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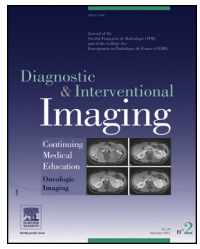

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Ultrasound elastography: Principles and techniques

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Abstract Ultrasonography has been widely used for diagnosis since it was first introduced in clinical practice in the 1970's. Since then, new ultrasound modalities have been developed, such as Doppler imaging, which provides new information for diagnosis. Elastography was developed in the 1990's to map tissue stiffness, and reproduces/replaces the palpation performed by clinicians. In this paper, we introduce the principles of elastography and give a technical summary for the main elastography techniques: from quasi-static methods that require a static compression of the tissue to dynamic methods that uses the propagation of mechanical waves in the body. Several dynamic methods are discussed: vibro-acoustography, Acoustic Radiation Force Impulsion (ARFI), transient elastography, shear wave imaging, etc. This paper aims to help the reader at understanding the differences between the different methods of this promising imaging modality that may become a significant tool in medical imaging.

Ultrasonography is a widely used medical imaging technique with many clinical applications. Used in clinical practice for more than 40 years, it is highly regarded for its ease of use, real-time capability, portability and low cost. Based on the propagation of mechanical waves and more particularly on high frequency compressional waves aka ultrasound, it allows the construction of morphological images of organs, but lacks a fundamental and quantitative information on tissue elastic properties; indeed the bulk modulus that governs the propagation of ultrasound is almost homogeneous in the different biological tissues and does not depend on tissue elasticity [1]. Elastography, whose development started about 20 years ago, aims at imaging tissue stiffness, which provides an additional and clinically relevant information. Mapping the stiffness can either be estimated from the analysis of the strain in the tissue under a stress (quasi-static methods), or by the imaging of shear waves, mechanical waves, whose propagation is governed by the tissue stiffness rather than by its bulk modulus.

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