The results of this study show that this 2D-shear wave elastography technique is accurate for staging liver fibrosis. Cutoff values:

- 7 kPa significant fibrosis F2
- 9 kPa Severe Fibrosis F3-F4

### Performance and cutoffs for liver fibrosis staging of a two-dimensional shear wave elastography technique

**Giovanni Ferraioli,1,4† Laura Maiocchi,2 Carolina Dellafiore,1,4 Carmine Tinelli,1 Elisabetta Above1 and Coro Filice1,4**

**Objectives:** To assess performance and cutoffs of the 2-dimensional shear wave elastography technique available on the Aplio i800 ultrasound system (Canon Medical Systems, Japan), using transient elastography as reference standard, and to assess the correlation of shear-wave-speed dispersion with liver fibrosis or cirrhosis.

**Methods:** This was a single-center, cross-sectional study. The correlations between values obtained with transient elastography and 2-dimensional shear wave elastography, and between shear-wave-speed dispersion and fibrosis or cirrhosis, were assessed with Pearson’s r. The diagnostic performance of the 2-dimensional shear wave elastography for staging significant fibrosis and severe fibrosis compared to transient elastography was assessed using the area under the receiver operating characteristic curve analysis.

**Results:** 190 healthy patients (98 males and 92 females) were enrolled. The area under the receiver operating characteristic curve of 2-dimensional shear wave elastography for staging significant fibrosis (F3) and severe fibrosis (F4) was 0.71 (95% confidence interval: 0.64-0.78) and 0.67 (95% confidence interval: 0.60-0.74). The best cutoffs for significant fibrosis and severe fibrosis, respectively, were 11.7 and 43.5 kPa. Shear wave-speed dispersion showed a high correlation with fibrosis (r=0.86, P<0.0001), whereas there was a very weak correlation with steatosis.

**Conclusions:** The results of this study show that the 2-dimensional shear wave elastography technique is accurate for staging liver fibrosis. Shear wave-speed dispersion is highly correlated with liver fibrosis but not with steatosis. Eur J Gastroenterol Hepatol 2020; 32:00.

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### Introduction

Liver fibrosis, which is due to the healing process of necroinflammation, is a common feature of chronic liver disease; it may lead to cirrhosis with its complications. For the treatment and prognosis of patients with chronic liver disease, it is important to assess whether the patient has significant fibrosis (F2 stage) or liver cirrhosis (F4 stage) [1]. On the other hand, the spectrum of fibrosis is a continuum; therefore, the term "compensated advanced chronic liver disease," which includes severe fibrosis (F3) and liver cirrhosis (F4), at an early

[1] In fact, oesophageal varices can occur not only in patients with established cirrhosis but also in patients with severe fibrosis [2, 3].

Nowadays, guidelines have accepted that liver stiffness assessment with shear wave elastography (SWE) can replace liver biopsies in several clinical scenarios [4]. Indeed, several studies and meta-analyses have shown that the SWE techniques are accurate for the evaluation of liver fibrosis. The first SWE technique available on the market was transient elastography (TE), which is performed with a dedicated device. It has become a point of reference in the evaluation of liver fibrosis, but has several limitations: it is operator-dependent, expensive, and needs a dedicated ultrasound device.

The Aplio i800 ultrasound system (Canon Medical Systems, Japan) uses 2D shear wave elastography, which combines the advantages of both transient and steady shear wave elastography. The 2D shear wave elastography technique can be performed with a conventional ultrasound device and does not require any special transducer or software.

**Journal Info**

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https://doi.org/10.1097/MEG.0000000000001702

**Year**

2020

**Authors**

G. Ferraioli, L. Maiocchi, C. Dellafiore, C. Tinelli, C. Filice (Italy)

**System used**

Aplio i800
Liver stiffness assessed with the help of the propagation map of a latest software for 2D shear wave elastography: Preliminary results

Propagation map of the latest software for 2D shear wave elastography implemented in the Aplio 500 system is a useful tool for the assessment of liver stiffness because it helps in choosing the area of liver parenchyma where measurements are likely more reliable.

<table>
<thead>
<tr>
<th>Journal Info</th>
<th>ECR 2016 Poster C-0754</th>
</tr>
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<tbody>
<tr>
<td></td>
<td><a href="http://dx.doi.org/10.1594/ecr2016/C-0754">http://dx.doi.org/10.1594/ecr2016/C-0754</a></td>
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<tr>
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<td>2016</td>
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<tr>
<td>Authors</td>
<td>G. Ferraioli, L. Maiocchi, R. Lissandrin, C. Tinelli, C. Filice (Italy)</td>
</tr>
<tr>
<td>System used</td>
<td>Aplio</td>
</tr>
</tbody>
</table>
Accuracy of the latest release of a 2D Shear Wave elastography method for staging liver fibrosis in patients with chronic hepatitis C: Preliminary results

The optimal cutoff values of the 2D shear wave elastography method:

- $F \geq 2$: 6.6 kPa
- $F \geq 3$: 9.4 kPa
- $F = 4$: 11.2 kPa.
2D SWE showed low overall measurement variability, with a minimum of 5 readings providing equivalent precision to the existing method using 10 samples.
Concordance of transient elastography and shear wave elastography for measurement of liver stiffness

SWE obtained using the Toshiba Aplio 500 and TE provides similar measurements for liver stiffness measurements of liver diseases. SWE has good inter-operator reliability and may be advantageous over TE owing to the availability of B-mode interrogation simultaneously and the reliability indicators this technology provides.
Comparison of steatosis respective diagnostic performance between ATI and CAP vs MRI PDFF (“gold standard”)

ATI performed better than CAP, and this improvement was statistically significant for S > 1

ATI Cutoff values for steatosis grading (dB/cm/kHz):

<table>
<thead>
<tr>
<th>Grade</th>
<th>Description</th>
<th>Cutoff Values</th>
</tr>
</thead>
<tbody>
<tr>
<td>S0</td>
<td>No steatosis</td>
<td>&lt; 0.63</td>
</tr>
<tr>
<td>S1</td>
<td>Mild Steatosis</td>
<td>0.63 – 0.72</td>
</tr>
<tr>
<td>S2-S3</td>
<td>Significant &amp; Severe Steatosis</td>
<td>&gt; 0.72</td>
</tr>
</tbody>
</table>

This study shows that, in patients with no prior ultrasound imaging, ATI is a very promising tool for the noninvasive assessment of steatosis.
Assessment of hepatic steatosis by using attenuation imaging: A quantitative, easy-to-perform ultrasound technique

The acoustic coefficient (AC) from ATI provided good diagnostic performance in detecting the varying degrees of hepatic steatosis. The degree of steatosis was the only significant factor affecting the AC, whereas fibrosis and inflammation were not.

### Cutoff values for steatosis grading (dB/cm/kHz):

<table>
<thead>
<tr>
<th></th>
<th>S0</th>
<th>S1</th>
<th>S2</th>
<th>S3</th>
</tr>
</thead>
<tbody>
<tr>
<td>No Steatosis</td>
<td>&lt; 0.63</td>
<td>&lt; 0.70</td>
<td>&gt; 0.70</td>
<td>&gt; 0.75</td>
</tr>
<tr>
<td>Mild Steatosis</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Moderate Steatosis</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Severe Steatosis</td>
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</table>

Journal Info

**European radiology**

[https://doi.org/10.1007/s00330-019-06272-y](https://doi.org/10.1007/s00330-019-06272-y)

**Year**

2019

**Authors**

Jae Seok Bae, Dong Ho Lee, Jae Young Lee, Haeryoung Kim, Su Jong Yu, Jeong-Hoon Lee, Eun Ju Cho & al

**System used**

Aplio i800
ATI Liver 3

Prospective Evaluation of Hepatic Steatosis using Ultrasound Attenuation Imaging in Patients with Chronic Liver Disease with Magnetic Resonance Imaging Proton Density Fat Fraction as the Reference Standard

ATI attenuation coefficients are well correlated with MRI-PDFF and, thus, may provide good diagnostic performance in the assessment of hepatic steatosis, making these coefficients a promising tool for the non-invasive assessment and quantification of hepatic steatosis.

Cutoff value for detection of steatosis

- MRI-PDFF > 5% 0.59 dB/cm/MHz
- MRI-PDFF > 10% 0.65 dB/cm/MHz

Original Contribution

PROSPECTIVE EVALUATION OF HEPATIC STEATOSIS USING ULTRASOUND ATTENUATION IMAGING IN PATIENTS WITH CHRONIC LIVER DISEASE WITH MAGNETIC RESONANCE IMAGING PROTON DENSITY FAT FRACTION AS THE REFERENCE STANDARD

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* Department of Radiology, Seoul National University Hospital, Seoul, South Korea; † Seoul National University College of Medicine, Seoul, South Korea; and ‡ Institute of Radiation Medicine, Seoul National University Hospital Research Institute, Seoul, South Korea.

(Received 26 October 2018, revised 31 January 2019, in final form 6 February 2019)

Abstract—The purpose of our study was to investigate the diagnostic performance of 2-D ultrasound attenuation imaging (ATI) for the assessment of hepatic steatosis in patients with chronic liver disease using magnetic resonance imaging proton density fat fractions (MRI-PDFF) as the reference standard. We prospectively analyzed 87 patients with chronic liver disease who had reliable measurements at both ATI and MRI-PDFF. For the detection of hepatic steatosis of MRI-PDFF ≥5% and MRI-PDFF ≥10%, ATI measurements yielded areas under the curve (AUC) of 1.00 (95% CI: 1.00, 1.00) and 0.99 (95% CI: 0.98, 1.00), respectively.

Journal Info

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<tr>
<td>Authors</td>
<td>Adegpst Un Kyung Jeon, Jeong Min Lee, Ijin Joo, Jeong Hee Yoon, Dong Ho Lee, Jae Young Lee, Joon Koo Han (Korea)</td>
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<td>Aplio i800</td>
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<td>Journal Info</td>
<td>Ultrasound in Med. &amp; Biol., Vol. 45, No. 6, pp. 1407-1416</td>
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<td><a href="https://doi.org/10.1016/j.ultrasmedbio.2019.02.008">https://doi.org/10.1016/j.ultrasmedbio.2019.02.008</a></td>
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</table>
ATI Liver 4

Quantification of hepatic steatosis with ultrasound: promising role of attenuation imaging coefficient in a biopsy-proven cohort

ATI coefficient has a significant positive correlation with the grade of steatosis and is a promising quantitative technique for the noninvasive diagnosis and quantification of hepatic steatosis.

Measurement of the attenuation coefficient is achieved with a very high rate of technical success.

Cutoff value for detection of steatosis

- S0 vs S1-2-3 0.69 dB/cm/MHz
- S0-1 vs S2-3 0.72 dB/cm/MHz

Journal Info

European Radiology
https://doi.org/10.1007/s00330-019-06480-6

Year
2019

Authors
Marco Dioguardi Burgio, Maxime Ronot, Edouard Reizine, Pierre-Emmanuel Rautou, Laurent Castéra, Valérie Paradis, Philippe Garteiser, Bernard Van Beers, Valérie Vilgrain (France)

System used
Aplio i800
Clinical utilization of shear wave dispersion imaging in diffuse liver disease

SW dispersion slope is more useful than SW speed for predicting the degree of necro-inflammation. Dispersion slope, which reflects viscosity, may provide additional pathophysiological insight into diffuse liver disease.

<table>
<thead>
<tr>
<th>Journal Info</th>
<th>Ultrasonography. 2019 Jul 26 [<a href="https://doi.org/10.14366/usg.19031">https://doi.org/10.14366/usg.19031</a>]</th>
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<td>Authors</td>
<td>Katsutoshi Sugimoto, Fuminori Moriyasu, Hisashi Oshiro, Hirohito Takeuchi, Yu Yoshimasu, Yoshitaka Kasai, Takao Itoi (Japan)</td>
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<td>System used</td>
<td>Aplio i800</td>
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</tbody>
</table>
Shear-wave dispersion slope is associated with both liver fibrosis and degree of necro-inflammatory activity \((P, .01)\) after liver transplant and provided better diagnostic performance than liver stiffness value in detection of allograft damage after liver transplant.

<table>
<thead>
<tr>
<th>Cutoff SWD (m/s/kHz)</th>
<th>Sensitivity</th>
<th>Specificity</th>
<th>PPV</th>
<th>NPV</th>
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<tbody>
<tr>
<td>10.8</td>
<td>97.8</td>
<td>62.1</td>
<td>67%</td>
<td>97%</td>
</tr>
<tr>
<td>12</td>
<td>80.4</td>
<td>67.2</td>
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<tr>
<td>14</td>
<td>56.5</td>
<td>86.2</td>
<td>76%</td>
<td>71%</td>
</tr>
</tbody>
</table>

Shear-Wave Dispersion Slope from US SWE: Detection of Allograft Damage after Liver Transplantation

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