Clinical, Cosmetic and Investigational Dermatology

Dovepress
Taylor & Francis Group

Open Access Full Text Article

ORIGINAL RESEARCH

Evaluation of the Effect of Laterality and Age on Pain Perception in Monopolar Radiofrequency Facial Therapy

Ying Wang*, Han Bai*, Congqi Shi, Meng Wang, Shasha Zhao, Xiaodong Lai, Yan Yan

Department of Dermatology, Plastic Surgery Hospital, Chinese Academy of Medical Sciences and Peking Union Medical College, Beijing, 100144, People's Republic of China

*These authors contributed equally to this work

Correspondence: Yan Yan, Department of Dermatology, Plastic Surgery Hospital, Chinese Academy of Medical Sciences and Peking Union Medical College, Beijing, 100144, People's Republic of China, Email yanyan@psh.pumc.edu.cn

Background: Monopolar radiofrequency (RF) is an established non-invasive modality for facial rejuvenation. Despite its proven efficacy, treatment-related pain remains a major barrier to patient compliance. Previous evidence suggests lateralized differences in pain perception, yet systematic evaluation in RF therapy is lacking.

Purpose: To investigate laterality in pain perception during monopolar RF treatment and to explore the influence of age on pain sensitivity.

Patients and Methods: A prospective study enrolled 46 patients (45 females, 1 male; age 30–58 years) with facial laxity undergoing bilateral monopolar RF (Thermage FLX) treatment. Treatment order (left-first or right-first) was randomized, and all procedures were performed by the same right-handed physician. Pain intensity was assessed within 5 minutes post-treatment for each hemiface using a 0–10 Visual Analogue Scale (VAS, scored to one decimal place).

Results: The left hemiface exhibited significantly higher VAS scores than the right (7.12 ± 2.05 vs. 6.62 ± 1.90, $p< 0.001$), irrespective of treatment order. Stratified analysis revealed that younger patients (≤42 years) reported higher VAS scores than older patients (>42 years) (left: 7.60 ± 1.46 vs. 6.64 ± 2.18; right: 7.07 ± 1.15 vs. 6.16 ± 2.17; both values of $p< 0.05$). Correlation analysis showed age was negatively associated with VAS scores.

Conclusion: Monopolar RF treatment demonstrates a consistent left-side dominance in pain perception, with younger patients exhibiting greater pain sensitivity and age negatively correlated with VAS scores.

Keywords: facial pain, pain laterality, age factors, Visual Analogue Scale

Introduction

With the rise in living standards and increasing public understanding of cosmetic science, radiofrequency (RF) medical aesthetics has emerged as a pivotal modality for skin rejuvenation due to its non-invasive nature, favorable safety profile, and short postoperative recovery period. Monopolar RF is widely regarded as a cornerstone non-invasive anti-aging technology, delivering high-frequency electromagnetic waves to the deep dermis and superficial subcutaneous tissues.[1] The resulting controlled thermal stimulation promotes type I/III collagen remodeling and fibrillar restructuring, thereby improving skin laxity, elasticity, and facial contouring through both immediate collagen contraction and long-term regenerative effects.[2] Research indicates that the thermal energy generated by monopolar radiofrequency not only inhibits Cutibacterium acnes proliferation but also remodels the dermal matrix via heat shock protein mediated repair pathways. Besides, compared to other non-ablative rejuvenation modalities, monopolar radiofrequency demonstrates a lower incidence of side effects, typically presenting as mild, self-limiting symptoms such as transient erythema and edema, thereby balancing efficacy with safety.[3]

https://doi.org/10.2147/CCID.S577283
Received: 28 November 2025
Accepted: 19 March 2026
Published: 27 March 2026

Interestingly, pain perception is not uniform; previous research has demonstrated lateralized differences, with the left side often perceived as more painful than the right.[4] This asymmetry has been documented in experimental settings and aesthetic facial injections, an effect attributed to right-hemispheric dominance in nociceptive processing involving the right anterior insula and amygdala.[5]

In the context of monopolar RF therapy, clinical observations similarly suggest that patients often report more intense pain on the left hemiface than the right. However, despite its potential clinical significance, this laterality phenomenon has not been rigorously investigated in RF treatment. Understanding whether pain asymmetry exists during monopolar RF procedures, and its possible neural mechanisms, is crucial for optimizing treatment strategies, improving patient comfort, and guiding individualized pain management. Therefore, the present study prospectively evaluated facial pain asymmetry in patients undergoing bilateral monopolar RF therapy, using a validated Visual Analogue Scale (VAS). To our knowledge, this represents the first systematic clinical investigation to not only quantify and compare pain perception between the left and right hemifaces during RF treatment but also evaluate the influence of age on pain sensitivity.

Patients and Methods

Ethical Considerations

All experiments complied with relevant laws and regulations. The Ethics Committee of the Plastic Surgery Hospital of the Chinese Academy of Medical Sciences has approved the study [2025 (077)]. Informed consent was obtained from all subjects.

Clinical Study Design and Patient Selection

Forty-six participants presenting with facial laxity were enrolled in this study (45 females, 1 male), aged 30–58 years. Exclusion criteria included pregnancy, lactation, local anesthetic hypersensitivity, active infections, keloid history, diabetic neuropathy, psychiatric or neurological disorders impairing cooperation, and objective sensory discrepancies (touch/pain/pressure/temperature) between the face. Written informed consent was obtained from all participants. Treatment order (left-first or right-first) was randomized via computer-generated allocation. A single physician with over 10 years of radiofrequency therapy experience performed all treatments to ensure procedural consistency. The standardized protocol comprised: (1) uniform application of 2% lidocaine cream to the prioritized hemiface for 30 minutes, followed by monopolar radiofrequency therapy. (2) contralateral facial anesthesia and treatment replication after completing the prioritized side. Anesthesia duration and device parameters (energy, depth) were matched bilaterally. Within 5 minutes post-treatment per side, patients quantified hemifacial pain intensity using a validated Visual Analogue Scale (VAS; 0.0–10.0, 0.1 increments). Besides, the evaluation of a single treatment session was designed to capture the immediate, acute nociceptive response, avoiding confounding factors such as pain memory or habituation associated with multiple treatments.

Data analysis was performed using [SPSS software version 26.0 (IBM Corp., Armonk, NY, USA)]. Continuous variables are presented as mean ± standard deviation (SD). To compare VAS scores between the left and right hemifaces within the same individuals, paired *t*-tests were utilized.

Results

Forty-six subjects meeting the criteria were finally enrolled in this study, of whom 45 (97.8%) were female and 1 (2.2%) male, with a mean age of 42 years (range 30–58). All enrolled cases were operated by the same right-handed (R-handed) practitioner, and the treatment parameters were strictly uniform: the number of treatments, the duration of a single session, the radiofrequency energy and the depth of action were kept exactly the same bilaterally. Table 1 shows the baseline characteristics of the enrolled population in detail.

Mean VAS scores for monopolar radiofrequency treatment of the left and right hemifaces are summarized in Figure 1 and Table 2. The left hemiface exhibited significantly higher pain scores compared to the right (7.12 ± 2.05 vs. 6.62 ± 1.90, $p< 0.001$). Stratified analysis by treatment prioritization Figure 2 revealed that patients receiving left-first treatment reported lower overall pain than those in the right-first cohort. To explore the potential influence of age, participants were

Table 1 Baseline Characteristics of Patients

Patient Information	Total	
No. of patients (%)	46 (100)	
Mean age, y (range)	42.0 (30–58)	
No. of men (%)	1 (2.2)	
No. of women (%)	45 (97.8)	
Handedness (%)	L	2 (4.4)
	R	44 (95.6)

stratified by the median age of 42 years into a younger group (≤42 years, n = 23) and an older group (>42 years, n = 23). Results in Table 3 Comparison of VAS scores between different age groups during monopolar RF facial treatment showed that: The younger group exhibited significantly higher mean VAS scores than the older group (left: 7.60 ± 1.46 vs. 6.64 ± 2.18; right: 7.07 ± 1.15 vs. 6.16 ± 2.17; both values of $p< 0.05$). Correlation analysis indicated that age was negatively correlated with VAS scores.

Discussion

Clinical observations revealed that during bilateral facial monopolar radiofrequency treatments, patients reported more intense pain on the left side compared to the right side. Notably, when the left side was treated first, patients' pain scores during subsequent treatments were lower compared to when the right side was addressed initially. The clinical adoption of monopolar radiofrequency aesthetic technology has seen a significant upward trend, driven by increasing demand for antiaging solutions. To our knowledge, based on an extensive literature review, this represents the first clinical investigation to systematically evaluate pain differences between the hemifaces following monopolar radiofrequency treatment. The VAS served as the standardized pain assessment tool, with sensitivity enhanced by replacing traditional integer-based scoring with a decimal-based system (0.0–10.0). All treatments were performed by the same senior practitioner, minimizing operator-induced variability through standardized treatment durations, radiofrequency energy levels, and depth parameters, thereby controlling technical variables. The principle of minimizing discomfort was adhered to throughout, with real-time feedback ensuring bilateral symmetry and safety.

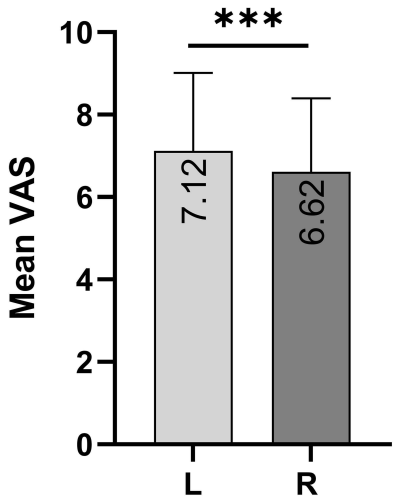

Figure 1 Pain intensity scores using the Visual Analogue Scale (VAS; 0, no pain; 10, worst pain). Bar graphs represent mean values; error bars indicate standard error of the mean. (L: Left facial side; R: Right facial side; ***p<0.001).

https://doi.org/10.2147/CCID.S577283

Table 2 VAS Scores for Monopolar Radiofrequency Treatments

	Side of Face	Mean VAS	SD	*p*
No. of patients (%)	46 (100)			
Monopolar Radiofrequency Treatments	L	7.12	2.05	$p<0.001$
	R	6.62	1.90	
	Sum	13.74		

Notes: Statistical analysis was performed using a paired *t*-test to compare VAS scores between the left and right hemifaces within the same individuals.
Abbreviations: SD, standard deviation; VAS, Visual Analogue Scale.

Our clinical evaluation revealed that VAS scores on the left hemiface were significantly higher than those on the right during monopolar RF treatment, confirming a "left-side dominance" in pain perception. Neuroanatomically, this can be explained by the contralateral transmission of nociceptive signals and cerebral hemispheric specialization. While the peripheral nervous system transmits noxious stimuli that decussate and ascend through spinal tracts, the right cerebral hemisphere (particularly the right anterior insula and right amygdala) plays a predominant, pro-nociceptive role in affective pain processing. Conversely, the left hemisphere primarily mediates nociceptive inhibition.[6] This cerebral lateralization provides a plausible biological foundation for the heightened pain sensitivity observed on the left hemiface in response to RF thermal stimulation.

This lateralization of pain is not unique to monopolar RF therapy; it has been widely corroborated in other minimally invasive facial rejuvenation techniques. For instance, research by Fouché et al, indicated that VAS scores are generally higher on the left hemiface during cosmetic facial injectable treatments[7] Similarly, recent evidence from Yi et al, confirmed that skin-booster injections consistently induce significantly greater pain on the left side[8] The elevated pain scores on the left hemiface observed in our monopolar RF treatment align closely with findings from these facial injection procedures, further reinforcing the clinical consensus in aesthetic medicine regarding heightened sensitivity in left-sided nociceptive pathways. Besides, this study not only confirmed the lateralization phenomenon of higher pain on the left hemiface during monopolar RF treatment but also revealed a significant influence of age on pain perception. Younger patients reported significantly higher VAS scores compared with older patients, and age was negatively correlated with pain intensity. These findings are consistent with previous studies showing that pain thresholds increase with advancing age. Potential mechanisms for this phenomenon include a reduced density of cutaneous nerve endings in

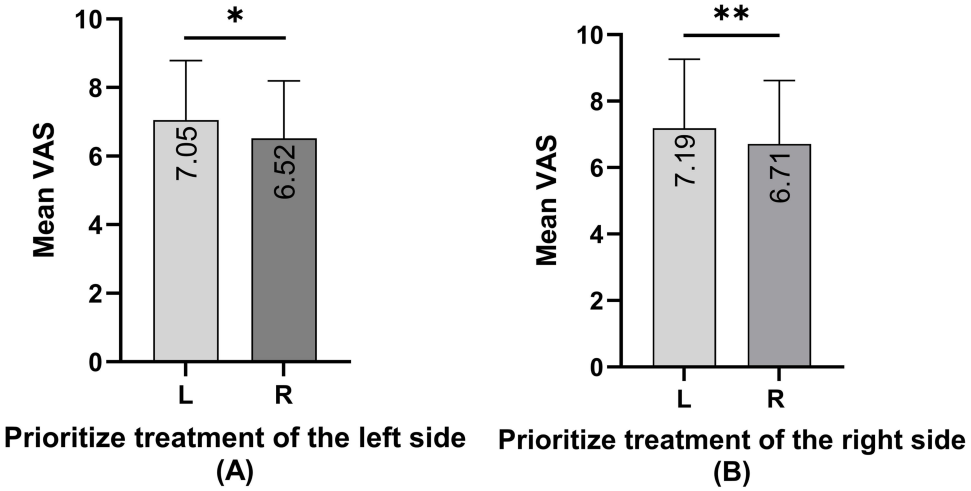

Figure 2 Pain intensity scores using the Visual Analogue Scale (VAS; 0, no pain; 10, worst pain). Bar graphs represent mean values; error bars indicate standard error of the mean. When treatments were performed first on the L side (**A**), when treatments were performed first on the R side (**B**). (L: Left facial side; R: Right facial side; *$p<0.05$, **$p<0.01$).

Table 3 Comparison of VAS Scores Between Different Age Groups During Monopolar RF Facial Treatment

Age Group	n	Mean Age (Years)	Left VAS (Mean ± SD)	Right VAS (Mean ± SD)	*p*
≤42 years	23	36.3	7.60 ± 1.46	7.07 ± 1.15	$p<0.05$
>42 years	23	47.7	6.64 ± 2.18	6.16 ± 2.17	

Notes: Statistical analysis was performed using an independent samples *t*-test to compare mean VAS scores between the younger (≤42 years) and older (>42 years) patient cohorts for both the left and right hemifaces.
Abbreviations: SD, standard deviation; VAS, Visual Analogue Scale.

older individuals, decreased levels of nociceptive neurotransmitters, and attenuated psychological and emotional modulation of pain by the central nervous system. To substantiate this, previous meta-analyses have confirmed the relationship between aging and increased pain thresholds,[9] while other studies have documented age-related structural and functional changes in brain regions involved in pain processing.[10] From a clinical perspective, these results suggest that younger patients may require more proactive pain management strategies during RF therapy, such as topical anesthesia, preemptive administration of analgesics, or psychological support, to improve comfort and compliance.

This study has several limitations that warrant cautious interpretation. Firstly, the single-center design inherently constrained the total sample size (n=46) and introduced a pronounced gender imbalance (2.2% male participants). Secondly, the low proportion of left-handed participants (4.4%), below population-level baselines, may limit the generalizability of pain laterality assessments due to handedness distribution bias. Given the insufficient subgroup sample sizes (male participants: n=1; left-handed individuals: n=2), stratified statistical analyses by gender and handedness were not conducted. Methodologically, the study prioritized elucidating the neurological basis of pain asymmetry over analyzing demographic variables. We therefore recommend future multicenter studies enroll samples of ≥200 participants with stratified designs by sex and handedness to systematically clarify how individual differences modulate therapeutic pain asymmetry. Lastly, future trials should incorporate standardized psychological assessments and functional neuroimaging to directly validate the influence of anxiety and explicitly justify the hypothesis of right-hemispheric dominance in nociceptive processing.

Conclusion

This study systematically demonstrated the lateralization of facial pain during monopolar radiofrequency (RF) treatment and further revealed the significant influence of age on pain perception. Overall, VAS scores were consistently higher on the left hemiface compared with the right, confirming a stable "left-side dominanc" in pain sensitivity. Additionally, younger patients (≤42 years) exhibited higher overall VAS scores than older patients (>42 years), with age showing a negative correlation with pain intensity.

Ethical Approval

All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki Declaration and its later amendments or comparable ethical standards. The study was approved by The Ethics Committee of the Plastic Surgery Hospital, Chinese Academy of Medical Sciences and Peking Union Medical College [2025 (077)].

Disclosure

The authors report no conflicts of interest in this work.

References

1. Hodgkinson DJ. Clinical applications of radiofrequency: nonsurgical skin tightening (thermage). *Clin Plast Surg*. 2009;36(2):261–268,viii. doi:10.1016/j.cps.2008.11.006

2. Goldman MP, Kilmer SL, Biesman B, McPherson K, Jacobson A. Monopolar radiofrequency-induced fibroblast stimulation for the prevention and improvement of skin laxity. *Dermatol Surg*. 2025;51(9S):S38–S43. doi:10.1097/DSS.0000000000004714
3. Weiss RA, Weiss MA, Munavalli G, Beasley KL. Monopolar radiofrequency facial tightening: a retrospective analysis of efficacy and safety in over 600 treatments. *J Drugs Dermatol*. 2006;5(8):707–712.
4. Pauli P, Wiedemann G, Nickola M. Pain sensitivity, cerebral laterality, and negative affect. *Pain*. 1999;80(1–2):359–364. doi:10.1016/s0304-3959(98)00231-0
5. Allen HN, Bobnar HJ, Kolber BJ. Left and right hemispheric lateralization of the amygdala in pain. *Prog Neurobiol*. 2021;196:101891. doi:10.1016/j.pneurobio.2020.101891
6. Cauzzo S, Singh K, Stauder M, et al. Functional connectome of brainstem nuclei involved in autonomic, limbic, pain and sensory processing in living humans from 7 Tesla resting state fMRI. *Neuroimage*. 2022;250:118925. doi:10.1016/j.neuroimage.2022.118925
7. Fouché JJ, Van Loghem JAJ, Thuis J, De Heer LM, van Oijen MGH. Left/right pain asymmetry with injectable cosmetic treatments for the face. *Aesthet Surg J*. 2017;37(6):708–714. doi:10.1093/asj/sjw214
8. Yi KH, Park HJ, Wan J, Suwanchinda A, Koppert E, Kim HJ. Skin-booster injection on the left and right sides: which side is more painful? *Dermatol Surg*. 2025;51(9):e52–e56. doi:10.1097/DSS.0000000000004670
9. Lautenbacher S, Peters JH, Heesen M, Scheel J, Kunz M. Age changes in pain perception: a systematic-review and meta-analysis of age effects on pain and tolerance thresholds. *Neurosci Biobehav Rev*. 2017;75:104–113. doi:10.1016/j.neubiorev.2017.01.039
10. Mj F. Age-related changes in the structure and function of brain regions involved in pain processing. *Pain Med*. 2012;13(Suppl 2). doi:10.1111/j.1526-4637.2011.01287.x