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Cryolipolysis Technology: A Review of Non-Surgical Fat Reduction with Minimal Pain

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ABSTRACT

Aims: Cryolipolysis is a successful non-invasive technique for reducing fat, offering a potential alternative for non-surgical body sculpting. This research conducts a thorough assessment of the existing data, focusing specifically on cry lipolysis-induced pain.

Method and Materials: A thorough search of electronic databases of PubMed, Web of Science, and Scopus were carried out in this systematic review to find relevant studies published until July 2024. The search strategy used terms linked to cry lipolysis and pain like "pain" and "cry lipolysis". The studies were evaluated for their methodological quality, and the findings were combined to give a summary.

Findings: In this review, 130 articles were obtained in the initial literature search. Following the application of inclusion criteria and the identification of additional articles through a manual review of references, 16 studies were chosen for review. The studies covered a variety of populations and research types like randomized controlled trials, prospective cohort studies, case series, and case reports. The findings of this review indicated that a variety range of pain in the treated area is commonly felt during and after the procedure.

Conclusion: Patients may experience pain and discomfort during and after the cry lipolysis procedure. By following recommended pain management strategies, they can achieve satisfactory results with minimal discomfort.

Keywords: : Pain, Cryolipolysis, Non-surgical, Review Study

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Introduction

Obesity, caused by an excess of body fat, is a significant health concern that is associated with an increased risk of cancer, diabetes, cardiovascular disease, and other health issues. It is also a top aesthetic concern [1].

Over the years, various invasive and non-invasive technologies have been developed to reduce unwanted fat, and researchers continue to seek and develop new techniques. While liposuction was the most effective technique for many years, it is invasive and has inherent risks and limitations [2]. Among the non-invasive procedures developed as an alternative to liposuction, cryolipolysis induces the death of subcutaneous fat cells by inducing cold panniculitis [3]. Cryolipolysis, known as fat freezing, is a non-invasive cosmetic procedure designed to reduce localized fat deposits. Although it is generally considered safe, patients should be aware of potential risks and side effects. Two months after a single 60-minute cryolipolysis treatment, the treated area shows a reduction in thickness due to an average fat volume loss of 40 mL [4]

After cryolipolysis procedures, most patients experience minimal discomfort. However, a small group of patients may experience pain. Unlike the expected temporary discomfort, the delay post-treatment pain side effect is unique due to its intensity and late-onset, typically occurring within a few days of the procedure [5]. Administering oral or parenteral medication to optimize pain control improves patient satisfaction and reduces side effects like anxiety and insomnia [6]. Patient safety and satisfaction with pain by cryolipolysis are important factors to consider when evaluating the effectiveness of this non-invasive fat reduction treatment [7]. In terms

of patient safety, it is essential for healthcare providers to carefully assess the patient's medical history and current health status before performing cry lipolysis. Patients with certain medical conditions or sensitivities to cold temperatures may not be suitable candidates for this treatment. Additionally, proper technique and equipment must be used to ensure the safety of the patient during the procedure [8]. Patient satisfaction with pain during cry lipolysis is also a crucial aspect of evaluating its effectiveness. While cry lipolysis is generally well-tolerated by most patients, some individuals may experience discomfort or mild pain during the treatment due to the sensation of intense cold and suction on the treated area [9]. Healthcare providers need to manage patient expectations regarding pain levels and provide adequate support throughout the procedure. Overall, assessing patient safety and satisfaction with pain by cry lipolysis involves careful consideration of individual health factors, proper technique by healthcare providers, and managing patient expectations on potential discomfort or pain during treatment; in order to it can effectively meet their needs while minimizing any potential risks or discomforts associated with it [10]. Furthermore, Pain management during cry lipolysis is an essential consideration for patients undergoing this procedure.

Considering the importance of the problem and the significant role of pain management in reducing complaints after intervention, this study reviews various existing studies in cry lipolysis Technology and related pain

Method and Materials

Our initial literature review stage involved conducting a PubMed, Web of Science, and Scopus search for English-language reports published from 2009 to July 2024 to gather all published literature on cry lipolysis. We employed a review approach with the following key search terms as follows:

"Cry lipolysis"[Title/Abstract] OR "fat-freezing"[Title/Abstract] OR "algorithm cry lipolysis"[Title/Abstract] OR "lipocryolysis"[Title/Abstract] OR "Cool sculpting"[Title/Abstract] AND "pain"[Title/Abstract]. The next step in our literature review involved gathering the papers that define our key terms and extracting relevant information from each to provide a comprehensive overview of different aspects of cry lipolysis.

In this review, a total of 130 reports were initially identified; these were screened based on predefined selection criteria. Following the abstract review, only 31 studies were deemed appropriate and had eligible full-text access, so 99 articles were excluded after a careful review of the titles and abstracts. These articles were unrelated to the topic of the present systematic review. After the final assessment, sixteen eligible studies satisfied the inclusion criteria and qualified for the systematic review.

The inclusion criteria for the selected studies required that they encompass a variety of study designs, including randomized controlled trials, prospective cohort studies, case series, and case reports. Only accessible full-text articles in English that utilize cry lipolysis technology were considered. The exclusion criteria were research studies involving animal studies and studies that did not provide information about pain compliance.

The variables extracted from the studies included various aspects such as sample size, age of participants, average BMI, duration of intervention, study type, and pain measure. Table 1 presents the characteristics of the studies that were included.

Findings

A total of 16 studies were incorporated into the systematic description, as shown in Table 1. All of these studies were published within the timeframe of 2009 to 2024 and also were conducted in various countries. The sample size of the participants ranged from 1 to 528 patients. Among the assessments that were examined, the Visual Analog Scale (VAS) was the most frequently utilized. It is worth noting that all sixteen studies included one measure of pain assessment.

Table 1) Summary of the studies which were assessed

First Author, Year (Ref)	Study Type	Patient (N)	Average Age (Year)	Average BMI (Kg/m^2)	Follow-Up	Outcomes
Klein, 2009 (11)	Prospective	40	40.9	26.1	12 weeks	2.5% reported pain at the treatment site at 1 week
Lee, 2013 (12)	Prospective	14	28.57	23.12	12 weeks	28.6% reported mild (7.1%), moderate (14.3%), and severe (7.1%) pain at the time of procedure
Dierickx, 2013 (13)	Retrospective	518	42.7	65.9	3 months	96% reported minimal to tolerable, 4% reported severe pain (during treatment
Stevens, 2013 (14)	Retrospective	528	46.55	n/a	2 and 3 months	n/a
Garibyan, 2014 (15)	Prospective	11	37.6	27.1	2 months	55% at 10 min after treatment (36% mild pain, 18% moderate pain), 0% at 1 week, 2 weeks, 3 weeks, or 2 months
Stefani, 2015 (16)	Case report	1	29		2-years	n/a
Keaney, 2015 (17)	retrospective	125	44.5	n/a	1 year	15.2% patients developed delayed post-cryolipolysis pain
Wanitphakdedecha, 2015 (18)	Clinical trial	20	30.2	21.15	6 months	41.2% of 34 treatments on the treated area reported mild to moderate pain.
Harrington, 2017 (19)	Prospective cohort study	31	50.4	26.6	2 months	61% of subjects reported pain in the lateral wall prior to the study, when queried post-treatment, only 13% reported pain; the remaining 87% reported no lateral wall pain.
Adjadj, 2017 (20)	prospective	53	38	23.61	6 months	The mean visual analog scale score of mild pain was 1.66 out of 10 after the session and 8.33 % of patients experience moderate pain after the session
Ko, 2018 (21)	Case report	2	Case1: 46 Case2: 45	Case1: 27.25 Case2: 20.5	12 weeks	Case1: Immediately after treatment, no pain was reported on the combination treatment side (HIFU and cryolipolysis) Case 2: VAS pain scores were 9 on both the combination treatment side.
Gregory, 2019 (22)	Case report	2	Case1: 66 Case 2: 32	n/a	n/a	Case1: reported 9/10 on the visual analog scale of pain in submental adipose tissue. Case 2: reported 7/10 on the visual analog scale of pain in submental adipose tissue.
Nishikawa, 2021 (23)	retrospective	146	34.7	n/a	6 months	Patients who had received treatment on their upper arms were more satisfied in the categories of pain compared to those who had received treatment on their abdomen.
Hong, 2022 (24)	prospective	15	33.0	30.21	16 weeks	The mean pain score after the initial treatment session was 2.0±1.36. The pain level decreased significantly after the procedure.
Altmann, 2022 (9)	retrospective	91	45.5	26	3 months	78% of all patients rated the pain level as either no pain at all or light pain.
Vignoli, 2023 (25)	retrospective	287	n/a	n/a	69 days	1.70% of patients reported pain during or after the treatment.

BMI: Body Mass Index, n/a: not available.

Discussion

Noninvasive techniques for localized fat reduction have become increasingly popular as they provide a nonsurgical alternative to liposuction, which carries typical surgical risks. Cry lipolysis, radiofrequency, and high-intensity focused ultrasound have emerged as popular choices among the technologies used for this purpose. However, cryolipolysis is considered the leading treatment option for noninvasive fat reduction due to its remarkable efficacy and high satisfaction rate (26). Mild and short-term side effects of cryolipolysis include redness, bruising, changes in sensation, and pain.

This systematic review examines cryolipolysis technology as non-surgical fat reduction with minimal pain. In a previously published retrospective review of 518 treated patients, there were no reports of delayed post-treatment pain in any study subject [13]. Another extensive series of 528 cryolipolysis treatments showed only 3 reports of mild to moderate pain [14]. Another review revealed that delayed post-treatment pain may be more common than previously reported. Over a one-year period, 15.2% of cryolipolysis patients and 13.5% of all treatments experienced delayed post-treatment pain [17]. However, young women undergone abdominal cryolipolysis treatments were at a higher risk of experiencing delayed post-treatment pain. In one study, pain during the procedure was generally either nonexistent or tolerable in 96% of the time [13].

The mechanism governing the apoptosis and subsequent elimination of fat tissue remains not fully understood. However, it is generally believed that caspase-3 activates the apoptotic pathway of adipose tissue [27]. Furthermore, cryo-energy triggers the formation of crystals in the fat cells, which ultimately causes the cells to undergo apoptosis [28]. Kwon et al [29] reported that a cryolipolysis device may enhance lipid breakdown by activating natural lipid compounds through the peroxisome proliferator-activated receptor pathway.

Also, the pathogenesis of pain in cryolipolysis technology is unknown. The hypothesized mechanisms include variations in sensory nerve anatomy and an increased inflammatory response to the treatment. A study by Coleman and colleagues examined the sensory function after cry lipolysis. The study showed that cry lipolysis can temporarily affect sensory function, but this doesn't lead to long-term damage to the structure or function of the nerve fibers in the skin. If the sensory nerve is in the coldest area, it could experience a more severe lack of blood flow, which might cause intense pain. This hypothesis could clarify why treating the same area again led to a recurrence of pain. Cryolipolysis also triggers an inflammatory response that peaks after one month [30]. Maybe inflammatory stimulation from cryolipolysis causes mild pain and other side effects during or after treatment.

Based on the literature, mild pain in the treated area is often experienced during and after the procedure, the majority of which resolves by 1 week [31]. This literature, consistent with our systematic review, indicated conciseness majority existence of mild pain experienced during and after cryolipolysis treatment.

Therefore, healthcare providers should thoroughly discuss the potential for pain with patients considering cryolipolysis and provide appropriate pain management options. Further research is needed to better understand the mechanisms of cryolipolysis-induced pain and to develop more effective pain management strategies for patients undergoing this procedure. Additionally, studies evaluating the long-term effects of cryolipolysis on pain and discomfort are warranted to ensure patient safety and satisfaction.

Conclusion

This review has provided a comprehensive overview of the current evidence on the inducement of cryolipolysis in pain during and after treatment. Most research indicated that cryolipolysis typically resulted in mild to moderate pain both during and after the procedure. Cryolipolysis is a popular and effective non-surgical method for reducing fat. However, patients should be aware that they may experience pain and discomfort during

and after the procedure. By understanding these potential side effects and adhering to recommended pain management strategies, patients can achieve satisfactory results with minimal discomfort

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Authors ' Contribution
FMB and FB participated in the study design and in the preparation of the manuscript by providing comments on drafts written by FMB. All authors read and approved the final manuscript.

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