

# ULTRASOUND ASSESSMENT OF LYMPHEDEMA

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Lymphedema (LE) is a chronic, progressive disorder characterized by impaired lymphatic drainage, leading to the accumulation of protein-rich lymphatic fluid in the cutaneous and sub-cutaneous tissues. It can arise from mechanical insufficiency of the lymphatic system (as in primary or secondary LE) or dynamic overload in the presence of an otherwise intact lymphatic network. Accurate diagnosis and staging of LE are crucial for optimal medical management, as the clinical course varies from reversible edema to irreversible fibro-adipose tissue remodeling [1]. Conventional examination and anthropometric measurements remain central to diagnosis, but are limited in sensitivity and specificity - especially in early and advanced stages [2]. High-resolution ultrasound (US) has emerged as a non-invasive, accessible, cost-effective, and dynamic imaging modality that enhances the diagnostic process by providing detailed insight into the histo-anatomical patterns at each stage of LE progression [3]. In the early stage, US detects dermal edema increased thickness and decreased echogenicity of the dermo-epidermal complex, reflecting fluid accumulation in the papillary and reticular dermis. This is anatomically significant as the dermis hosts a rich superficial and deep lymphovascular plexus tangled with collagen and glycosaminoglycan-rich ground substance, which binds water and contributes to edema [4].

As LE advances, US reveals cellular infiltration, increased echogenicity, and eventually fibrotic involution, with loss of the dermo-hypodermal interface. US also facilitates the evaluation of subcutaneous tissues, detecting patterns such as dilated lymphatic collectors ("cobblestone"), lymphatic lakes, and sclero-edematous changes within adipose lobules ("snowfall"), which correlate with disease severity and influence treatment responsiveness. Moreover, US contributes to differential diagnosis, distinguishing LE from other causes of edema - such as venous insufficiency or lipedema - by revealing specific patterns of fluid distribution and tissue architecture [5]. US-guided dynamic maneuvers, like "sono-palpation" and "refill test", should be used to characterize tissue compressibility and fluid mobility, identifying non-pitting and fibrotic components which are not discernible by standard physical examination alone. Compared to other imaging modalities such as magnetic resonance imaging, US offers superior resolution of superficial structures, with real-time dynamic imaging and greater accessibility, making it particularly valuable in routine valuations [6]. In conclusion, US represents a powerful extension of the physical examination for LE, providing objective, reproducible, and detailed assessment of LE-related tissue changes. Its ability to characterize the depth, severity, and potentially the reversibility of tissue changes underscores its central role in modern LE care [7].

**Keywords:** Lymphedema, Ultrasound, Lymphedema-Diagnosis

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