ABOUT THE AUTHOR

Sonya Abdulla, MSc MD FRCPC
Dermatology on Bloor, Toronto

Dr. Abdulla is a board-certified dermatologist in Canada and the US. She completed additional Fellowship training in Dermatologic Laser Surgery and Aesthetic Medicine from the University of Toronto. She earned her Doctor of Medicine from the University of Ottawa where she was recognized with the Dr. André Peloquin Award for excellence in patient care. Dr Abdulla has a blended medical and aesthetic dermatology practice at Dermatology on Bloor in Toronto. Her areas of specialty include aesthetic injectables, laser surgery and medical grade skincare. She is also a clinical expert in acne and rosacea.
Dr Abdulla's evidence-based, multimodal approach to aesthetic dermatology has established her as a thought leader in her field. Her opinion is one often sought by media on a local and national scale. As a passionate teacher and advocate for medical education, Dr Abdulla is involved as a clinical instructor at the University of Toronto. She is an active committee member of the Canadian Dermatology Association and the American Society for Dermatologic Surgery.

THE BELTLINE AND BEYOND: A REVIEW OF MINIMALLY INVASIVE BODY CONTOURING MODALITIES

Body contouring refers to the use of surgical or non-surgical interventions to modify the shape of the body, most commonly targeting adipose tissue. While tumescent liposuction is the most popular means of body sculpting, there is rapidly growing interest in minimally invasive body contouring technologies[1,2]. These include cryolipolysis, laser therapy, radiofrequency, ultrasound, and High Intensity Focused Electro-Magnetic Technology (HIFEM).

The following report will review treatment classes, their mechanism of action, treatment protocols and potential adverse events.

Cryolipolysis

Cryolipolysis borrows the concept of cold-induced panniculitis, delivering targeted, controlled cooling to the subcutaneous layer to induce selective adipocyte apoptosis[3,4]. Histological assessment shows cool-induced adipocyte damage peaks at 14 days and is subsequently cleared by macrophages through an inflammatory process which lasts up to 3 months[2,3,5]

The most commonly used technology in North America is CoolSculpting® (ZELTIQ Aesthetics, Inc., Pleasanton, CA, USA), approved for treatment of the flanks, abdomen, submentum, upper arms, bra fat, and medial thighs[2,5]. Subcutaneous fat is cooled to -10°C for 35 to 60 minutes based on the anatomic area. Fat reduction ranges from 14-25.5% per treatment[6-8]. Localized areas of fat accumulation tend to respond better given the nature of the applicator[2].Treatment response is typically seen at 3 weeks post-procedure but may continue for up to 6 months[3]. Cryolipolysis is overall well tolerated. Initial cold-associated discomfort subsides after 5-10 minutes of treatment[9]. Erythema, edema, ecchymosis and delayed onset pain may occur post-treatment lasting from a few days to weeks[9]. Rare side effects such as paradoxical adipose hyperplasia (PAH) occur in 0.0051-0.021% of cases but may be underreported[10,11]. There is a disproportionate number of cases among Hispanic males seeking abdominal and chest treatment, potentially related to anatomic sexual dimorphism[11].

Cryolipolysis provides an effective treatment option for fat reduction with high levels of patient satisfaction[12]. Skin laxity may improve through normal elastic recoil properties but more commonly a secondary intervention is required to address skin laxity[13].

Laser-assisted Lipolysis

Laser-assisted lipolysis uses a 1060-nm diode laser that triggers heat-mediated inflammation to induce adipocyte apoptosis (SculpSure® Cynosure, Westford, MA, USA). Treatment temperatures selectively target adipocytes at 42-47°C which disrupts cell membrane integrity and fat is eventually cleared from the interstitial space[14,15]. The device's contact cooling system is necessary to preserve the integrity of the skin and adnexae, preventing potential thermal complications[2].

Laser lipolysis is indicated for fat reduction of the abdomen, flanks and submentum – it does not address skin laxity. The ideal treatment duration for 1060-nm is targeted to 20 and 25 minutes to avoid undertreating, or subcutaneous nodules if heated too long[2]. Slimmer abdomens and pinchable fat respond best to treatment with reduction of 11.5% reported with a single treatment[2]. Anecdotally, patients require 1-3 sessions with improvement seen 3 months post-procedure[2]. Tolerability is favourable - mild to moderate tenderness lasting up to 2 weeks is common[16].

Magnetic Resonance Contouring

High intensity focused electromagnetic technology (HIFEM) is the newest technology for body contouring, inducing fat reduction and potentially improving muscle thickness, strength and tone[17].

HIFEM technology was initially approved for contouring of the abdomen and buttocks (EMSculpt®, BTL Industries, Inc., New York, NY, USA). Electromagentic energy is used to stimulate 20 000 supramaximal muscle contractions during a 30-minute treatment session[18,19]. The high level of contractions may stimulate lipolysis which releases a large amount of tissue-damaging free fatty acids into the surrounding fat to induce adipocyte apoptosis[20] demonstrated by a 91.7% increase in the adipocyte apoptotic index in 120 histologic samples[18].

The major differentiator with HIFEM technology is the resultant effect on muscle tissue. A recent study showed an 18.6% reduction of adipose tissue thickness, 15.4% increase in rectus abdominis muscle thickness, and 10.4% reduction in diastasis recti[18]. Positive results have also been reported for gluteal toning and lifting as well as with a secondary device (Emsella®, BTL Industries, Inc., New York, NY, USA) for urinary incontinence[19,21].

Treatment protocols include a minimum of four 30-minute sessions over 2 weeks and a single maintenance treatment session performed every 3 to 6 months[18]. Treatment is well tolerated with rare reports of painful, gripping muscle contractions or brief electric shocks[18]. Contraindications to treatment include pregnancy, metal or electronic implants.

The ideal HIFEM patient has not been established. Patients who respond best to treatment typically have a low to medium BMI and less than 2.5cm of pinchable fat[18,19]. This is likely due to the distance between the EM coil and target tissue[18,19]. It is unclear if HIFEM is suitable to treat visceral fat. Lastly, skin laxity is not targeted with HIFEM technology.

Radiofrequency

Radiofrequency treatment is most commonly associated with skin tightening, and more recently, fat reduction[22]. Volumetric heating and tissue impedance selectively target collagen-rich tissue to induce tissue remodeling and tightening over 60-90 days[23]. Adipocyte apoptosis and fat reduction occur through this bulk heating process[17]. Radiofrequency heats tissue to 43-45°C for up to 45 minutes, followed by epidermal cooling to reverse the thermal gradient[17]. Tissue cooling is an essential component in order to avoid complications such as burns, infection, scarring and dyspigmentation[17]. Treatment is generally well tolerated with heat-related discomfort noted at the time of the procedure. Topical anesthetic is not recommended and may enhance dermal sensitivity and interfere with penetration of RF waves[13]. Transient erythema and edema lasting 24 hours may occur[24]. Rare side effects such as dysesthesia, fat atrophy, subcutaneous nodule formation are reported[24].

There are now a number of radiofrequency devices indicated for body contouring. Vanquish® (BTL Industries, Boston, MA, USA) is a monopolar radiofrequency device used for fat reduction of the mid-section. Its novel panels placed 1 cm above the skin allow contactless treatment of a large surface area, decreasing the overall treatment time and potentially the number of treatment sessions, making it a suitable option for patients with elevated BMI (i.e. >25)[2, 25, 26] truSculpt® (Cutera, Brisbane, CA, USA) is another monopolar RF device with various size hand pieces that allow flexible treatment of both small and large areas. The Venus Legacy® (Venus Concept, Toronto, ON, Canada) combines multipolar RF and-or pulsed electromagnetic fields to promote either skin tightening or fat reduction depending on the applicator used, allowing increased versatility. Pulsed EM stimulates angiogenesis and growth factor release to induce collagen formation through a non-thermal mechanism. Patients with low to moderate BMI and presence of skin laxity tend to be ideal candidates for this class of technology[17].

Ultrasound

Ultrasound technology has been used in medicine for many years for ablation of renal calculi, cardiac ablation and ablation of various benign and malignant tumors[13]. Two classes of ultrasound are used for body contouring.

The first class (Ultrashape, Syneron Candela) uses low-intensity/low frequency nonthermal pulsed ultrasonic waves to induce cavitation at specific depth resulting in fat cell lysis[27]. The absence of thermal effect limits its effect on collagen and skin tightening. Studies have shown its efficacy in treating focal adiposity of the abdomen, hips and thighs in nonobese patients (BMI < 30)[27,28]. The recommended protocol involves 3 treatments at 2-week intervals. A single treatment yields a mean reduction in waist circumference by 1.3–2.5 cm[27-29]. Three treatments reduced waist circumference by 2.3–3.5 cm[27,29].

The second class (Liposonix, Solta Hayward, CA, USA) uses highly convergent energy to deliver heat at 56°C to a focal zone known as High-Intensity Focused Ultrasound (HIFU), inducing coagulative necrosis, adipocyte apoptosis and neocollagenesis[13]. HIFU may also induce ultrasonic cavitation of adipocytes. HIFU has been evaluated for treatment of focal adiposity of the abdomen, waist, hips, outer and inner thighs, and buttocks, and in male breast hypertrophy[30,31]. A single treatment is typically sufficient[13]. Total treatment time is 45-60 minutes involving two to 3 passes over the target

area[31]. Mean reductions in waist circumference range from of 4.2 to 4.7 cm 12 weeks post-procedure[30,31].
Clinical improvement with ultrasound contouring is typically noted by 2 weeks and continues up to 12 weeks for both classes of treatment[30-32].
Treatment-associated symptoms include pain during and post-treatment, ecchymoses, erythema and dysesthesia[28-32].
Severe adverse events such as burns, blisters or scars were not reported.

Discussion

Minimally invasive body contouring procedures continue to gain traction in aesthetic dermatology as patients seek effective treatments with limited recovery and low risk of adverse events. These treatment modalities offer options for non-obese patients seeking modest to moderate improvement. None of the named technologies induce changes in lipid profile or liver enzymes. The success of these treatments is largely based on a comprehensive clinical assessment, understanding of the various modalities, and where combination therapy may be necessary. Identification of the contributory changes in the treatment area – increased fat, skin laxity, cellulite or volume loss – should ultimately guide therapeutic decision-making. Discussion around treatment expectations is key, including anticipated clinical outcomes, time to improvement and need for maintenance therapy.

References

1. Triana L, Triana C, Barbato C, Zambrano M (2009) Liposuction: 25 years of experience in 26,259 patients using different devices. Aesthet Surg J 29:509–512

2. Chilukuri,S MD FAAD. ""Hands-Free" Noninvasive Body Contouring Devices: Review of Effectiveness and Patient Satisfaction." Journal of Drugs in Dermatology 15.11 (2016): 1402-1406.

3. Avram MM, Harry RS. Cryolipolysis for subcutaneous fat layer reduction. Lasers Surg. Med. 2009; 41: 703–708.

4. Derrick CD, Shridharani SM, Broyles JM. The safety and efficacy of cryolipolysis: a systematic review of available literature. Aesthet. Surg. J. 2015; 35: 830–836

5. Klein KB, Bachelor EP, Becker EV et al. Multiple same day cryolipolysis treatments for the reduction of subcutaneous fat are safe. Lasers Surg. 2017; 49: 640–644.

6. Dover J, Burns J, Coleman S, et al. A prospective clinical study of non-invasive cryolipolysis for subcutaneous fat layer reduction: Interim report of available subject data. Lasers Surg Med. 2009;41:43.

7. Coleman SR, Sachdeva K, Egbert BM, Preciado J, Allison J. Clinical efficacy of noninvasive cryolipolysis and its effects on peripheral nerves. Aesthetic Plast Surg. 2009;33:482-488.

8. Shek SY, Chan NPY, Chan HH. Non-invasive cryolipolysis for body contouring in Chinese – A first commercial experience. Lasers Surg Med. 2012;44:125-130.

9. Dierickx CC, Mazer J-M, Sand M, et al. Safety, tolerance, and patient satis- faction with noninvasive cryolipolysis. Dermatol Surg. 2013;39:1209-1216.

10. Jalian HR, Avram MM, Garibyan L, Mihm MC, Anderson RR. Paradoxical adipose hyperplasia after cryolipolysis. JAMA Dermatol. 2014;150(3):317–319. doi:10.1001/jamadermatol.2013.8071

11. Keaney, TC, Naga, LI (2016), Men at risk for paradoxical adipose hyperplasia after cryolipolysis. J Cosmet Dermatol, 15: 575-577. doi:10.1111/jocd.12256

12. Krueger N, Mai SV, Luebberding S, Sadick NS. Cryolipolysis for noninvasive body contouring: clinical efficacy and patient satisfaction. Clin Cosmet Investig Dermatol. 2014; 7: 201–205. Published online 2014 Jun 26. doi: 10.2147/CCID.S44371

13. Jewell, Mark L., Nowell J. Solish, and Charles S. Desilets. "Noninvasive body sculpting technologies with an emphasis on high-intensity focused ultrasound." Aesthetic plastic surgery 35.5 (2011): 901.

14. Bass LS, Doherty ST. Safety and efficacy of a non-invasive 1060 nm diode laser for fat reduction of the abdomen. J. Drugs Dermatol. 2018; 17: 106–12

15. Schilling L, Saedi N, Weiss R. 1060 nm diode hyperthermic laser lipolysis: the latest in non-invasive body contouring. J. Drugs Dermatol. 2017; 16: 48–52.

16. Katz B, Doherty S. A multicenter study of the safety and efficacy of a non-invasive 1060 nm diode laser for fat reduction of the flanks. Annual Meeting, American Society for Laser Medicine and Surgery, April 22-26, Kissimmee, FL, 2015.

17. Mazzoni D, Lin MJ, Dubin DP, Khorasani. Review of non-invasive body contouring devices for fat reduction, skin tightening and muscle definition. Australasian Journal of Dermatology (2019) 60, 278–283.

18. Kinney BM, Lozanova P. High intensity focused electromagnetic therapy evaluated by magnetic resonance imaging: safety and efficacy study of a dual tissue effect based non- invasive abdominal body shaping. Lasers Surg. Med. 2018; 51: 40–6.

19. Jacob CI, Paskova K. Safety and efficacy of a novel high- intensity focused electromagnetic technology device for non- invasive abdominal body shaping. J. Cosmet. Dermatol. 2018; 17: 783–7.

20. Stallknecht B, Dela F, Helge JW. Are blood flow and lipolysis in subcutaneous adipose tissue influenced by contractions in adjacent muscles in humans. Am. J. Physiol. Endocrinol. Metab. 2007; 292: e39409.

21. Samuels, Julene B., et al. "Safety and Efficacy of a Non‐Invasive High‐Intensity Focused Electromagnetic Field (HIFEM) Device for Treatment of Urinary Incontinence and Enhancement of Quality

of Life." Lasers in surgery and medicine 51.9 (2019): 760-766.

22. Manuskiatti W, Wachirakaphan C, Lektrakul N, Varothai S (2009) Circumference reduction and cellulite treatment with a TriPollar radiofrequency device: a pilot study. J Eur Acad Dermatol Venereol 23:820–827

23. Hodgkinson DJ. Clinical applications of radiofrequency: non- surgical skin tightening (thermage). Clin. Plast. Surg. 2009; 36: 261–8.

24. Alster TS, Tanzi E. Improvement of neck and cheek laxity with a nonablative radiofrequency device: a lifting experience. Der- matol. Surg. 2004; 30: 503–7.

25. Downie J, Kaspar M. Contactless abdominal fat reduction with selective RF evaluated by Magnetic Resonance Imaging (MRI): case study. J Drugs Dermatol. 2016;15:491-495.

26. Moradi A, Palm M. Selective non-contact field radiofrequency extended treatment protocol: Evaluation of safety and efficacy. J Drugs Derm, 2015;14(9):982-985.

27. Moreno-Moraga J, Valero-Altes T, Riquelme AM, Isarria-Marcosy MI, de la Torre JR (2007) Body contouring by noninvasive transdermal focused ultrasound. Lasers Surg Med 39:315–323

28. Teitelbaum SA, Burns JL, Kubota J, Matsuda H, Otto MJ, Shirakabe Y, Suzuki Y, Brown SA (2007) Noninvasive body contouring by focused ultrasound: safety and efficacy of the Contour I device in a multicenter, controlled, clinical study. Plast Reconstr Surg 120:779–789 discussion 790

29. Ascher B (2010) Safety and efficacy of UltraShape Contour I treatments to improve the appearance of body contours: multiple treatments in shorter intervals. Aesthet Surg J 30:217–224

30. Fatemi A (2009) High-intensity focused ultrasound effectively reduces adipose tissue. Semin Cutan Med Surg 28:257–262

31. Fatemi A, Kane MA (2010) High-intensity focused ultrasound effectively reduces waist circumference by ablating adipose tissue from the abdomen and flanks: a retrospective case series. Aesthetic Plast Surg 34:577–582

32. Gadsden E, Aguilar MT, Smoller BR, et al. Evaluation of a novel high-intensity focused ultrasound device for ablating subcutaneous adipose tissue for non-invasive body contouring: Safety studies in human volunteers. Aesthet Surg J. 2011;31:401-410.