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Cellulite – Etiology, Epidemiology and Management

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ABSTRACT

Cellulite is a common dermatologic condition affecting 80-90% of post-pubertal females, particularly on the thighs, buttocks, and hips. It is characterized by dimpling and a "mattress-like" skin appearance, significantly impacting body image and quality of life. More prevalent in Caucasian women, it results from multifactorial causes, including hormonal influences (e.g., estrogen), structural differences in subcutaneous tissues, vascular changes, and low-grade inflammation. Lifestyle and aging further contribute to its severity. Treatments range from topical applications and energy-based devices to minimally invasive procedures, though results are often temporary. Due to its complex etiopathogenesis and structural changes, cellulite remains challenging to treat, necessitating realistic patient expectations and further research for improved and lasting solutions.

KEYWORDS

cellulite, etiology, epidemiology, cellulite management, cellulite treatment options

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1. INTRODUCTION

Cellulite is a dermatologic condition that predominantly affects post-pubertal females, characterized by topographic skin changes such as dimpling, denting, and nodulation. These changes, commonly observed on the thighs, buttocks, and hips, lead to a "mattress-like" or "orange peel" appearance of the skin. Although painless, cellulite has significant psychosocial effects, including body dissatisfaction, anxiety, and reduced quality of life. Due to its aesthetic implications, it drives many women to seek treatments, with over 86,000 minimally invasive procedures performed in the U.S. in 2021 alone. Despite numerous therapeutic options, cellulite remains challenging to treat due to its complex etiopathogenesis and the limited efficacy of available modalities [1].

2. EPIDEMIOLOGY

Cellulite is highly prevalent among females, affecting approximately 80-90% of post-pubertal women

across all races and ethnicities, though it is more common in Caucasians than Asians or African Americans. While cellulite can manifest at any age after puberty, it typically becomes noticeable between the ages of 20 and 30. In males, cellulite is rare (approximately 2%), typically occurring in cases of androgen deficiency due to conditions like Klinefelter syndrome or hormonal therapies for prostate cancer [2,3,4].

3. ETIOPATHOGENESIS

The pathophysiology of cellulite is multifactorial, involving structural, hormonal, vascular, and inflammatory components. Anatomical studies have shown that cellulite primarily arises from an architectural disorder in the dermis and subcutaneous tissues. Key factors include:

- a) Anatomical structure: the subcutaneous tissue in cellulite-prone regions consists of five layers: the dermis, superficial fat, superficial fascia, deep fat, and deep fascia. Two types of fibrous septa are present. Short, thin septa that connect the superficial fascia to the dermis and tall, thick septa connecting the deep fascia to the dermis. In females, the septa are vertically oriented and less stable, which contributes to fat protrusion and dimpling. In contrast, male septa are stronger, more stable, and oriented at a 45-degree angle, reducing susceptibility to cellulite. [3]
- b) Biomechanical forces: cellulite results from imbalances in the biomechanical forces within the dermis, adipose tissue, and fibrous septa. The short, thin septa, being less stable, fail to contain superficial fat lobules, leading to dimpling and skin irregularities. In women with higher body mass index (BMI), the thickness of both superficial and deep fat layers increases, exacerbating these imbalances and causing more pronounced cellulite [3,5].
- c) Hormonal factors: estrogen is a critical factor influencing cellulite development. High-estrogen states, such as pregnancy, oral contraceptive use, or hormone replacement therapy, can exacerbate cellulite. The gender-specific structural differences in septa and fat lobules further highlight the role of estrogen in cellulite formation [3].
- d) Vascular hypothesis: vascular changes, such as altered capillary permeability and increased interstitial fluid, contribute to cellulite. Chronic venous stasis-like changes can lead to tissue hypoxia, neovascularization, and thickening of fibrous septa, which worsen the skin's uneven appearance.

- e) Inflammation hypothesis: low-grade inflammation may contribute to cellulite development by promoting dermal atrophy, fibrous septal changes, and endothelial damage. Pro-inflammatory states, such as obesity and insulin resistance, can aggravate these processes through macrophages, cytokines, and other inflammatory mediators.
- f) Aging and lifestyle factors: aging leads to reduced collagen and elastin in the dermis, causing atrophy and fat herniation. Older individuals, particularly those with high BMI, are at greater risk of developing severe cellulite. Lifestyle factors, including poor diet and sedentary behavior, can promote lipogenesis and fat hypertrophy, increasing cellulite risk. Weight gain stretches the fibrous septal network, which remains elongated even after weight loss, necessitating specific treatment approaches [6].

4. CLINICAL PRESENTATION AND ASSESSMENT

The clinical evaluation of cellulite begins with a thorough assessment of the affected areas to identify contributing factors such as skin laxity, dermal atrophy, volume loss, or fat deposition. Differential diagnoses must also be considered, as conditions like lipoatrophy, generalized edema, lymphedema, and obesity may mimic cellulite and require different treatments. Using cellulite-specific therapies on such conditions can worsen their appearance. Evaluation is conducted with the patient standing, as this position highlights tension on the fibrous septa, accentuating dimples. Observing the patient in a relaxed state is followed by muscle contraction and pinching of the affected areas, which further reveals dimples. Handheld lighting can assist in assessing skin surface irregularities [1].

Cellulite severity is graded using scales such as the Nürnberger–Müller Scale and the Cellulite Severity Scale (CSS). The Nürnberger–Müller Scale is simple but unvalidated, categorizing cellulite into four grades based on visual assessment and pinch tests. The CSS is more comprehensive, rating five parameters on a 0-3 scale, providing a total score to classify cellulite as mild, moderate, or severe [1,7]. Pretreatment and posttreatment photographs are critical for evaluating outcomes. Standardized patient positioning and controlled lighting conditions are essential to ensure consistency in photographic documentation.

5. TREATMENT OPTIONS

While a wide range of noninvasive and minimally

invasive treatments exist, their efficacy varies, and results are often temporary. An individualized approach is essential for optimal outcomes with common treatment modalities.

5.1. Non-invasive treatments

- a) Topical creams: products containing retinoids, caffeine, or aminophylline aim to improve skin elasticity and reduce fat deposition but have limited efficacy.
- b) Energy-based devices: radiofrequency, ultrasound, and laser devices target adipose tissue and fibrous septa to reduce dimpling. These therapies often require multiple sessions for noticeable improvement [1,2].

5.2. Minimally invasive treatments

- a) Laser-assisted lipolysis: combines liposuction and laser therapy to remove fat and tighten skin.
- b) Collagenase enzyme injections: approved by the FDA, collagenase injections target fibrous septa, improving skin smoothness [2].

5.3 Adjunctive therapies

- a) Diet and exercise: weight management can help reduce the severity of cellulite, although it may not eliminate it entirely due to structural changes in the fibrous septa [8,9].
- b) Compression garments: these may improve lymphatic drainage and reduce swelling, providing temporary relief [4].

5.4. Emerging therapies

Novel treatments, including stem cell therapy and advanced laser systems, are being explored for more effective and lasting results [5,10].

5.5. Challenges in management

The complexity of cellulite's etiopathogenesis makes it a challenging condition to treat. Many therapies offer temporary improvement rather than a permanent solution. Moreover, the structural changes in the subcutaneous tissues, especially after weight loss or aging, often require a combination of treatments to address both the fibrous septa and skin laxity. Patient expectations should be managed realistically, emphasizing that treatments may reduce the appearance of cellulite but are unlikely to achieve complete resolution [3].

6. CONCLUSION

Cellulite is a multifactorial condition with significant psychosocial implications, affecting the majority of post-pubertal females. Its development is influenced by structural, hormonal, vascular, inflammatory, and lifestyle factors. Despite the high prevalence, robust epidemiological data remain limited, and treatment options are variably effective. Personalized management, combining lifestyle changes, noninvasive therapies, and minimally invasive techniques, holds the most promise for achieving satisfactory outcomes. Further research into its pathophysiology and innovative treatment modalities is essential for improving care for those affected by cellulite.

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CONFLICT OF INTEREST STATEMENT

The authors declare no conflicts of interest.

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