

# Practical Guidance for Optimizing Patient Comfort During Microfocused Ultrasound with Visualization and Improving Patient Satisfaction

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## Abstract

### Background

Microfocused ultrasound with visualization (MFU-V; Ultherapy<sup>®</sup>) is an effective method for correction of skin laxity through lifting and tightening skin on the face, neck, and décolleté as well as on other parts of the body such as the knees, arms, and abdomen. In addition to being a noninvasive modality for tissue tightening, MFU-V has a biological effect on tissue, rejuvenating the skin through stimulation of elastogenesis and neocollagenesis. MFU-V is also commonly combined with other interventions such as fillers, neuromodulators, and absorbable suspension sutures.

### Objectives

The aim of this study was to share the extensive experience of the authors in optimizing comfort for their MFU-V patients in order to provide guidance to the broader community surrounding optimal patient comfort with this procedure.

### Methods

The authors discuss their approaches to patient comfort and satisfaction. Elements of each approach include patient selection, pharmacologic and nonpharmacologic comfort measures, and how

prioritization of patient comfort affects both their individual patients and practices.

## Results

The authors share their approaches for optimizing patient comfort during the procedure and provide an overview of both pharmacologic and nonpharmacologic measures that can be adopted to support patient comfort and satisfaction. The similarities and differences of each approach are discussed.

## Conclusions

In addition to diligent patient selection, the authors find that attention to patient comfort is directly related to satisfaction and appears to be a primary factor in patients' decisions to return for additional treatments.

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**Topic:** [client satisfaction](#), [neck](#), [ultrasonography](#), [knee region](#), [lifting](#), [pharmacology](#), [skin](#), [comfort measures](#), [patient comfort](#)

**Subject:** [Cosmetic Medicine](#)

**Issue Section:** [Original Articles](#)

Microfocused ultrasound (MFU) is unique among noninvasive skin-tightening procedures in that it allows for precise heating of mid to deep layers of subcutaneous tissues without disrupting the papillary dermis and epidermis.<sup>1</sup> MFU heats tissues in the deep dermis and fibromuscular layers, including the superficial muscular aponeurotic system (SMAS) of the face and the superficial fibroseptal network of the body, to 60°C to 70°C, the optimal temperature for collagen denaturation, while surface temperatures remain between 45°C and 47°C ([Figure 1](#)).<sup>2-4</sup> Upon heating, denatured collagen fibrils contract, which causes the skin to tighten and initiates the wound-healing response. The resulting neocollagenesis and elastogenesis<sup>5</sup> further tighten the skin

and improve the appearance of deep wrinkles.<sup>6</sup> Together, these outcomes result in skin that is both tighter and more elastic, and thus better able to recoil onto underlying structures. These biological changes give rise to skin that behaves in a more youthful way.

**Figure 1.**

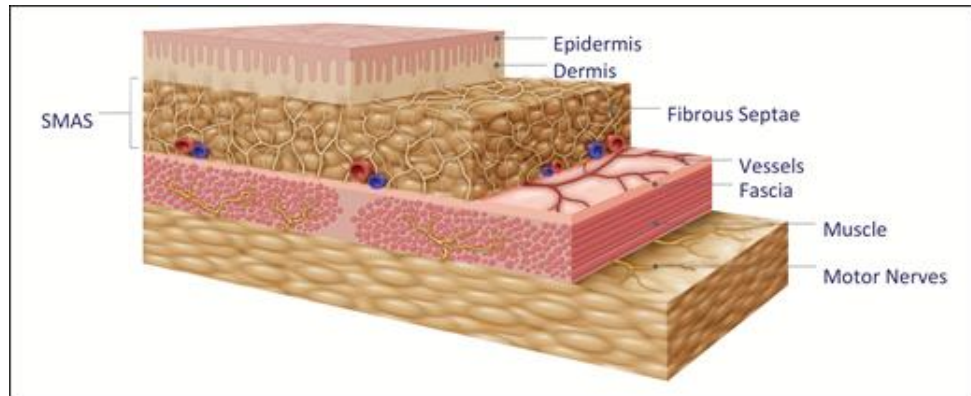
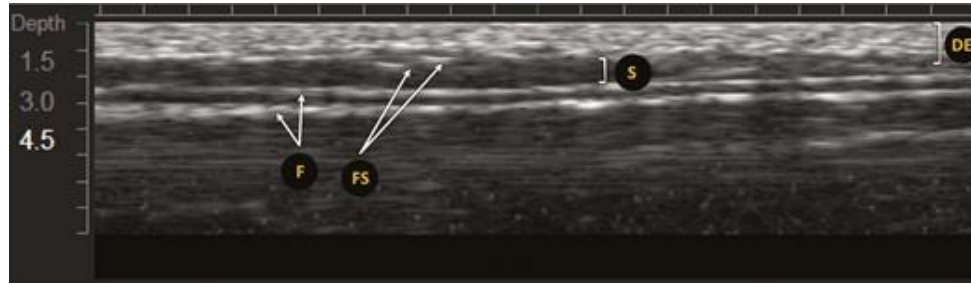


Diagram showing layers of the skin. The deep dermis and superficial musculoaponeurotic system (SMAS) are tissues targeted by MFU. (Used with permission from Merz North America.)

The MFU-V system (Ulthera<sup>®</sup> System, Merz North America, Raleigh, NC) incorporates an ultrasound imaging transducer, allowing for visualization of the treated area to a depth of 8 mm. The transducer ensures proper coupling of the device to the skin and confirms that treatment is being carried out at the appropriate depth. This type of visualization allows for precise targeting of treatment to specific depths (Figure 2), minimizing inadvertent targeting of tissues such as bone, and thus minimizing unnecessary pain. The MFU-V system is indicated for use as a noninvasive dermatologic aesthetic treatment to lift the eyebrows, lift lax submental and neck tissue, and improve lines and wrinkles of the décolleté.<sup>1</sup> In addition to these uses, common off-label applications include treatment of the arms, thighs, knees, buttocks, and abdomen.<sup>7</sup>

**Figure 2.**



Ultrasound image obtained with the MFU-V transducer. The dermis and epidermis (DE), fascia (F), fibrous septae (FS), and subcutaneous adipose (SA) are shown. The deep dermis and superficial musculoaponeurotic system (SMAS) are the tissues targeted by MFU. (Used with permission from Merz North America.)

## METHODS

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In the experience of the authors, who have collectively treated more than 5000 patients over the course of 7.5 years, both in clinical practice and in clinical studies, patient satisfaction with any MFU-V procedure is strongly tied to appropriate patient selection and expectation management, as well as to the care taken to optimize patient comfort during the procedure itself. In a retrospective study conducted in one of the authors' practices (S.F.) on treatment of the face and neck with a low-density line treatment, 81% and 84% of patients noted an improvement in the appearance of their face and neck at both 90 and 180 days after treatment, respectively.<sup>8</sup> At 90 days, 62% of patients were at least satisfied with the treatment (25% were very satisfied), and at 180 days, 60% were at least satisfied (11% were very satisfied). A thorough review of the literature that details efficacy outcomes is also available.<sup>9</sup> Here, the authors collaborate and discuss their approaches to optimizing patient comfort and satisfaction. Included within their respective approaches are practical guidance for patient selection and setting expectations, as well as multiple research-based pharmacologic and nonpharmacologic approaches that may be used to maximize patient comfort. The authors report that in their own practices between 50%

and 60% of MFU-V patients are returning patients, an indication that prioritizing patient comfort and satisfaction is critical for patient retention. Further underscoring the importance of comfort is the widespread concern voiced by patients surrounding procedure discomfort: patient queries and reviews on Realself.com frequently mention pain, and many mainstream articles and YouTube videos emphasize this aspect of the procedure. The authors' patients were treated in accordance with the International Conference on Harmonization (ICH) guidance for Good Clinical Practice. All patients who have participated in clinical studies were treated in accordance with the Declaration of Helsinki.

## RESULTS

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### Patient Selection and Expectations

A positive outcome for any procedure begins with patient selection. The features of the ideal candidate for MFU-V treatment are shown in [Table 1](#), along with contraindications for treatment. The patient must have good tissue elasticity and sufficient volume, such that tightening the skin does not reveal volume deficits. MFU-V is best suited to patients with mild to moderate fine lines and wrinkles and should not be used in patients with severe static rhytids. Patients who take anti-inflammatory or immunosuppressive medications may not be well suited to treatment with MFU-V. The technique is particularly useful in younger patients (in their 20s and 30s) for prevention and maintenance,<sup>10</sup> in more mature patients who wish to tighten and restore elasticity to their skin, and in patients who have already had a facelift and wish to maintain results. The primary tool for ensuring that the results achievable with MFU-V are in line with patient aesthetic goals is patient review of before and after images ([Figure 3](#)). If the patient is unimpressed by the nature of the results, he/she is most likely a surgical candidate. An important part of patient selection is ensuring the patient is not seeking a

surgical equivalent. Further, the patient must be accepting of the need for ongoing maintenance. In addition, although some anatomic areas may be treated in isolation, the lower face and neck should be treated as a single unit to improve the appearance of the jawline. Because the platysma muscle extends over the anterior portion of the mandible, where it connects to the SMAS layer that extends into the midface, optimal treatment requires that both areas be treated concomitantly.

**Table 1.** Features of the Ideal Patient Indicators/Contraindicators for MFU-V Treatment

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<b>Features of the ideal patient</b>
• Good tissue elasticity
• Good midface volume
• Mild to moderate to minimal fine lines and wrinkles
• Realistic expectations
• Wants minimal downtime lift and is willing to have maintenance
• Efficacy is skin color independent
<b>Features of the nonideal patient</b>
• Patient is seeking surgical equivalence
• Very thin patients
• Patients with severe static rhytids
• The patient has active or metallic implant or breast implants in the treatment area
• Breast implants are not a contraindication; however, care must be taken to avoid administering MFU into the implant

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**Figure 3.**



A 42-year-old woman shown at (A) baseline and at (B) 6 months postprocedure.

Patient expectations are often rooted in understanding of the treatment modality itself. For patients to appreciate the value of MFU-V, it is important to convey that, in contrast to a surgical facelift, where the outcome is the redraping of tissue, ultrasound biologically changes tissue to slow the aging process by stimulating collagen and elastin production, thereby restoring the tissue itself. An important aspect of this educational process is establishing trust by providing clear and complete information about the procedure itself and the nature of the discomfort to be expected. Patient anxiety and discomfort during the procedure are directly influenced by the accuracy of the information obtained: inadequate information on discomfort is associated with patients reporting excess pain during the procedure.<sup>11</sup> Taking the time to educate patients about what to expect, both in terms of outcome and the procedure itself, is of paramount importance.

In addition to patient education, patient photographs before the procedure and at follow-up visits must be obtained. Patient perceptions of change, in particular gradual change, may be limited by ongoing patient drift in self-perception

and adjustment to their “new baseline.”<sup>12</sup>

## Combination Therapy

It is unrealistic to expect that a single modality can adequately address the presenting concerns of all patients. Optimal patient comfort lends itself to combination therapy, and MFU-V can serve as a platform for synergistic treatments such as fillers, neuromodulators, absorbable suspension sutures, and lasers. Tightening the skin with MFU-V to strengthen the envelope into which fillers will be placed optimizes the efficacy of hyaluronic acid (HA) and calcium hydroxylapatite (CaHA) fillers.<sup>13,14</sup> In addition, neuromodulators may also be safely combined with MFU-V.<sup>13,15,16</sup> Although fillers injected to depths of between 1.5 and 4.5 mm are at risk of adverse effects from MFU-V, combination treatment is not only an emerging approach, but one supported by research.<sup>13,14,16</sup> This combination approach involves the MFU-V treatment being carried out first, followed by the filler injection. This order makes sense not just from a safety standpoint, but also because of the nature of the effect of each procedure. MFU-V can provide a foundation upon which fillers can have the best effect. Finally, there is some evidence that in addition to being a safe agent for use in combination therapy with MFU-V, poly-L-lactic acid (PLLA) and/or CaHA have a synergistic effect with MFU-V through their ability to further provide volume restoration and promote neocollagenesis.<sup>17</sup>

Given that MFU-V may improve the functionality of other treatments, a layering approach has emerged as promising way to maximize results while reducing overall downtime and the number of office visits.<sup>10</sup> Any additional treatment should be discussed prior to sedation.

## Optimizing Patient Comfort

Of utmost significance is the training of the administering physician. The measures described below are important to



optimize comfort in the context of a correctly performed procedure. It is critical that proper training be sought, as there are elements of care that are needed to maintain both patient comfort and safety. For example, application of excess ultrasound gel or inadvertent pulse stacking (repeatedly treating the same area) can lead to burns.

## Pretreatment Planning

It is important to ensure that patients are adequately premedicated and that the prescribed regimen is sufficient for the duration of the procedure. Prevention of discomfort at the outset of treatment rather than addressing it as it arises is critical: once pain is perceived, anticipation and anxiety heighten the perceived intensity of subsequent identical events.<sup>18</sup> Although patient comfort measures vary, as shown in [Table 2](#) and described here,<sup>19-26</sup> an important element of each approach for reducing discomfort is prevention.

**Table 2.** Representative Summary of Patient Comfort Measures Reported in the Literature

Study	Areas treated	Comfort measures	Discomfort reported
Fabi et al, 2015 <sup>20</sup>	Décolleté	Oral diazepam (2.5-10 mg), ibuprofen (400-1200 mg), or acetaminophen (400-1000 mg) administered 30-60 minutes before treatment	Mean pain score: 4.8-4.9 on a validated 11-point (0-10) numeric rating scale
Gold et al, 2014 <sup>21</sup>	Knee	60% of subjects received pretreatment medications of hydrocodone/acetaminophen (7.5/500 mg or 7.5 mg/750 mg), hydrocodone (7.5 mg or 10 mg) plus 5 mg diazepam or 2 mg lorazepam	Mean pain score: <ul style="list-style-type: none"> <li>• 5.0 for the 3-MHz/4.5-mm transducer</li> <li>• 6.0 for the 3-MHz/3-mm transducer</li> </ul> on a validated 11-point (0-10) numeric rating scale

Goldberg and Hornfeldt, 2014 <sup>22</sup>	Buttocks	Pretreatment medications given “at the discretion of the physician and subject.” No specific regimen provided	Mean pain score: <ul style="list-style-type: none"> <li>• 6.6 for the MHz/4.5-m transducer</li> <li>• 6.9 for the MHz/3.0-m transducer</li> </ul> a validated point (0–100) numeric rating scale
Lee et al, 2012 <sup>23</sup>	Lower face and neck	None provided by the authors	Mean pain score 3.9 on analog visual pain scale 10
Oni et al, 2014 <sup>24</sup>	Lower face	Oral medications (5–10 mg diazepam and 5 mg/325 mg hydrocodone/acetaminophen) were administered at least 30 minutes before treatment. Intramuscular ketorolac tromethamine (60 mg) was given 60 min prior to treatment	Mean pain score was 6.09 for the submental region, and 6.53 in the submandibular region on a 11-point pain scale
Rokhsar et al, 2015 <sup>25</sup>	Elbow	Oral ibuprofen (400 mg, n = 1; 800 mg, n = 18) with or without lorazepam (2 mg, n = 12)	Mean pain score: <ul style="list-style-type: none"> <li>• 5.7 with 4 MHz/4.5-m transducer</li> <li>• 5.0 with 7 MHz/3.0-m transducer</li> </ul> a validated point (0–100) numeric rating scale
Sasaki and Tevez, 2012 <sup>26</sup>	Brow and periorbital areas (among others)	Topical analgesic gels 1 hour prior to treatment, nonsteroidal anti-inflammatory drugs, and pain and sedative medications, distraction with hand/foot	Mean pain score: 5.7 for brow and periorbital areas on a 10-point heat

massage, reducing skin  
temperatures

pain  
perception  
scale

Appropriate clinical management of discomfort begins with determining the duration of the procedure. Treatment time is dictated by the surface area to be treated. Based on the treatment recommendation of 800 lines for the full face and upper neck, and the stated time for the procedure of 1 hour, each line can be expected to take approximately 3 seconds, plus 1.5 seconds to advance the transducer. Thus, based on these guidelines, approximate treatment times can be easily calculated from the following equation:<sup>27</sup> number of lines × 4.5 seconds/line = approximate treatment time.

This calculation is in agreement with the experience of the authors; however, procedure duration is also shaped by patient comfort. If the patient is uncomfortable, the session will take longer. The software that accompanies the MFU-V device includes treatment-planning maps that can be utilized for calculating the number of lines (see [Figure 4](#) and [Supplemental Figure 1](#), available online at [www.aestheticsurgeryjournal.com](http://www.aestheticsurgeryjournal.com)).

**Figure 4.**



MFU-V device in use for treatment of the face. Note the treatment marking lines, ultrasound image, and treatment plan image, and the size of the device. (Image courtesy of Shay Moinuddin, MHA, CANS, RN.)

# Optimizing Patient Comfort

The connection between pain perception and environmental and emotional stimuli is well established.<sup>28</sup> In the experience of the authors, minor procedural adjustments can help to optimize comfort and dramatically improve the patient's experience. Although these methods are outlined here for MFU-V, they may be applied more broadly to procedures in which the patient may experience discomfort.

## Nonpharmacologic Measures

- In addition to explaining the technical aspects of the procedure ahead of time, it is important that patients be assured of their privacy. Giving patients a sense of how many people will be in the room at a given time and their role in the procedure can reduce general anxiety, further improve patient confidence, and diminish any potential for the startle response to minor unpredictable events that can exacerbate patient discomfort (eg, unexpected opening of the treatment room door).<sup>29-31</sup>
- One of the authors (J.F.) reclines patients at 30°. If a person is lying flat, increased vascular stasis to the head and neck may cause heat sinking and increased perception of pain. This simple adjustment can make a significant difference for some patients. Regardless of the patient's position, it is critically important that appropriate contact with the transducer is maintained.
- Environmental changes such as dimming the lights to create a relaxing ambiance can minimize anxiety and tension, a contributor to heightened perceptions of pain.<sup>32</sup> Furthermore, reducing ocular stimulation reduces activity in the neuronal networks within the areas of the brain dedicated to visual perception and processing. This diminished alertness may permit patients to release the physical tension that may heighten perceptions of pain.

- The Ulthera MFU-V system comes with a vibrating device that can be placed adjacent to the site being treated, preferably on bone. These vibrations gate pain perception by balancing the sensory input of small and large nerve fibers,<sup>33</sup> lessening the perception of high-intensity stimuli (eg, pain) by the brain.<sup>34</sup>
- Patients should be encouraged to bring music to listen to during the procedure, as distractions and positive emotions can gate pain processing.<sup>18</sup> Further, music has been shown to be a powerful modulator of stress and tension.<sup>35,36</sup>
- The clinician can reduce the volume on the MFU-V device. Anticipation of negative stimuli can be heightened by the beeping of the device, thus intensifying perceptions of pain.<sup>28</sup>

## **Pharmacologic Measures**

In this section, each of the authors will share his/her approach to optimizing patient comfort. Additional practices gleaned from the literature are presented in [Table 2](#). Although approaches may vary, the goal of patient comfort is universally recognized as central to achieving high satisfaction. Further, initiation of comfort measures before the start of the procedure is critical, because initial experiences of discomfort strongly affect the overall experience.<sup>18</sup>

## **A Dermatologic Surgeon's Approach**

An emerging modality for optimal patient comfort during MFU-V treatment is delivery of a mixture containing 50% oxygen and 50% nitrous oxide (Pro-Nox, CAREstream Medical Ltd, Surrey, Canada).<sup>37</sup> The patient can modulate inhalation through a flexible tube placed in the mouth, and hence comfort is self-regulated as well as being tailored to individual needs throughout the procedure. The mouthpiece

may easily be moved out of the way if its placement clashes with the device, or if it proves bothersome to the patient. This method is well suited for both short and long procedure times: the authors have used it for treatments lasting up to 5 hours. The half-life of nitrous oxide is 5 minutes, and patients are lucid after 30 minutes without drowsiness. One of the authors (S.G.F.) takes precautionary measures and still requires patients to have a driver after administration of this gas. Patients appreciate the option to avoid narcotics and the ability to return to daily activities soon after the procedure. Within one author's (S.G.F.) practice, this modality is eclipsing other methods. Although the authors have used 50% oxygen and 50% nitrous oxide for a wide range of patients without issue, this ratio may not be ideal for highly sensitive patients or patients being treated at high altitude. Regardless of the pharmacologic intervention, 1 hour prior to the procedure, topical 23% lidocaine/7% tetracaine alone is applied both to minimize discomfort from ultrasound waves and to alter the perception of pain.

## Video



[Video/Audio] available online

Watch now at <https://academic.oup.com/asj/article-lookup/doi/10.1093/asj/sjz079>

Prior to adoption of the 50% oxygen/50% nitrous oxide mixture, approximately 80% of patients received 5 mg to 10 mg oral diazepam 30 minutes prior to the procedure start

time along with an intramuscular injection of 50 mg to 100 mg meperidine and 50 mg promethazine. Approximately 10% of patients elected to take 5 mg to 10 mg oral diazepam and oral oxycodone/acetaminophen 30 minutes before treatment. The remaining patients elected to take 800 mg ibuprofen or received 60 mg of intramuscular ketorolac. Treatment selection is not guided by the area being addressed, but rather by the individual patient's need for comfort management.

## **A Plastic Surgeon's Approach**

Patients are premedicated with 800 mg ibuprofen, 5 mg to 10 mg oral diazepam, and 25 mg to 50 mg diphenhydramine 30 minutes prior to the procedure start time. Diphenhydramine has synergistic effects; it can reduce the flush response and increase patient sedation.<sup>38</sup> For most patients, this combination is sufficient for optimal comfort.

In addition to the above measures, the author (JF) recommends a low threshold for administration of a low-volume regional lidocaine block. In the treatment of the face and neck, approximately 50% of patients require 6 mL to 8 mL of 1% lidocaine with epinephrine injected into the subdermis. Injection into the more superficial dermis can create a heat sink, resulting in a burn. Lidocaine with epinephrine has the added benefit of reducing bruising.<sup>19</sup> A video highlighting the regional block technique can be found online at [www.aestheticsurgeryjournal.com](http://www.aestheticsurgeryjournal.com) (Video).

## **Postprocedure Care**

In the authors' experience, there have been no issues with hematoma, bleeding, or clinically significant accumulation of blood around the tissues. Patients are monitored for 30 minutes following the procedure and instructed not to ice the area. Ideally, follow-up at 3 months is scheduled to capture the onset of treatment results. Standardized photography at baseline and each visit is critically important for expectation

management.

## DISCUSSION

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In the context of MFU-V, patient satisfaction is most directly influenced by proper patient selection, adequate patient education, and effective measures for optimizing patient comfort. Both nonpharmacologic adjustments to the procedure and pharmacologic interventions can be used to minimize discomfort, and satisfaction is further supported by diligent capture of baseline and posttreatment images. MFU-V is the only Food and Drug Administration–cleared, nonsurgical lifting modality for addressing the brows, lax submental and neck tissue, and lines and wrinkles of the décolleté. Its clinical use has expanded into other anatomic areas, including the knees, abdomen, buttock, and arms. As the surface area that may be treated increases, and the utility of MFU-V as a treatment that can be stacked with other modalities is further explored, it is of particular importance that patient comfort be well managed. By providing an overview of individual practices, the authors provide viable strategies for optimizing comfort that can be adapted to any practice. Especially as patient access to this treatment grows, an improved experience will be a powerful differentiator between providers. Importantly, the comfort measures described here are rooted in the scientific study of pain perception. Many of these principals, for example gate theory or the importance of patient education, can be applied to other, non-MFU-V procedures that may cause patients some discomfort.

Although this manuscript provides guidance based in extensive experience, there is much more to be learned about the relation between different comfort management approaches and patient satisfaction scores. Future studies could further explore different pain management approaches, elucidating the average reduction in pain score for each constellation of comfort measures. In addition,



future studies on the nature of the relation between pain scores during the procedure and patient satisfaction at different time points postprocedure may also inform future practice.

## **CONCLUSIONS**

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Despite the attention paid to the discomfort inherent in the MFU-V procedure, proper prioritization and management of patient comfort can optimize the experience for the patient, and in many cases can lead to patients returning for additional treatments. By prioritizing comfort, the utility of MFU-V can be fully realized, especially in the context of layering treatments, leading to greater overall patient satisfaction and retention.

## **Disclosures**

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Dr Fabi is a consultant and a consultant and/or investigator for Allergan, Galderma, Merz Pharmaceuticals, Valeant, and Thermi Aesthetics. Dr Few is a consultant and investigator for Sinclair Pharma and a consultant and investigator for Allergan, Galderma, Merz, Venus Concepts, and Zeltiq. Ms Moinuddin declared no potential conflicts of interest with respect to the research, authorship, and publication of this article.

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## REFERENCES

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1. *Ulthera [instructions for use]*. Mesa, AZ: Ulthera, Inc; 2018.  
[Google Scholar](#)   [Google Preview](#)   [WorldCat](#)   [COPAC](#)
2. Bozec L, Odlyha M. Thermal denaturation studies of collagen by microthermal analysis and atomic force microscopy. *Biophys J*. 2011;101(1):228-236.  
[Google Scholar](#)   [Crossref](#)   [PubMed](#)   [WorldCat](#)
3. Dubinsky TJ, Cuevas C, Dighe MK, Kolokythas O, Hwang JH. High-intensity focused ultrasound: current potential and oncologic applications. *AJR Am J Roentgenol*. 2008;190(1):191-199.  
[Google Scholar](#)   [Crossref](#)   [PubMed](#)   [WorldCat](#)
4. Fabi SG. Noninvasive skin tightening: focus on new ultrasound techniques. *Clin Cosmet Investig Dermatol*. 2015;8:47-52.  
[Google Scholar](#)   [Crossref](#)   [PubMed](#)   [WorldCat](#)
5. Yokoyama Y, Akita H, Hasegawa S, Negishi K, Akamatsu H, Matsunaga K. Histologic study of collagen and stem cells after radiofrequency treatment for aging skin. *Dermatol Surg*. 2014;40(4):390-397.  
[Google Scholar](#)   [Crossref](#)   [PubMed](#)   [WorldCat](#)
6. Duncan DI, Kreindel M. Basic radiofrequency: physics and safety and application to aesthetic medicine. In: Lapidoth M, Halachmi S, eds. *Radiofrequency in Cosmetic Dermatology*, Vol. 2. Basel, Switzerland: Karger; 2015:1-22.  
[Google Scholar](#)   [Crossref](#)   [Google Preview](#)   [WorldCat](#)  
[COPAC](#)
7. Alster TS, Tanzi EL. Noninvasive lifting of arm, thigh, and knee skin

with transcutaneous intense focused ultrasound. *Dermatol Surg.* 2012;38(5):754-759.

[Google Scholar](#)   [Crossref](#)   [PubMed](#)   [WorldCat](#)

8. Fabi SG, Goldman MP. Retrospective evaluation of micro-focused ultrasound for lifting and tightening the face and neck. *Dermatol Surg.* 2014;40(5):569-575.

[Google Scholar](#)   [Crossref](#)   [PubMed](#)   [WorldCat](#)

9. Fabi SG. Microfocused ultrasound with visualization for skin tightening and lifting: my experience and a review of the literature. *Dermatol Surg.* 2014;40(Suppl 12):S164-S167.

[Google Scholar](#)   [Crossref](#)   [PubMed](#)   [WorldCat](#)

10. Few JW. *The Art of Combining Surgical and Nonsurgical Techniques in Aesthetic Medicine*. New York, NY: Thieme Medical Publishers, Inc; 2018.

[Google Scholar](#)   [Crossref](#)   [Google Preview](#)  
[WorldCat](#)   [COPAC](#)

11. Degen C, Christen S, Rovo A, Gratwohl A. Bone marrow examination: a prospective survey on factors associated with pain. *Ann Hematol.* 2010;89(6):619-624.

[Google Scholar](#)   [Crossref](#)   [PubMed](#)   [WorldCat](#)

12. Fabi SG, Sola C. Perception Shift. *Prime: International J of Aesthetic and Anti-Ageing Medicine.* 2018;8(1):4.

[Google Scholar](#)   [WorldCat](#)

13. Fabi SG, Goldman MP, Mills DC, et al. Combining microfocused ultrasound with botulinum toxin and temporary and semi-permanent dermal fillers: safety and current use. *Dermatol Surg.* 2016;42(Suppl 2):S168-S176.

[Google Scholar](#)   [Crossref](#)   [PubMed](#)   [WorldCat](#)

14. Casabona G, Nogueira Teixeira D. Microfocused ultrasound in combination with diluted calcium hydroxylapatite for improving skin laxity and the appearance of lines in the neck and décolletage. *J Cosmet Dermatol.* 2018;17(1):66-72.

[Google Scholar](#)   [Crossref](#)   [PubMed](#)   [WorldCat](#)

15. Carruthers J, Burgess C, Day D, et al. Consensus recommendations for combined aesthetic interventions in the face using botulinum toxin, fillers, and energy-based devices. *Dermatol Surg*. 2016;42(5):586-597.  
[Google Scholar](#)   [Crossref](#)   [PubMed](#)   [WorldCat](#)
16. Casabona G, Michalany N. Microfocused ultrasound with visualization and fillers for increased neocollagenesis: clinical and histological evaluation. *Dermatol Surg*. 2014;40(Suppl 12):S194-S198.  
[Google Scholar](#)   [Crossref](#)   [PubMed](#)   [WorldCat](#)
17. Hart DR, Fabi SG, White WM, Fitzgerald R, Goldman MP. Current concepts in the use of PLLA: clinical synergy noted with combined use of microfocused ultrasound and poly-L-lactic acid on the face, neck, and décolletage. *Plast Reconstr Surg*. 2015;136(5 Suppl):180S-187S.  
[Google Scholar](#)   [Crossref](#)   [PubMed](#)   [WorldCat](#)
18. Tracey I, Mantyh PW. The cerebral signature for pain perception and its modulation. *Neuron*. 2007;55(3):377-391.  
[Google Scholar](#)   [Crossref](#)   [PubMed](#)   [WorldCat](#)
19. Funt D, Pavicic T. Dermal fillers in aesthetics: an overview of adverse events and treatment approaches. *Clin Cosmet Investig Dermatol*. 2013;6:295-316.  
[Google Scholar](#)   [PubMed](#)   [WorldCat](#)
20. Fabi SG, Goldman MP, Dayan SH, Gold MH, Kilmer SL, Hornfeldt CS. A prospective multicenter pilot study of the safety and efficacy of microfocused ultrasound with visualization for improving lines and wrinkles of the décolleté. *Dermatol Surg*. 2015;41(3):327-335.  
[Google Scholar](#)   [Crossref](#)   [PubMed](#)   [WorldCat](#)
21. Gold MH, Sensing W, Biron J. Use of micro-focused ultrasound with visualization to lift and tighten lax knee skin (1.). *J Cosmet Laser Ther*. 2014;16(5):225-229.  
[Google Scholar](#)   [Crossref](#)   [PubMed](#)   [WorldCat](#)
22. Goldberg DJ, Hornfeldt CS. Safety and efficacy of microfocused ultrasound to lift, tighten, and smooth the buttocks. *Dermatol Surg*.

2014;40(10):1113-1117.

[Google Scholar](#)   [Crossref](#)   [PubMed](#)   [WorldCat](#)

23. Lee HS, Jang WS, Cha YJ, et al. Multiple pass ultrasound tightening of skin laxity of the lower face and neck. *Dermatol Surg.* 2012;38(1):20-27.

[Google Scholar](#)   [Crossref](#)   [PubMed](#)   [WorldCat](#)

24. Oni G, Hoxworth R, Teotia S, Brown S, Kenkel JM. Evaluation of a microfocused ultrasound system for improving skin laxity and tightening in the lower face. *Aesthet Surg J.* 2014;34(7):1099-1110.

[Google Scholar](#)   [Crossref](#)   [PubMed](#)   [WorldCat](#)

25. Rokhsar C, Schnebelen W, West A, Hornfeldt C. Safety and efficacy of microfocused ultrasound in tightening of lax elbow skin. *Dermatol Surg.* 2015;41(7):821-826.

[Google Scholar](#)   [Crossref](#)   [PubMed](#)   [WorldCat](#)

26. Sasaki GH, Tevez A. Microfocused ultrasound for nonablative skin and subdermal tightening to the periorbitum and body sites: preliminary report on eighty-two patients. *J Cosmet Dermatol Sci Appl.* 2012;2:108-116.

[Google Scholar](#)   [WorldCat](#)

27. Ulthera. *Ulthera Treatment Guideline (5.0 PLUS)*. Mesa, AZ: Ulthera, Inc.

[Google Scholar](#)   [Google Preview](#)   [WorldCat](#)   [COPAC](#)

28. Reicherts P, Wiemer J, Gerdes ABM, Schulz SM, Pauli P, Wieser MJ. Anxious anticipation and pain: the influence of instructed vs conditioned threat on pain. *Soc Cogn Affect Neurosci.* 2017;12(4):544-554.

[Google Scholar](#)   [Crossref](#)   [PubMed](#)   [WorldCat](#)

29. Hubbard CS, Ornitz E, Gaspar JX, et al. Modulation of nociceptive and acoustic startle responses to an unpredictable threat in men and women. *Pain.* 2011;152(7):1632-1640.

[Google Scholar](#)   [Crossref](#)   [PubMed](#)   [WorldCat](#)

30. Rhudy JL, Meagher MW. The role of emotion in pain modulation. *Curr Opin Psychiatry.* 2001;14(3):241-245.

31. Hjortholm N, Jaddini E, Hałaburda K, Snarski E. Strategies of pain reduction during the bone marrow biopsy. *Ann Hematol*. 2013;92(2):145-149.  
[Google Scholar](#)   [Crossref](#)   [PubMed](#)   [WorldCat](#)
32. Ploghaus A, Narain C, Beckmann CF, et al. Exacerbation of pain by anxiety is associated with activity in a hippocampal network. *J Neurosci*. 2001;21(24): 9896-9903.  
[Google Scholar](#)   [Crossref](#)   [PubMed](#)   [WorldCat](#)
33. Melzack R, Wall PD. Pain mechanisms: a new theory. *Science*. 1965;150(3699):971-979.  
[Google Scholar](#)   [Crossref](#)   [PubMed](#)   [WorldCat](#)
34. Mendell LM. Constructing and deconstructing the gate theory of pain. *Pain*. 2014;155(2):210-216.  
[Google Scholar](#)   [Crossref](#)   [PubMed](#)   [WorldCat](#)
35. Choi S, Park SG, Lee HH. The analgesic effect of music on cold pressor pain responses: the influence of anxiety and attitude toward pain. *PLoS One*. 2018;13(8):e0201897.  
[Google Scholar](#)   [Crossref](#)   [PubMed](#)   [WorldCat](#)
36. Wulff V, Hepp P, Fehm T, Schaal NK. Music in obstetrics: an intervention option to reduce tension, pain and stress. *Geburtshilfe Frauenheilkd*. 2017;77(9):967-975.  
[Google Scholar](#)   [Crossref](#)   [PubMed](#)   [WorldCat](#)
37. CAREstream America. PRO-NOX™. CAREstream America website. <http://www.carestreamamerica.com/pro-nox/>. Updated 2014. Accessed October 11, 2018.
38. Montoro J, Bartra J, Sastre J, et al. H1 antihistamines and benzodiazepines. Pharmacological interactions and their impact on cerebral function. *J Investig Allergol Clin Immunol*. 2013;23(Suppl 1):17-26.  
[Google Scholar](#)   [PubMed](#)   [WorldCat](#)

## Author notes

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## Supplementary data

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