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Ultrasonography / Échographie

Extended Field-of-View Sonography: Evaluation of the Superficial Lesions

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Abstract

Objective: To evaluate the usefulness of extended-field-of-view 2-dimensional ultrasonography technique in superficial lesions.
Methods: During a 6-month period, 44 patients with superficial lesions on various parts of their bodies were evaluated with extended-field-of-view ultrasonography in addition to routine traditional 2-dimensional ultrasonography. If the diagnosis could not be made without the extended-field-of-view images, it was considered *diagnostic*. The radiologist decided if the extended-field-of-view ultrasonography helped spatial orientation, communicate findings, or compare the contralateral side in a single image, or if it was useful for follow-up evaluation.
Results: By using extended-field-of-view imaging including the surrounding anatomy, 22 musculoskeletal, 8 scrotal, 8 thyroid, 2 breast, and 4 abdominal wall lesions were documented successfully as a single image. Nevertheless, no new cases were diagnosed solely based on the extended-field-of-view images. Extended-field-of-view ultrasonography was considered helpful for spatial orientation in 25 cases (56.8%), for comparing the contralateral side in 16 cases (36.3%), and for communicating findings in 20 cases (45.4%). It was useful for follow-up evaluation in 13 cases (29.5%).
Conclusions: None of the extended-field-of-view images was diagnostic. However, they did provide valuable additional information and better documentation of the lesions.

Abrégé

Objectif: Évaluer l'utilité de technique d'échographie panoramiques et en deux dimensions pour l'examen des lésions superficielles.
Méthodologie: Durant six mois, 44 patients atteints de lésions superficielles à différents endroits du corps ont été examinés à l'aide de l'échographie panoramique en plus de la technique classique en deux dimensions. S'il était impossible de poser un diagnostic sans l'utilisation de la technique panoramique, cette dernière était alors considérée comme d'utilité *diagnostique*. Le radiologiste devait déterminer si elle favorise l'orientation spatiale, la communication des résultats ou la comparaison avec la région controlatérale à l'aide d'une seule image ou si elle était utile lors d'évaluation de suivi.
Résultats: Grâce à la technique d'échographie panoramique permettant de visualiser la région adjacente à l'objet de l'examen, 22 lésions musculo-squelettiques, huit lésions scrotales, huit lésions thyroïdiennes, deux lésions mammaires et quatre lésions à la paroi abdominale ont été décelées à l'aide d'un seul cliché. Néanmoins, aucun nouveau cas n'a été diagnostiqué seulement au moyen des images panoramiques. Cette technique d'échographie a été considérée utile à l'orientation spatiale dans 25 des cas (56,8 %), à la comparaison de la région controlatérale dans 16 cas (36,3 %) et à la communication des résultats dans 20 cas (45,4 %). Elle a également été pratique pour la réalisation d'évaluations de suivi chez 13 patients (29,5 %).
Conclusion: Aucune des images panoramiques n'a été classée comme étant d'utilité diagnostique. Toutefois, elles ont fourni de précieux renseignements complémentaires et de meilleures preuves des lésions.

Key Words: Ultrasound; Biomedical technology; Ultrasonography

Ultrasonography (US) has several advantages over other diagnostic techniques such as magnetic resonance imaging, computed tomography, and angiography. It is less expensive, may be performed more quickly, is noninvasive, and allows

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Table 1
Anatomic sites analysed by EFOV

Anatomic site and lesions	Number of lesions	Distribution of lesions, %
Musculoskeletal	22	50
Achilles' tendon injury/rupture	5	
Posttraumatic fat replacement	2	
Lipoma	3	
Cellulitis	2	
Baker cyst	4	
Arthritis	2	
Tenosynovitis	1	
Hematoma	2	
Partial rupture of supraspinatus	1	
Scrotum	8	18
Pyocele/hydrocele	7	
Lipoma	1	
Neck	8	18
Thyroid nodule	4	
Thyroid hyperplasia	4	
Breast	2	4
Fibroadenoma	1	
Lipoma	1	
Abdominal Wall	4	9
Herniation	3	
Collection	1	

easy comparison with the contralateral healthy side. In addition, it does not include ionizing radiation. However, the limited-image field of view (FOV) of a real-time ultrasound scanner is a disadvantage because the linear array probes used to scan superficial lesions are limited to probe widths

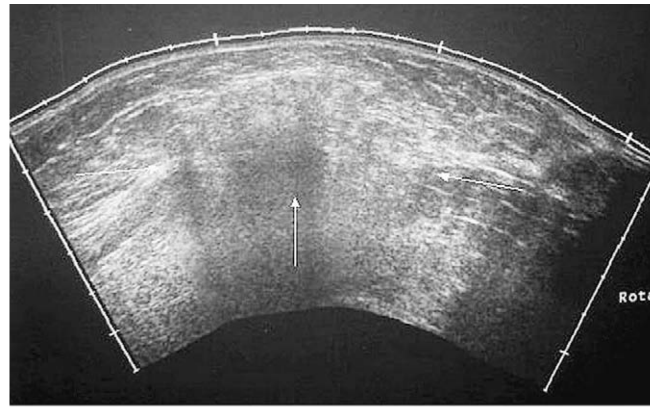

Figure 1. Longitudinal EFOV sonogram showing herniation of the intestinal segments through the big fascia defect (arrows). The 2 ends of the fascia defect could be included only in the EFOV image.

that are about 4 to 6 cm. By using split-screen technology (which basically allows combining 2 images from 2 adjacent areas), the FOV can be doubled to 12 cm [1]. Extended FOV (EFOV) technology, which enables panoramic imaging with real-time probes, was first described by Weng et al [2] in 1997. It differs from traditional US by allowing global depiction of an abnormality and its relation to adjacent anatomic structures within a single image. The purpose of this study was to evaluate the usefulness of EFOV US imaging in improving overall superficial lesion documentation.

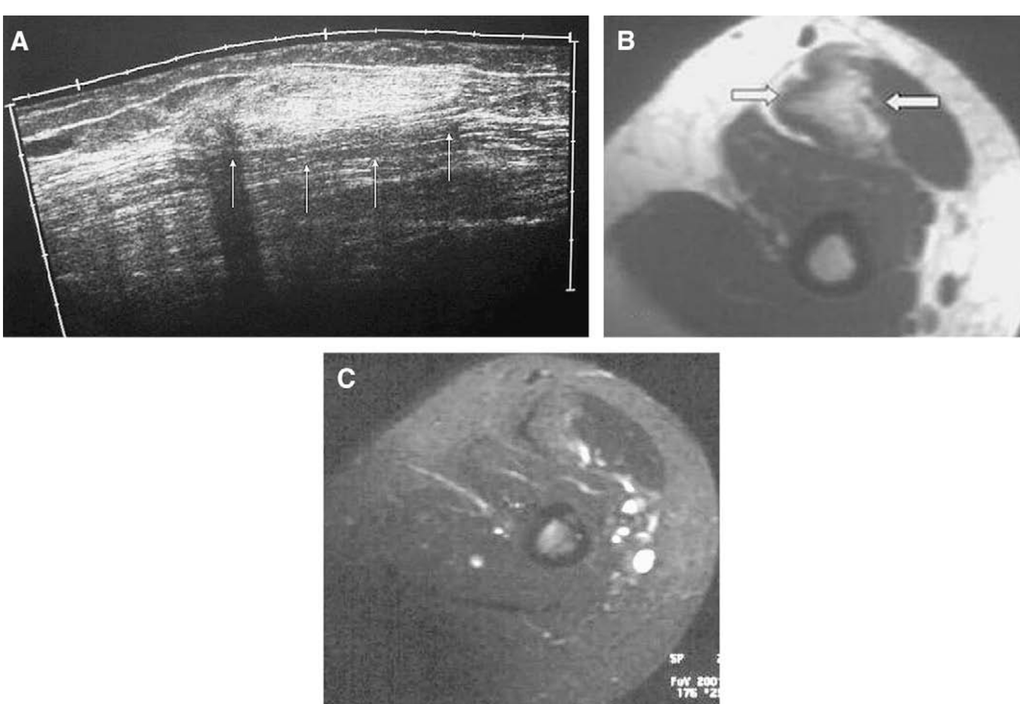

Figure 2. A 62-year-old woman with an area of posttraumatic fat replacement. (A) The entire hyperechoic solid lesion within the midportion of the right biceps muscle was imaged with the EFOV technique. (B) T1-weighted (TR/TE: 500/12) MR image shows a hyperintense lesion (between the arrows) that is (C) suppressed in the fat-suppressed sequence. TR/TE = The repetition time/The echo time.

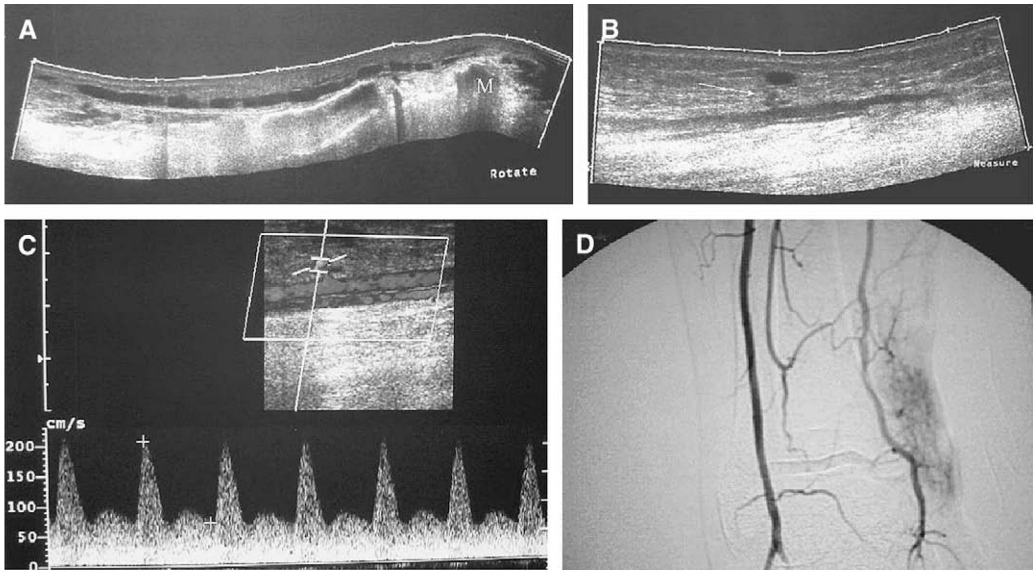

Figure 3. A 43-year-old man with cellulitis. (A) Subcutaneous oedema originating at the level of medial malleolus is seen up to the level of one third of the distal cruris. (B) A tibialis posterior branch (arrow) feeding the inflamed area at the level of the midcruris. (C) Spectral Doppler imaging showing high volume flow within the arterial structure. (D) Late arterial phase of angiography planned to exclude arteriovenous malformation confirms the EFOV findings.

Methods

For 6 months, 44 patients (24 men, 20 women; mean age, 49 y) who had superficial lesions on different parts of their bodies were evaluated with EFOV imaging during routine 2-dimensional (2D) US examinations. Five anatomic areas were identified for analysis (Table 1). The EFOV US technique was used only when the dimensions of the region of interest were larger than the FOV maintained by the transducer. All images were acquired using a SieScape, Sonoline Elegra ultrasound system (Siemens Medical Systems, Erlangen, Germany) with a multihertz linear probe operating at 5 to 9 MHz. Panoramic images were shown by placing the conventional probe on the skin, activating the SieScape button, and, to avoid distortion, slowly advancing the transducer longitudinally in a single plane over the region of interest while the examination occurred in real time. All of the patients were scanned by a radiology specialist experienced with the particular ultrasound system and the technique. The process was repeated when there was image distortion because of patient movement or because of surface irregularity. For each patient, the radiologist commented on the usefulness of EFOV images in 5 categories. If the diagnosis could not be made without the EFOV images, it was considered *diagnostic*. The radiologist also had to decide if the EFOV images helped with *spatial orientation*, *communicate findings*, or to *compare the contralateral side* in a single image. Again, the radiologist determined if the EFOV images would be helpful for *follow-up* evaluation.

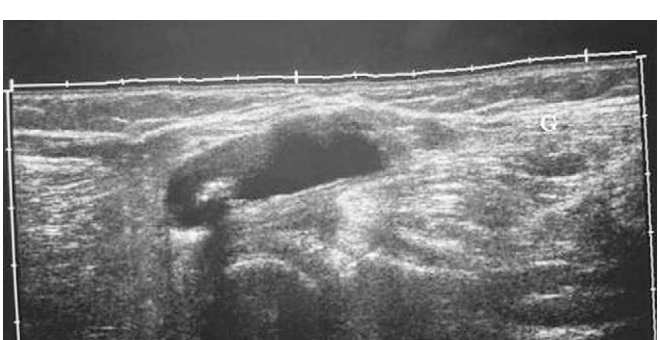

Figure 4. A 36-year-old woman with pain in her right knee. Longitudinal EFOV sonogram showing the full extent of the lesion from the medial popliteal fossa to the superomedial portion of the gastrocnemius muscle (G) which was helpful in the spatial orientation.

Results

A total of 44 lesions were documented with EFOV imaging. The lesion distribution and anatomic areas examined by EFOV sonography are shown in Table 1. When compared with smooth surfaces, there was more image distortion while scanning the articular surfaces, and the time needed to obtain an EFOV image in these surfaces was greater. However, all of the lesions were documented successfully with EFOV imaging as single images that included the surrounding anatomic context. The FOV documented by the EFOV composite

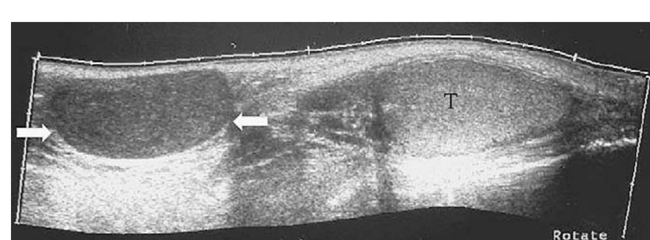

Figure 5. Patient with a palpable mass in the inguinal region. Longitudinal EFOV sonogram showing a hypoechoic solid lesion (arrows) at the superolateral aspect of the right testis (T). The pathologic diagnosis confirmed lipoma.

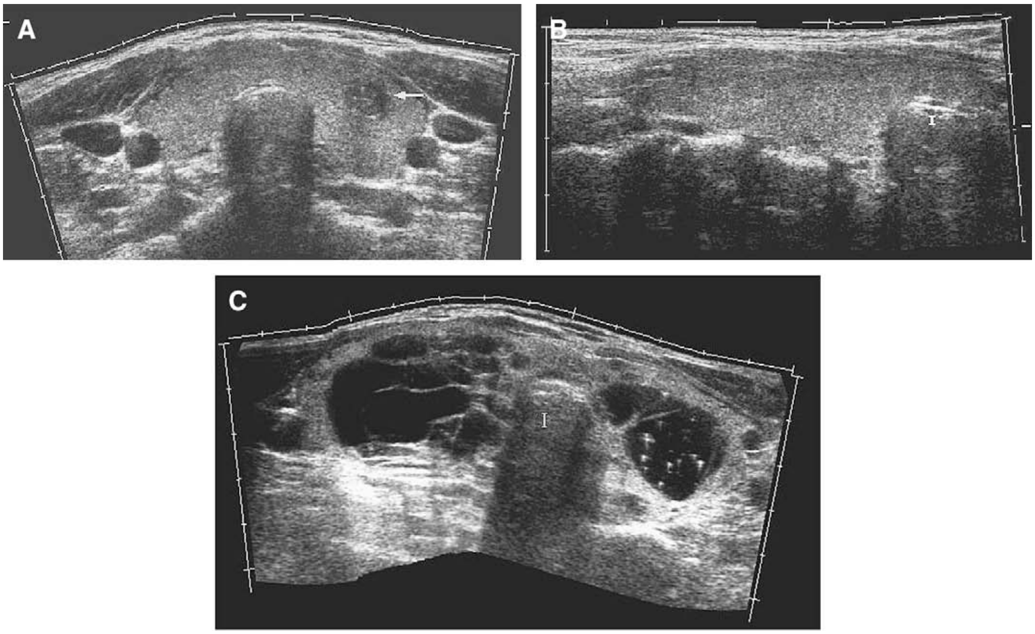

Figure 6. Transverse EFOV sonogram showing both thyroid lobes and isthmus in the same image, (A) allowing comparison of parenchymal textures of both lobes (arrow shows a nodule). (B) The longitudinal EFOV sonogram covering the whole vertical dimension of the hypertrophic lobe together with the isthmus facilitating the routine measurements. (C) Transverse EFOV sonogram of another thyroid gland showing multiple cystic nodules (I, isthmus).

images ranged from 6 to 15 cm (mean, 10 cm). The time needed to acquire a panoramic image varied between 30 seconds and 5 minutes (mean, 3 min).

Successful EFOV images that allowed measurement of the abnormality could be obtained in every case (Figures 1 and 2). All diagnoses were readily made by traditional 2D imaging so that none of the EFOV images were actually *diagnostic*. However, in 1 patient with cellulitis, a tibialis posterior branch with a high flow volume could be documented only by EFOV images and was missed with traditional US (Figure 3). The diagnosis of cellulitis could be made by the real-time images, and the EFOV images again were not diagnostic in this case; however, they provided additional information. EFOV images were considered helpful for spatial orientation in 25 cases (56.8%) (Figures 4 and 5), helpful for comparing the contralateral side in 16 cases (36.3%) (Figure 6), helpful for communicating findings in 20 cases (45.4%) (Figure 7), and useful for follow-up evaluation in 13 cases (29.5%) (Figure 8). The distribution of the contributions of the EFOV images to routine US scanning is summarized in Table 2.

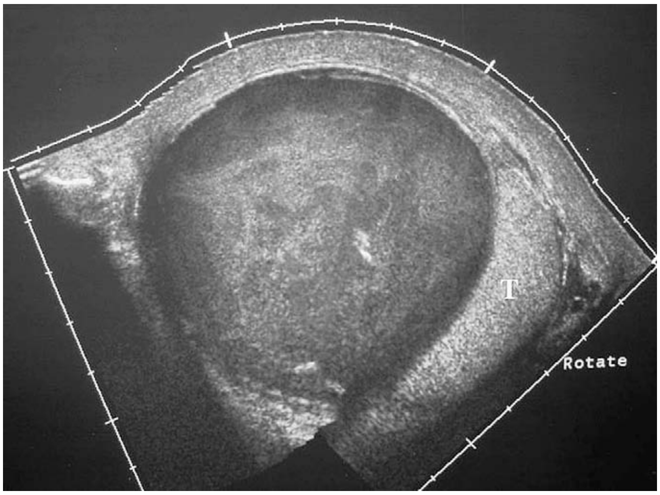

Figure 7. Compression effect on the right testis (T) caused by the right hemiscrotal pyocele is documented successfully by the transverse EFOV sonogram. Oedema within the cutaneous and subcutaneous tissue also is shown.

Discussion

US is a highly popular imaging modality with well-known advantages. A limitation of US, as compared with sectional imaging methods, is its restricted FOV [2,3]. The EFOV imaging technique enables us to obtain an image with a FOV larger than an ultrasound probe can obtain. After activating the EFOV option on ultrasound machines that have EFOV US software (ie, Logiq View; GE, Milwaukee, WI; Panoramic Imaging; Philips, Eindhoven, The Netherlands; SieScape; Siemens, Erlangen, Germany; Panoramic View; Toshiba, Tokyo, Japan), the probe slowly is advanced longitudinally in a single plane over the region of interest while the examination takes place in real time. The motion of the transducer is calculated by the computer, and sequential images are reconstructed as a large panoramic view without a loss in resolution. Because this method is sensitive to any change in position, patient stability during probe motion is crucial for increasing image quality and preventing artifacts [2]. The application can be performed by all US probes [4]. The potential contributions of EFOV US are greatest with high-frequency linear transducers. This is why we chose to study the use and helpfulness of EFOV US in superficial lesions.

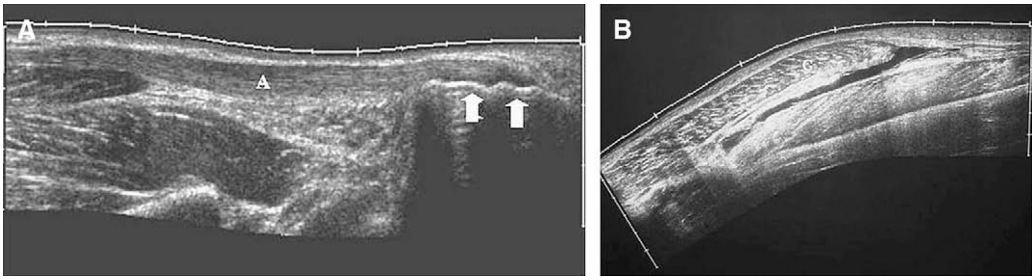

Figure 8. (A) Longitudinal sonogram of a normal Achilles' tendon (A, Achilles' tendon; arrows, calcaneus). (B) The extent of the collection posterior to the Achilles tendon and the gastrocnemius muscle was later followed-up by repeated ultrasounds (G, gastrocnemius muscle).

Table 2
EFOV additions to routine US

	Number of lesions	%
Diagnostic	None	0
Helpful for spatial orientation	25	56.8
Useful for comparison	16	36.3
Useful for communicating findings	20	45.4
Helpful for follow-up evaluation	13	29.5

In our study, EFOV US was used simply when the region of interest was greater than the FOV maintained by the transducer. This appears to be the most frequent indication for using the EFOV US technique [4–6]. The EFOV images take additional time after routine 2D gray-scale ultrasound. However, obtaining EFOV images appears to be easier than trying to combine 2 images including 2 different parts of a large lesion. In our study, the mean time needed to acquire a panoramic image was 3 minutes. Ying and Sin [7] concluded that in distance measurements, EFOV sonography has greater accuracy and reliability than dual-imaging US. Phantom experiments have confirmed that EFOV sonography is accurate in measurements of distances up to 40 to 60 cm [2,8].

Consistent with the results of most studies [4,6], EFOV images in the current study were not diagnostic in any of the cases. In 1 patient, they were useful for documenting a tibialis posterior branch with a high flow volume that could not be shown by real-time images. However, this was additional information, and the diagnosis of cellulitis already had been made with traditional images.

In our series, EFOV images were considered helpful for spatial orientation in 25 cases (56.8%), especially in musculoskeletal imaging, in the evaluation of complex anatomic relationships between the bone structures and pathologic soft-tissue areas. However, it is more difficult to obtain an EFOV image without distortion from articular surfaces, and the time needed to acquire an EFOV image in articular surfaces is greater than that needed to acquire the image in smooth surfaces.

In 16 cases (36.3%) consisting of 8 scrotal and 8 thyroid lesions, EFOV US was helpful for comparing the contralateral side. EFOV images made it possible to image both thyroid lobes and testicles within the same image. This might be helpful when the diagnosis depends basically on comparing parenchymal textures, as in the case of thyroiditis or epididimo-orchitis. When there is no inflammatory process, EFOV US still might be helpful in showing the uniformity of both sides and excluding suspicions.

In this study, EFOV US provided additional information by communicating findings in 20 patients (45.4%). EFOV US was useful in the follow-up evaluation of 13 patients (29.5%). The use of EFOV US appears to make follow-up evaluation easier of lesions located in wider areas such as collection, Achilles' tendon injury, and abdominal wall herniation. Reiter et al [9] have reported that the combination of EFOV US and gray-scale sonography improved sensitivity in diagnosing Achilles' tendon diseases.

In conclusion, although EFOV imaging cannot take the place of traditional US because EFOV imaging is infrequently diagnostic, the technique may be useful for showing spatial relationships, communicating findings, comparing the contralateral side, and follow-up evaluation. Further study combining different sonographic techniques such as EFOV US and tissue harmonic imaging may be helpful in improving lesion documentation in different anatomic areas.

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