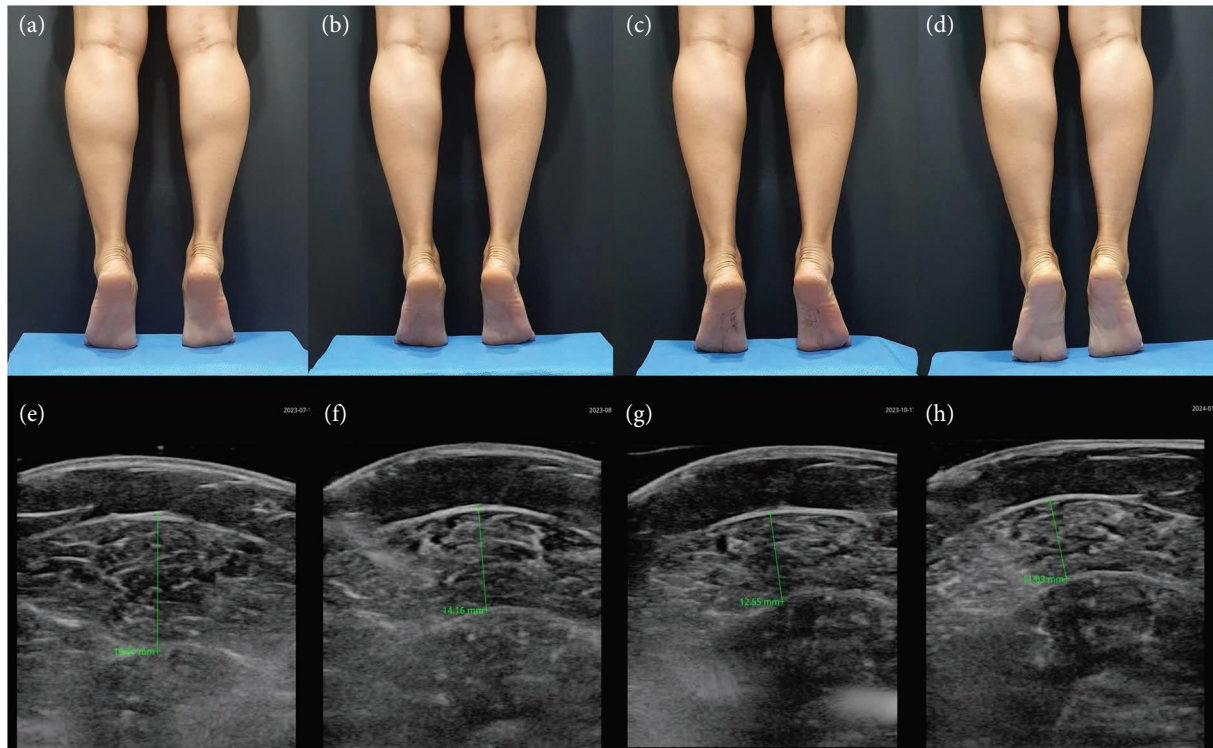


FIGURE 6: Clinical photographs of the posterior calf and corresponding ultrasound images of Subject 5, taken at 5 cm above the midpoint of the medial calf: prior to injection of 150 U of IncoBoNT-A (a), and at 1 (b), 3 (c), and 6 (d) months after treatment. (e)–(h) Ultrasound-based muscle thickness was measured at the site where the gastrocnemius muscle appeared thickest on the transverse view. The measurement was defined as the longest vertical distance between the outer and inner fascia of the muscle.

measurements, or patient satisfaction. Interestingly, PRA demonstrated slightly earlier and more consistent reductions in calf thickness, particularly in the lateral GM, though the clinical significance was limited. No significant adverse effects or functional impairments were reported.

The formation of NABs remains a growing concern in the use of BoNT-A, as it can result in secondary treatment failure and limit future therapeutic options. Variations in the immunogenicity of BoNT-A formulations have been attributed to the presence of nonessential bacterial components [6]. As it is difficult to predict the course of NAB resolution, the most effective strategy is to prevent NAB induction by using the lowest effective dose, optimizing injection frequency, minimizing booster injections, and choosing a BoNT-A preparation with a lower protein load and free of complexing proteins. Notably, the rate of antibody-mediated secondary nonresponse (SNR) is reported to be lowest with CF IncoBoNT-A [6]. Moreover, a switch to IncoBoNT-A has been shown to improve outcomes in patients experiencing secondary treatment failure [13]. In the context of calf contouring, where relatively large doses of toxin are used, employing a CF BoNT-A preparation allows both patients and clinicians to anticipate favorable treatment results without concerns about NAB development. When treating patients with particularly large calf muscles, achieving effective muscle reduction may require a higher initial dose of BoNT-A or planning two injection sessions spaced 2–3 months apart from the outset.

Therefore, greater consideration should be given to the potential formation of NABs.

Table 2 presents the correlation between repeated measurements of body weight and calf circumference among participants. The variables exhibit a statistically significant positive correlation (green mark in the table), indicating that over time, increases in body weight are significantly associated with increases in calf circumference. Previous studies assessing muscle groups, such as the calf or deltoid, have reported relatively lower satisfaction levels compared to masseter muscle treatments [1, 14, 15]. This disparity may be explained by the masking effect of thick subcutaneous fat tissue, which can obscure reductions in muscle size. Therefore, educating patients on avoiding weight gain during calf contouring with BoNT-A may be crucial to achieving optimal results.

Morhy et al. [16] conducted a study evaluating the impact of physical activity (PA) on the durability of BoNT-A's aesthetic effects. Their findings demonstrated that lower levels of PA were associated with longer-lasting aesthetic benefits, evidenced by significant reductions in muscle activity and improved severity scores for forehead and glabellar lines in the Low-PA group compared to those with higher PA levels. These findings suggest that PA may negatively influence the longevity of BoNT-A's effects. However, this is inconsistent with the results observed in our study. Two potential explanations for this discrepancy are proposed: first, the calf muscles are larger than the facial

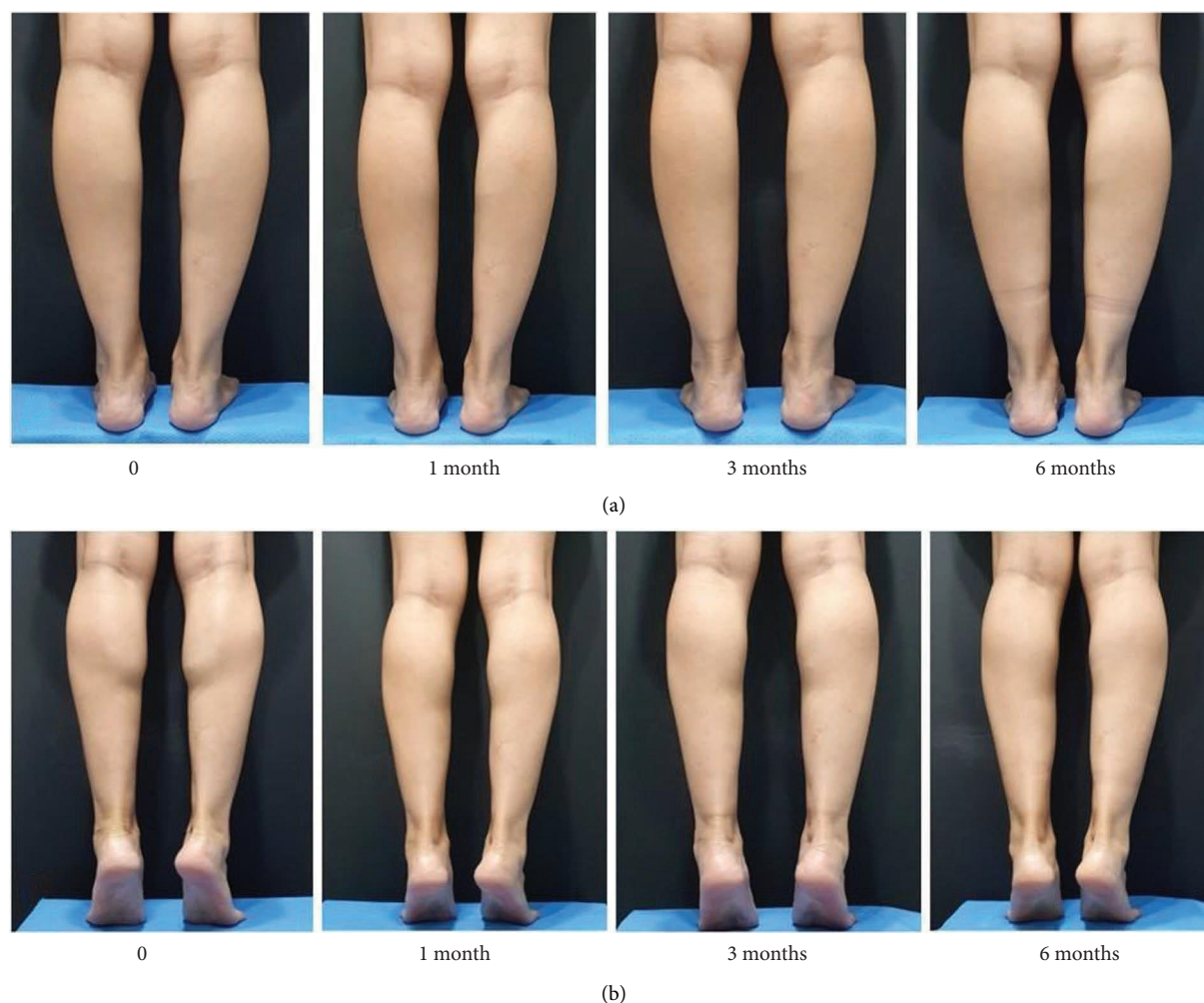


FIGURE 7: Clinical photographs of a representative case demonstrating improvements in calf contour. (a) Static states before and after treatment. (b) Dynamic states before and after treatment.

muscles, so the effects of BoNT-A treatment may not be as impacted by routine physical activity, and second, the larger quantity of BoNT-A injected into the calf muscles compared to the face may have mitigated the effect of exercise on the treatment outcome.

In addition, for more effective and efficient calf muscle reduction with BoNT-A injections, it is recommended to use ultrasound imaging to assess the injection site beforehand. This approach allows injectors to determine the appropriate dose of BoNT-A based on the target muscle size, accurately identifying the injection area and depth, and predicting the potential effects of the procedure in advance.

This study has several limitations, including the absence of a double-blind comparative method, a small sample size, the inclusion of only female participants, and the evaluation of a single treatment, which limits the ability to make long-term comparisons. Future studies should include carefully controlled, prospective trials with larger sample sizes to validate these outcomes. Despite these limitations, the study demonstrated a statistically significant benefit of IncoBoNT-A injections for calf contouring. The precision in

dosing and the targeting of specific muscle groups based on their contribution to overall leg shape highlight the importance of a customized treatment approach in achieving favorable cosmetic outcomes. The positive results of this study can be attributed to the careful consideration of individual anatomy and the strategic distribution of BoNT-A across the calf muscles. Furthermore, the low antigenicity of IncoBoNT-A has been well-documented, alleviating concerns about reduced treatment efficacy due to the formation of NABs during calf contouring procedures.

Data Availability Statement

The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

Disclosure

All authors have read and agreed to the published version of the manuscript.

Conflicts of Interest

Hosung Choi is a consultant for Merz Aesthetics Asia Pacific, and Kui Young Park declares no conflicts of interest.

Author Contributions

Conceptualization: Hosung Choi and Kui Young Park. Methodology: Hosung Choi. Software: Kui Young Park. Validation: Hosung Choi and Kui Young Park. Investigation: Hosung Choi. Data curation: Kui Young Park. Writing—original draft preparation: Kui Young Park. Writing—review and editing: Hosung Choi.

Funding

This trial was supported by an unrestricted research grant from Merz Aesthetics Asia Pacific, Inc. In addition, this work was supported by the Technology Innovation Program (or Industrial Strategic Technology Development Program—Material and Component Technology Development Project [Heterogeneous Technology Convergence Type] [20024946, Development of Tissue Regenerative Biosurgery Convergence Medical Products Using High-Functional Implantable Biomaterials]) funded by the Ministry of Trade, Industry & Energy (MOTIE, Korea).

References

- [1] J. Cheng, H. J. Chung, M. Friedland, and S. H. Hsu, "Botulinum Toxin Injections for Leg Contouring in East Asians," *Dermatologic Surgery* 46, no. 1 (2020): S62–S70, <https://doi.org/10.1097/DSS.0000000000002320>.
- [2] Y. G. Koh, S. H. Shin, K. R. Kim, S. H. Yeoum, W. W. Choi, and K. Y. Park, "A Double-Blinded, Randomized, Dose-Comparison Pilot Study to Comparatively Evaluate Efficacy and Safety of Two Doses of Botulinum Toxin Type A Injection for Deltoid Muscle Hypertrophy," *Annals of Dermatology* 35, no. 5 (2023): 355–359, <https://doi.org/10.5021/ad.22.155>.
- [3] S. Bellows and J. Jankovic, "Immunogenicity Associated With Botulinum Toxin Treatment," *Toxins* 11, no. 9 (2019): 491, <https://doi.org/10.3390/toxins11090491>.
- [4] S. M. Oh, H. M. Kim, T. H. Ahn, M. S. Park, Y. S. Ree, and E. S. Park, "Aesthetic Doctors' Perception and Attitudes Toward Tolerance in Botulinum Toxin," *Skin Research and Technology* 30, no. 4 (2024): e413691, <https://doi.org/10.1111/srt.13691>.
- [5] H. Hefter, D. Rosenthal, A. Jansen, et al., "Significantly Lower Antigenicity of Incobotulinumtoxin Than Abo- or Onabotulinumtoxin," *Journal of Neurology* 270, no. 2 (2023): 788–796, <https://doi.org/10.1007/s00415-022-11395-2>.
- [6] M. U. Martin, J. Frevert, and C. M. Tay, "Complexing Protein-Free Botulinum Neurotoxin A Formulations: Implications of Excipients for Immunogenicity," *Toxins* 16, no. 2 (2024): 101, <https://doi.org/10.3390/toxins16020101>.
- [7] M. Kerscher, S. Fabi, T. Fischer, et al., "IncobotulinumtoxinA Demonstrates Safety and Prolonged Duration of Effect in a Dose-Ranging Study for Glabellar Lines," *Journal of Drugs in Dermatology* 19, no. 10 (2020): 985–991, <https://doi.org/10.36849/JDD.2020.5454>.
- [8] J. H. Lee, J. H. Park, S. K. Lee, et al., "Efficacy and Safety of Incobotulinum Toxin A in Periocular Rhytides and Masseteric Hypertrophy: Side-By-Side Comparison With Onabotulinum Toxin A," *Journal of Dermatological Treatment* 25, no. 4 (2014): 326–330, <https://doi.org/10.3109/09546634.2013.769041>.
- [9] O. Oliveira de Moraes, E. Matos Reis-Filho, L. Vilela Pereira, C. Martins Gomes, and G. Alves, "Comparison of Four Botulinum Neurotoxin Type A Preparations in the Treatment of Hyperdynamic Forehead Lines in Men: A Pilot Study," *Journal of Drugs in Dermatology* 11, no. 2 (2012): 216–219.
- [10] S. H. Han, S. W. Park, D. H. Kim, et al., "The Efficacy of Botulinum Toxin A Injection for Gastrocnemius Hypertrophy: A Prospective Randomized Double-Blinded Controlled Trial," *Plastic and Reconstructive Surgery* 11, no. 2 (2023): e4205.
- [11] Z. Li, Y. Chong, L. Jin, et al., "Botulinum Toxin Treatment for Calf Contouring Based on the Study of Combined Injection of Gastrocnemius and Soleus," *Aesthetic Surgery Journal* 44, no. 5 (2024): 545–555, <https://doi.org/10.1093/asj/sjad365>.
- [12] R. Wanitphakdeedecha, C. Ungakornpairote, A. Kaewkes, A. Sathaworawong, B. Vanadurongwan, and N. Lektrakul, "A Pilot Study Comparing the Efficacy of Two Formulations of Botulinum Toxin Type A for Muscular Calves Contouring," *Journal of Cosmetic Dermatology* 17, no. 6 (December 2018): 984–990, <https://doi.org/10.1111/jocd.12787>.
- [13] H. Hefter, B. Ürer, R. Brauns, et al., "The Complex Relationship Between Antibody Titers and Clinical Outcome in Botulinum Toxin Type A Long-Term Treated Patients With Cervical Dystonia," *Journal of Neurology* 269, no. 11 (2022): 5991–6002, <https://doi.org/10.1007/s00415-022-11235-3>.
- [14] S. H. Shin, S. J. Park, S. H. Yeoum, C. S. Youn, and K. Y. Park, "Efficacy and Safety of Botulinum Toxin Injection in Reducing Deltoid Muscle Hypertrophy," *Dermatologic Therapy* 34, no. 6 (2021): e15168, <https://doi.org/10.1111/dth.15168>.
- [15] N. H. Kim, J. H. Chung, R. H. Park, and J. B. Park, "The Use of Botulinum Toxin Type A in Aesthetic Mandibular Contouring," *Plastic and Reconstructive Surgery* 115, no. 3 (2005): 919–930, <https://doi.org/10.1097/01.prs.0000153236.79775.a0>.
- [16] O. N. Morhy, A. L. Sisnando, M. B. Câmara-Souza, A. C. Carbone, and G. De la Torre Canales, "High Levels of Physical Activity Reduce the Esthetic Durability of Botulinum Toxin Type A: A Controlled Single-Blind Clinical Trial," *Toxins* 15, no. 7 (2023): 463, <https://doi.org/10.3390/toxins15070463>.