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REVIEW

Elastography in Dermatology☆

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Abstract Elastography is a recently developed ultrasound technique applicable to various medical specialties. It provides information on the physical properties of tissues in the context of physiologic and pathologic alterations. In this review we explain the physical principles of the method, the information provided by the different elastography techniques, and its new applications in clinical dermatology.

PALABRAS CLAVE
Elastografía;
Ecografía cutánea;
Ecografía dermatológica

Elastografía en dermatología

Resumen La elastografía es una técnica ecográfica de reciente desarrollo en varias especialidades médicas que aporta información sobre las propiedades físicas de los tejidos en procesos fisiológicos y patológicos. En esta revisión se explican los principios físicos de la técnica, la información que aportan las distintas modalidades de elastografía y las nuevas aplicaciones en dermatología clínica.

Introduction

Since antiquity, palpation has played an important role in the general physical examination of patients because it provides information about the physical characteristics of the tissues.[1] A loss of elasticity or increase in rigidity of organs or tissues has traditionally been associated with a poorer prognosis in inflammatory processes, which histologically tend to be associated with fibrosis, and in tumor processes, in which the elastic properties of healthy tissues decrease.[2,3]

Estimation of the elasticity or rigidity of tissues could therefore facilitate early, noninvasive monitoring and treatment of inflammatory and tumor processes.[4] Elastography is a technique in which ultrasound is used to detect changes in the elasticity of tissues.[5] Since the late 20th century, elastography has been used in various diseases, including tumors of the breast, thyroid, and liver, as well as in inflammatory processes in the same organs.[6]

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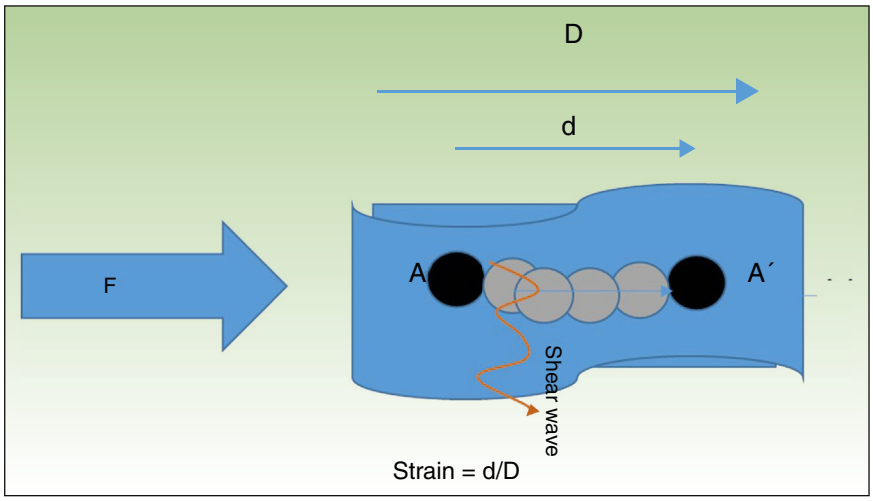

Figure 1 When tissue is compressed with a force F, the tissue particles (A) undergo a displacement (A′). The quotient of the displacement (d) of the structure being examined and its total initial length (D) is known as strain. The particles are displaced in perpendicular to this pressure wave, generating waves called shear waves.

The recent introduction of high-frequency linear ultrasound probes has made it possible for this technology to be applied to superficial tissues such as the bone and muscle system,[6] the superficial vascular system,[6] and the skin and adnexa.[7]

This review details the basic physical concepts of elastography and the possible utility of this technique in the assessment of the skin and adnexa.

It is important to note that most cutaneous elastography studies are small case series, a majority of which are observational and of limited scientific robustness. Nevertheless, a review that introduces elastography to dermatologists and encourages future studies of the practical utility of the technique in dermatology could still be useful.

Elastography: The Physical Concepts of Strain and Shear Wave

When a tissue is subjected to pressure, it deforms and tends to recover its initial shape (elasticity). The resistance of the tissue to deformation is called *rigidity* or *stiffness*.[8]

The term *strain* describes the change in the relative length of a structure subjected to pressure with respect to the surrounding tissue[9] (Fig. 1).

In addition to this physical phenomenon, a series of waves perpendicular to the displacement of the pressure wave—known as *shear waves*—are also generated in the tissue.[10] It is possible to determine the velocity of the shear wave, which provides indirect quantitative information about the stiffness of the tissue (Fig. 1).

Types of Elastography and Their Limitations

According to the clinical guidelines on elastography published by the European Federation of Societies for Ultrasound in Medicine and Biology (EFSUMB),[11] there are two basic types of elastography: strain elastography (SE), which assesses tissue deformation, and shear wave elastography (SWE), which characterizes the shear waves (Table 1). Types of elastography can also be classified according to the physical force that produces the tissue deformation. This force can be mechanical (manual or automatic) or it can be produced by an ultrasound pulse called acoustic radiation force impulse (ARFI). Each of these elastography methods offers qualitative or quantitative information about the rigidity or stiffness (terms used interchangeably in this review) of tissues.

Semiquantitative measurement scales normally associate a number from 1 to 5 with the rigidity percentage of a structure, with 1 being softest and 5 being stiffest.[11]

Another way to quantify the stiffness of a structure is to express it in relation to the surrounding parenchyma. This quotient is known as the strain ratio.[12]

In SWE, which determines shear wave displacement velocities, measurements are quantitative and can be expressed in either kPa or m/s.[13]

This technique has certain limitations. Because of the great variability of the various types of elastography, studies of the technique have been isolated and there are no universal measures used by all elastography equipment.[11]

Table 1 Types of Elastography.

Method	Type of Force	Quantitative/ Qualitative
Strain imaging (SE)	Mechanical ARFI	Qualitative
Shear wave imaging/ velocity measurement (SWE)	Mechanical ARFI	Quantitative

Source: Adapted from the clinical guidelines on elastography of the European Federation of Societies for Ultrasound in Medicine and Biology (EFSUMB).
Abbreviations: ARFI, acoustic radiation force impulse; SE, strain elastography; SWE, shear wave elastography.