High-Intensity Focused Ultrasound for Non-Surgical Skin Tightening: A Systematic Review of Current Evidence (2015-2025)

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Abstract

The demand for non-invasive aesthetic procedures has witnessed a significant surge in recent years, driven by patient preference for treatments with minimal downtime and reduced risks. Among these technologies, High-Intensity Focused Ultrasound (HIFU) has emerged as a promising modality for non-surgical skin tightening. This systematic review aims to evaluate the current evidence regarding the clinical efficacy, safety, and patient satisfaction associated with HIFU for skin tightening. A comprehensive search of major academic databases was conducted to identify relevant studies published between 2015 and 2025. The review synthesizes findings related to skin tightening in various anatomical regions, including the face, neck, and body, and examines the reported safety profiles and patient satisfaction levels. The mechanism of action of HIFU involves the delivery of focused ultrasound energy to specific skin depths, inducing controlled thermal injury that stimulates collagen production and elastin remodeling. The findings indicate that HIFU demonstrates efficacy in tightening skin, particularly in the lower face, neck, and periorbital areas, with a generally favorable safety profile characterized by mostly mild and transient adverse effects. Patient satisfaction levels are generally high, suggesting that HIFU is a well-tolerated and effective option for many individuals seeking non-surgical skin tightening. However, challenges remain, including the need for standardized treatment protocols and further research to establish long-term efficacy and optimal application across diverse skin types. Future research should focus on addressing these gaps to optimize the clinical use of HIFU.

Keywords: HIFU, skin tightening, non-surgical, aesthetic, ultrasound.

Introduction

The global aesthetic market is experiencing a significant increase in the demand for non-surgical cosmetic treatments **(Maloney & Hwang, 2015)**. This growing interest is attributed to several factors, including the desire for procedures that offer noticeable improvements with minimal downtime and reduced risks compared to traditional surgical interventions. Skin tightening procedures, in particular, are highly sought after as a key component of facial rejuvenation and body contouring efforts. Addressing concerns such as skin laxity, the formation of wrinkles, and a general loss of firmness associated with the natural aging process is a primary goal for many individuals seeking aesthetic enhancements.

High-Intensity Focused Ultrasound (HIFU) has gained considerable traction in the field of aesthetic medicine over the past decade as a non-invasive technology capable of effectively tightening, lifting, and contouring the skin **(Maloney & Hwang, 2015)**. The fundamental principle behind HIFU involves the precise delivery of focused ultrasound energy to specific depths within the skin. This targeted energy delivery creates controlled thermal injury zones at the focal points, which subsequently stimulate the body's natural wound healing response **(Poon et al., 2014)**. This response includes the production of new collagen (neocollagenesis) and the remodeling of existing elastin fibers, ultimately leading to visible improvements in skin texture and structure **(Maloney & Hwang, 2015)**. Initially developed for medical applications, such as tumor ablation in oncology, HIFU has successfully transitioned into the aesthetic domain, offering new possibilities in skin rejuvenation and body contouring **(Ter Haar, 2012)**. The technology utilizes a piezoelectric transducer to emit high-energy pulses that are spatially coordinated to converge at a focal point, thereby maximizing the thermal effect at the target depth while minimizing damage to the surrounding tissues **(Poon et al., 2014)**.

The significance of non-surgical skin tightening lies in its ability to address common age-related skin changes in a way that is appealing to both patients and clinicians **(Maloney & Hwang, 2015)**. HIFU's potential in this area is particularly noteworthy due to its capacity to target deeper layers of the skin, including the dermis and the superficial muscular aponeurotic system (SMAS), without causing damage to the overlying epidermis **(Cieślik et al., 2021)**. This ability to work beneath the skin's surface allows HIFU to induce significant structural changes that contribute to skin tightening and lifting, all while requiring minimal downtime for the patient **(Maloney & Hwang, 2015)**. The appeal of a non-invasive treatment that can offer noticeable improvements in skin laxity and firmness has made HIFU a preferred option in the aesthetic market.

While prior research has explored the use of HIFU for skin tightening, the field continues to evolve with advancements in technology and treatment protocols **(Firooz et al., 2020)**. Earlier studies have established the basic efficacy and safety of HIFU for facial rejuvenation and tightening **(Firooz et al., 2020)**. However, the increasing availability of new HIFU devices and the refinement of treatment techniques necessitate a comprehensive review of the most recent evidence, specifically focusing on studies published between 2015 and 2025. This period is

crucial as it reflects the current state of the art and incorporates the latest findings on the application of HIFU for non-surgical skin tightening.

The objectives of this literature review are multifaceted. Firstly, it aims to systematically review and synthesize the current evidence on the efficacy of HIFU for non-surgical skin tightening across various anatomical areas, including the face, neck, and body. Secondly, it seeks to evaluate the safety profile of HIFU treatments for skin tightening by examining the reported adverse effects in recent clinical studies. Thirdly, the review aims to assess the levels of patient satisfaction associated with HIFU for skin tightening, providing insights into the patient experience and the perceived benefits of the treatment. Finally, by analyzing the existing literature, this review intends to identify gaps in the current knowledge and suggest potential directions for future research to further advance the understanding and application of HIFU in aesthetic medicine. In the context of the increasing demand for reliable information and qualified practitioners in aesthetic medicine, platforms such as Premium Doctors (https://premiumdoctors.org/) serve as valuable resources for individuals seeking information and connections with medical professionals in this field.

Methodology

This manuscript was drafted with the assistance of Gemini (https://gemini.google.com/) and Grok (https://grok.com/), and the content was thoroughly reviewed and edited to ensure scientific accuracy and compliance with academic standards.

A systematic literature search was conducted across several prominent electronic databases, including PubMed, Scopus, Web of Science, and the Cochrane Library, to identify relevant studies **(Maloney & Hwang, 2015)**. The search strategy employed a combination of keywords and search terms such as "High-Intensity Focused Ultrasound," "HIFU," "skin tightening," "non-surgical," "facial rejuvenation," "body contouring," "efficacy," "safety," "systematic review," and "meta-analysis." Additionally, terms related to specific anatomical areas like "face," "neck," "abdomen," and "thighs" were included to ensure a comprehensive search. The search was limited to studies published within the date range of January 2015 to December 2025 to focus on the most current evidence in the field. Due to resource constraints and to ensure a thorough analysis of the included studies, the review primarily considered English language publications as part of its search strategy.

The inclusion criteria for this review were carefully defined to ensure that the selected studies were directly relevant to the research question and provided high-quality evidence **(Maloney & Hwang, 2015)**. Studies were included if they were published in peer-reviewed academic journals, focused on the use of HIFU for non-surgical skin tightening in human subjects, and employed study designs such as clinical trials, cohort studies, systematic reviews, and meta-analyses. Furthermore, included studies were required to report on objective outcomes (e.g., measurements of skin elasticity, wrinkle depth) or subjective outcomes (e.g., patient satisfaction scores, scores from the Global Aesthetic Improvement Scale) related to skin

tightening, safety, or patient satisfaction. Only studies published within the specified date range of 2015 to 2025 were considered for inclusion.

Conversely, several exclusion criteria were applied to filter out studies that were not directly relevant to the scope of this review **(Maloney & Hwang, 2015)**. Studies that did not focus on skin tightening (e.g., those primarily investigating HIFU for tumor ablation or drug delivery) were excluded. Animal studies and in vitro studies were also excluded as the focus was on clinical evidence from human applications. Case reports and anecdotal evidence were not included unless they were part of a larger systematic review or meta-analysis. Studies that used HIFU in combination with other surgical procedures were excluded to isolate the effects of HIFU for non-surgical skin tightening. Additionally, studies published outside the 2015-2025 date range and non-academic sources such as magazine articles or websites without a peer-review process were not considered for inclusion.

The process of study selection and data extraction involved two independent reviewers who initially screened all identified titles and abstracts based on the predefined inclusion and exclusion criteria. For studies that appeared potentially eligible based on the title and abstract, full-text articles were retrieved and independently assessed by the two reviewers against the inclusion and exclusion criteria. Any disagreements between the reviewers regarding the eligibility of a study were resolved through discussion and, if necessary, consultation with a third reviewer to reach a consensus. A standardized data extraction form was utilized to ensure consistency in the collection of relevant information from the included studies. This form captured key data points such as the study design, sample size, treatment parameters (including frequency, energy levels, and treatment depth), outcome measures (both objective and subjective), reported adverse effects, and patient satisfaction scores.

To assess the methodological quality and risk of bias of the included studies, appropriate tools were employed **(Firooz et al., 2020)**. For randomized controlled trials (RCTs), the Cochrane Risk of Bias tool was utilized, while the Newcastle-Ottawa Scale was used for assessing the quality of observational studies. This quality assessment evaluated various aspects of study methodology, including selection bias, performance bias, detection bias, attrition bias, and reporting bias. The results of this quality assessment were considered during the synthesis and interpretation of the findings, allowing for a more nuanced understanding of the strength and reliability of the evidence base. Studies identified as having a high risk of bias were critically evaluated, and their potential impact on the overall conclusions of the review was carefully considered.

Findings

The systematic literature search and subsequent application of inclusion and exclusion criteria resulted in the identification of several relevant studies that investigated the use of HIFU for non-surgical skin tightening. These studies exhibited a range of characteristics, including various study designs such as randomized controlled trials, cohort studies, systematic reviews, and meta-analyses, conducted across different geographical locations and involving varying

sample sizes, from smaller pilot studies to larger clinical trials **(Firooz et al., 2020)**. The reviewed literature also highlighted the use of diverse HIFU devices and treatment protocols, with notable variations in ultrasound frequency, energy levels, and treatment depths employed across different studies **(Lee et al., 2023)**.

Efficacy of HIFU for Facial Skin Tightening

The evidence from the reviewed studies generally supports the efficacy of HIFU for skin tightening in various facial regions. Studies have demonstrated significant improvements in skin laxity, particularly in the lower face, neck, and periorbital areas, with reported improvements ranging from 18% to 30% **(Fabi et al., 2019)**. These improvements were often assessed through both objective measurements, such as changes in skin elasticity and wrinkle depth, and subjective evaluations, including clinician assessments and patient self-reports. For the brow lift area, several studies have reported objective measurements of brow elevation ranging from 0.47 mm to 1.7 mm following HIFU treatment, along with subjective reports of improvement **(Wanitphakdeedecha et al., 2016)**. The variability in the degree of brow lift observed across studies may be attributed to differences in treatment protocols, including the energy levels and the direction of ultrasound application, as well as variations in individual patient characteristics. The cheeks and jawline have also been identified as areas showing significant improvement with HIFU, with studies reporting reductions in wrinkle scores and enhancements in skin laxity in these regions **(Suh et al., 2017)**. These areas are thought to respond well to HIFU due to the targeted heating of the dermis and the SMAS layer, leading to collagen contraction and subsequent tightening. Furthermore, some research has explored the potential benefits of combining HIFU with topical agents. Studies investigating such combination treatments have reported enhanced skin quality and brightness compared to the use of topical agents alone, suggesting a synergistic effect that could further improve aesthetic outcomes **(Yi et al., 2024)**.

Table 1: Efficacy of HIFU for Facial Skin Tightening

Study (Author, Year)	**Study Design**	**Sample Size**	**Treated Areas**	**Key Efficacy Outcomes**	**Follow-up Period**
Fabi et al., 2019	Prospective	50	Face	Improvement in skin laxity, wrinkle reduction	3 months
Lee et al., 2015	Retrospective	21	Face, Neck	Improvement in wrinkling and sagging	1-4 months
Ko et al., 2017	Prospective	32	Face, Body	Improved skin elasticity, clinical contouring	12 weeks
Alizadeh et al., 2017	Systematic Review	17 studies	Face, Neck	Moderate improvement in	Varies

				objective and subjective scores	
Suh et al., 2017	Prospective	20	Face	Significant improvement in wrinkle score	6 months
Jung et al., 2016	Split-face	30	Face	Significant difference in lifting effects and skin laxity improvement	90 days
Wanitphakdeedecha et al., 2016	Prospective	35	Upper Face	Average eyebrow height elevation	6 months
Oni et al., 2015	Prospective	32	Lower Face	Average reduction in submental area	3 months
Yi et al., 2024	Non-randomized Controlled Trial	20	Full Face	Significant reductions in fine wrinkles and hyperpigmentation, increased hydration	2 sessions
Ryu et al., 2022	Retrospective	12	Forehead, Temporal, Zygomatic	Significant increase in eyebrow peak angle and vertical elevation of supraorbital tissues	90 days

Efficacy of HIFU for Body Skin Tightening

The reviewed literature also provides evidence for the efficacy of HIFU in tightening skin on various body areas. Several studies have documented a reduction in circumference ranging from 2.5 cm to 4.5 cm in the abdomen and thighs following HIFU treatments **(Soliman et al., 2022)**. These findings suggest that HIFU can be an effective non-surgical option for body contouring and reducing localized fat deposits in these areas. Additionally, some studies have reported skin tightening effects in the upper arms after HIFU treatments **(Aşiran Serdar & Tukenmez Demirci, 2020)**. This indicates that HIFU's applications extend beyond facial rejuvenation to address skin laxity in other body regions as well.

Table 2: Efficacy of HIFU for Body Skin Tightening

Study (Author, Year)	**Study Design**	**Sample Size**	**Treated Areas**	**Key Efficacy Outcomes**	**Follow-up Period**

Ko et al., 2017	Prospective	32	Face, Body	Improved skin elasticity, clinical contouring	12 weeks
Soliman et al., 2022	Systematic Review	45 studies	Abdomen, Thighs	Reduction in circumference (2.5-4.5 cm)	Varies
Aşiran Serdar & Tukenmez Demirci, 2020	Prospective	Not specified	Upper Arms	Effective tightening	Not specified

Mechanism of Action of HIFU in Achieving Skin Tightening

The mechanism by which HIFU achieves skin tightening is well-established in the literature. The focused ultrasound energy delivered by HIFU devices creates thermal coagulation zones at specific depths within the skin, typically targeting the dermis and the SMAS layer **(Maloney & Hwang, 2015)**. This targeted heating leads to the denaturation of collagen fibers, causing an immediate contraction of the tissue **(Ko et al., 2017)**. Subsequently, the body initiates a natural wound healing process, which includes the production of new collagen (neocollagenesis) and the remodeling of elastin fibers **(Maloney & Hwang, 2015)**. The creation of multiple, small thermal injury zones (TIZ) of approximately 1 mm^3 in size at these predetermined depths plays a crucial role in stimulating this long-term collagen production **(Fabi et al., 2019)**. The prolonged effect of HIFU treatment can be attributed to this remodeling process, which can continue for more than one year, resulting in a gradual but sustained tightening and lifting effect **(Ko et al., 2017)**. HIFU's action involves both thermal effects, where the focused heat causes coagulation, and mechanical effects, including acoustic cavitation, which contributes to tissue disruption and the stimulation of cellular responses **(Poon et al., 2014)**.

Safety Profile of HIFU Treatments

The safety profile of HIFU treatments for skin tightening is generally considered favorable, with most reported adverse effects being mild and transient **(Maloney & Hwang, 2015)**. Common side effects include erythema (redness), swelling, mild discomfort, and pain experienced during the procedure **(Firooz et al., 2020)**. These effects typically resolve spontaneously within a few hours to days following the treatment. However, some rare but potentially significant complications have been reported, including fat atrophy, nerve irritation, hyperpigmentation, mandibular burns, striations, and contact dermatitis **(Kontosis et al., 2025)**. The occurrence of these less common adverse events is often associated with factors such as improper device settings, inadequate practitioner expertise, or insufficient patient assessment. Overall, studies suggest that significant transient effects are reported in fewer than 5% of patients, highlighting the relatively low risk associated with HIFU when administered correctly **(Firooz et al., 2020)**. Factors that can contribute to complications include insufficient contact between the device head and the skin, inadequate application of ultrasound gel, and the use of higher-than-recommended energy intensities **(Kontosis et al., 2025)**. Adherence to

established treatment protocols and proper training for practitioners are crucial for minimizing the risk of adverse events.

Table 3: Adverse Effects of HIFU for Skin Tightening

Study (Author, Year)	Study Design	Sample Size	Common Adverse Effects	Rare Adverse Effects
Alizadeh et al., 2017	Systematic Review	17 studies	Erythema, Edema, Pain	Hyperpigmentation
Fabi et al., 2015	Prospective	50	Mild erythema, swelling	None reported
Ko et al., 2017	Prospective	32	Mild pain	None reported
Lee et al., 2015	Retrospective	21	Erythema, Edema, Pain	Numbness
Suh et al., 2017	Prospective	20	Erythema, Swelling	Purpura, Bruising
Yi et al., 2024	Non-randomized Controlled Trial	20	Warming sensation, mild pain, mild redness	None reported
Kontosis et al., 2025	Review	22 studies	Erythema, Swelling, Discomfort	Fat atrophy, nerve irritation, hyperpigmentation, burns, striations, dermatitis
Hitchens et al., 2024	Systematic Review	19 articles	Edema, Erythema, Postprocedural pain	Subcutaneous atrophy, lipoatrophy, neurologic sequelae, scarring, facelift compromise

Patient Satisfaction

Patient satisfaction levels following HIFU treatments for skin tightening are generally reported to be high in the reviewed literature **(Suh et al., 2017)**. Studies have shown overall satisfaction rates exceeding 85% among participants who underwent HIFU for facial rejuvenation and skin tightening **(Choi et al., 2025)**. Patients have also reported satisfaction with specific outcomes such as improvements in facial contouring, with approximately 70% noting positive changes in this aspect **(Choi et al., 2025)**. Assessments of patient satisfaction in different facial areas, such as the jawline, cheeks, and peroral region, have also indicated positive responses, with patients often reporting noticeable improvements in these specific areas **(Suh et al., 2017)**. However, it is important to note that factors such as the degree of perceived improvement and individual expectations can influence overall patient satisfaction **(Park et al., 2019)**. Therefore, managing patient expectations through clear communication about the potential outcomes and limitations of HIFU treatment is essential for ensuring a positive patient experience.

Comparison of HIFU with Other Non-Surgical Skin Tightening Modalities

Some of the reviewed studies provided comparisons between HIFU and other non-surgical skin tightening modalities. For instance, one study comparing HIFU with Laser Assisted Liposuction (LAL) for neck tightening reported similar excellent improvements in skin laxity, with HIFU being considered a safer, more rapid, effective, and non-invasive procedure **(Kim et al., 2020)**. Another study that compared HIFU and radiofrequency (RF) for improving neck skin sagging found no significant difference in outcomes across short, medium, and long-term follow-up periods **(Firooz et al., 2020)**. These comparative findings suggest that HIFU is a competitive option within the landscape of non-surgical skin tightening treatments, often offering comparable efficacy with the added benefits of being non-invasive and associated with a favorable safety profile.

Discussion

The synthesis of findings from this systematic review indicates that High-Intensity Focused Ultrasound (HIFU) is a generally effective and safe non-surgical modality for skin tightening in various anatomical areas, including the face, neck, and body. The consistency of positive outcomes across different studies and treated regions suggests that HIFU is a reliable option for individuals seeking non-invasive aesthetic improvements. While variations in treatment protocols and outcome measures across studies contribute to some heterogeneity in the reported results, the overall trend supports the efficacy of HIFU in improving skin laxity and achieving a tightening effect. The reported adverse effects are predominantly mild and transient, further supporting the favorable safety profile of HIFU when administered by trained professionals. High levels of patient satisfaction indicate that the treatment is generally well-received and meets the expectations of many individuals seeking non-surgical skin rejuvenation.

The findings of this review align with and build upon previous research that established the foundational principles and initial applications of HIFU in aesthetic medicine. The period between 2015 and 2025 has witnessed advancements in HIFU technology, such as the development of parallel-beam ultrasound, which has improved treatment precision and patient comfort **(Maloney & Hwang, 2015)**. The increasing number of clinical studies published during this period further solidifies the evidence base supporting the use of HIFU for skin tightening. These recent studies have provided more detailed insights into optimal treatment parameters for different facial and body areas and have also explored the potential for combination therapies to enhance outcomes.

Despite the promising findings, several gaps in the current knowledge warrant further investigation. One significant limitation is the lack of standardized treatment protocols regarding optimal energy settings, the number of treatment passes required, and specific patient selection criteria **(Firooz et al., 2020)**. This variability makes it challenging to directly compare results across different studies and to establish universal guidelines for clinical practice. Furthermore, there is a need for more research on the long-term efficacy and durability of HIFU treatment effects beyond one year **(Soliman et al., 2022)**. While short-term and medium-term

benefits have been documented, the sustainability of these results over an extended period requires further evaluation. Another area needing more attention is the application of HIFU in diverse skin types and ethnicities **(Cieślik et al., 2021)**. The majority of existing studies have been conducted on Caucasian and Asian populations, and more research is needed to understand the efficacy and safety of HIFU in individuals with different skin characteristics. The variability in outcome measures and scoring systems used across studies also poses a challenge for synthesizing the evidence and drawing definitive conclusions **(Firooz et al., 2020)**. Finally, more well-designed comparative studies directly comparing HIFU with other non-surgical and surgical skin tightening modalities would be valuable in establishing the relative benefits and drawbacks of each approach **(Soliman et al., 2022)**.

The clinical implications of this review are significant for practitioners considering HIFU for non-surgical skin tightening. The evidence suggests that HIFU is a viable option for patients seeking non-invasive aesthetic improvements with minimal downtime. However, careful patient selection, based on factors such as the degree of skin laxity and individual expectations, is crucial for achieving optimal outcomes and maximizing patient satisfaction. Proper training and a thorough understanding of HIFU technology and safety guidelines are essential for practitioners to ensure safe and effective treatment administration. While HIFU offers a promising non-surgical alternative to surgical lifting procedures for mild to moderate skin laxity, it is important for clinicians to manage patient expectations regarding the extent and longevity of the results.

Future research should focus on addressing the identified gaps in knowledge to further optimize the use of HIFU for skin tightening. Large-scale, randomized controlled trials employing standardized treatment protocols and outcome measures are needed to provide more definitive evidence on the efficacy and safety of HIFU. Longitudinal studies with follow-up periods extending beyond one year would be valuable in evaluating the long-term durability of treatment effects. Research investigating the effectiveness and safety of HIFU in diverse ethnic populations and skin types is also essential to broaden its applicability. The development and validation of objective outcome measures for skin tightening would help to reduce reliance on subjective assessments and facilitate more robust comparisons across studies. Additionally, well-designed comparative studies directly comparing different HIFU devices and treatment protocols, as well as comparing HIFU to other skin tightening modalities, would provide valuable insights for clinicians in selecting the most appropriate treatment for individual patients. Finally, exploring the potential for combining HIFU with other energy-based devices or injectables could lead to the development of synergistic treatment approaches that further enhance aesthetic outcomes.

Conclusion

In conclusion, the current evidence base, as synthesized in this systematic review, supports the use of High-Intensity Focused Ultrasound (HIFU) as an effective and generally safe non-surgical treatment for skin tightening in various anatomical areas. HIFU offers the advantages of being non-invasive, requiring minimal downtime, and targeting deep tissue layers to

stimulate collagen production and elastin remodeling. While patient satisfaction levels are generally high, indicating a positive perception of the treatment benefits, there are still gaps in our understanding, particularly regarding long-term efficacy, the need for standardized treatment protocols, and optimal application across diverse populations. Addressing these gaps through future research will be crucial for further refining the clinical use of HIFU and maximizing patient outcomes in the field of non-surgical aesthetic medicine.

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