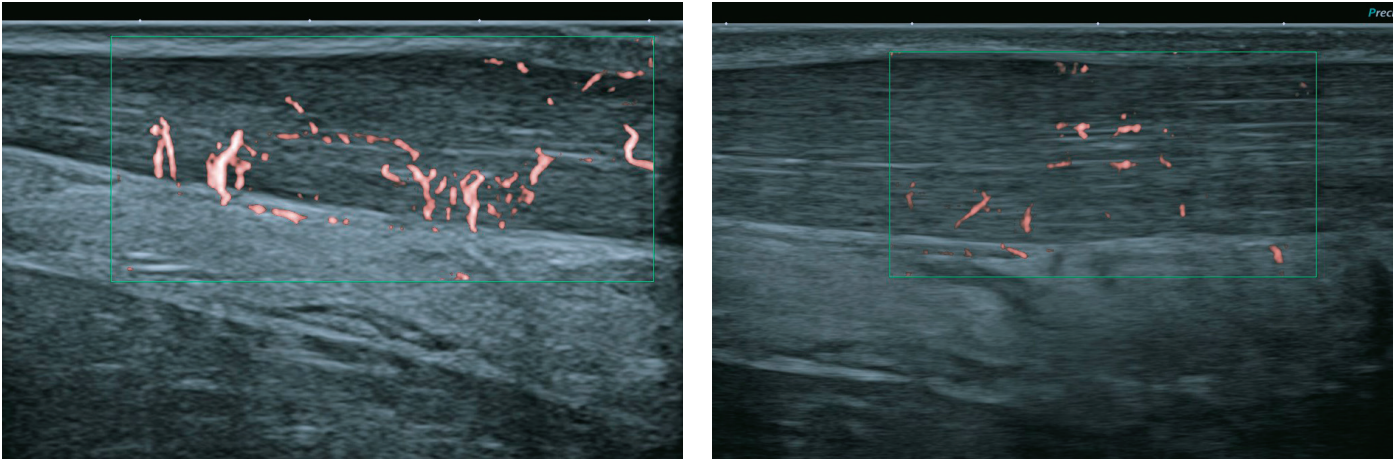


Preliminary Experience of  
Ultra-High Frequency Imaging



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*Made For life*

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INTRODUCTION

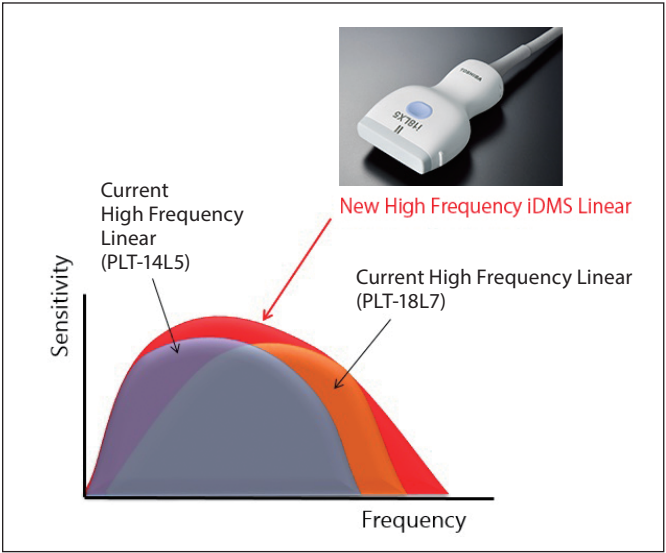
The advancing technological improvements of high frequency linear transducers offer significant clinical benefits for ultrasound operators where the anatomical structures and hemodynamics of minute vessels can be delineated with clarity and definition. These advances in high frequency transducers are of particular benefit where very high resolution is paramount. For example, in musculoskeletal (MSK) and peripheral nerve imaging, small parts (salivary and thyroid glands), as well as soft tissue “lumps and bumps.” The detailed information of the surrounding vasculature can also be of significant diagnostic benefit.

Incorporating the innovative iBeam forming technology, front-end Intelligent Dynamic Micro-Slice technology (iDMS) and latest transducer components, two new high frequency linear transducers have been developed for the Aplio i-series. These technologies produce a sharp, fine and uniform ultrasound beam. The grayscale images have enhanced

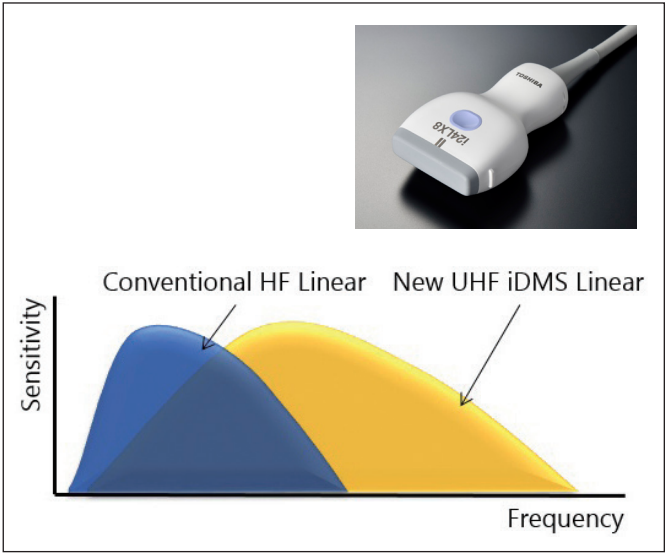
resolution and penetration while the Doppler sensitivity is improved, especially with Superb Micro-vascular Imaging (SMI), enabling depiction of neovascularity not possible with conventional Color/Power Doppler.\*

The ultra-wideband high frequency 18 MHz linear transducer covers the frequency range normally provided by two previous conventional linear transducers (14L5 and 18L7) and provides optimum resolution and penetration in one transducer. This two-in-one transducer can therefore enable more effective transducer management.

The outstanding new development however, has to be the ultra-high frequency probe which utilizes frequencies of up to 24 MHz. This new probe provides exquisite spatial resolution on both grayscale and Doppler imaging but with surprisingly sufficient penetration for it to be utilized in routine clinical scans. This elevated frequency range expands the horizon of clinical ultrasound.



Ultra-wideband high frequency linear transducer



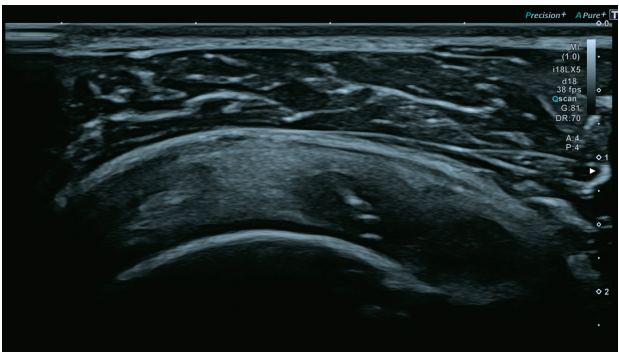
Ultra-high frequency linear transducer

CASE STUDIES

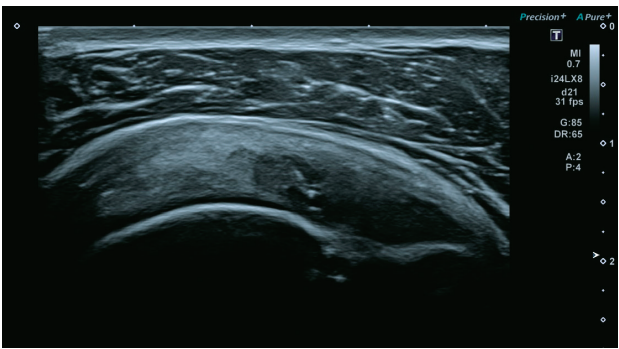
MSK

Case 1: Supraspinatus Tear

A former cricket player complained of ongoing shoulder pain. Using the i18LX5, a partial width, partial thickness, humeral surface supraspinatus tear was identified. However, with the i24LX8, the tissue structures and tear were delineated with greater detail and definition. The high resolution of the ultra-high frequency transducer allows greater diagnostic confidence which may reduce the need for further imaging and thus expedite treatment.



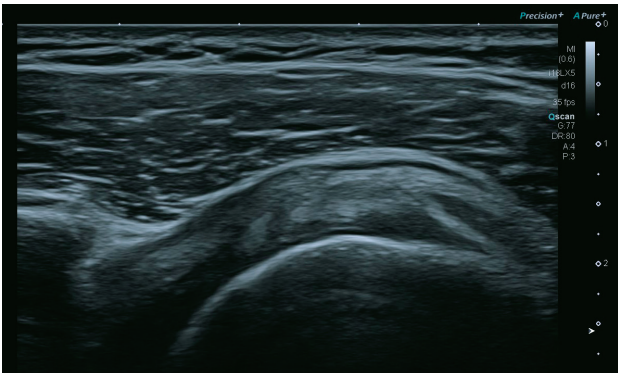
i18LX5



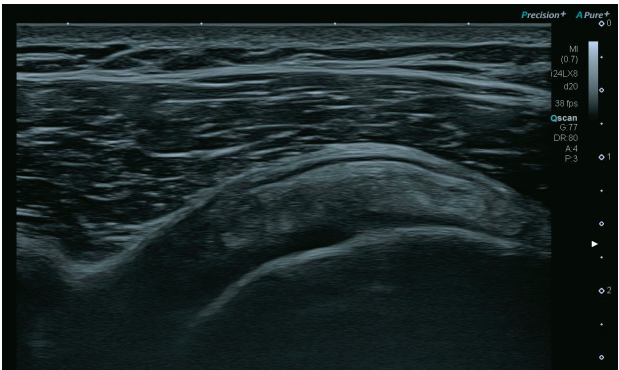
i24LX8

Case 2: Supraspinatus Tendinosis and Subacromial Subdeltoid Bursitis

The i18LX5 shows detailed structures with good penetration for an operator to perform this routine examination rapidly with good diagnostic confidence. The i24LX8, shows significantly increased tissue detail in the near field and with sufficient penetration through the whole supraspinatus tendon for it to be diagnosed clinically. These paired images demonstrate the capabilities of both the i18LX5 and particularly the adequate penetration of the ultra-high frequency transducer, i24LX8, which allows it to be utilized in general MSK imaging.



i18LX5



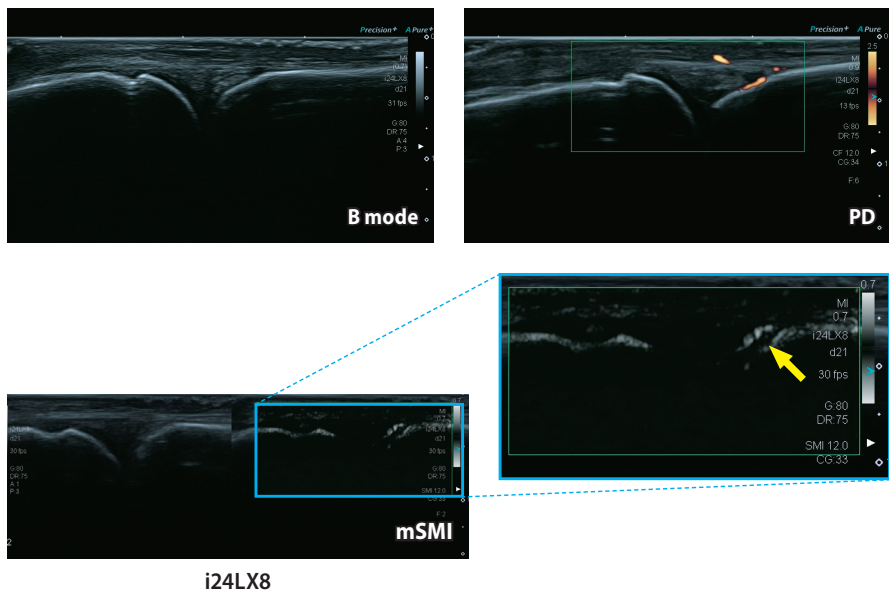
i24LX8

\*Compared to Aplio 500 Platinum



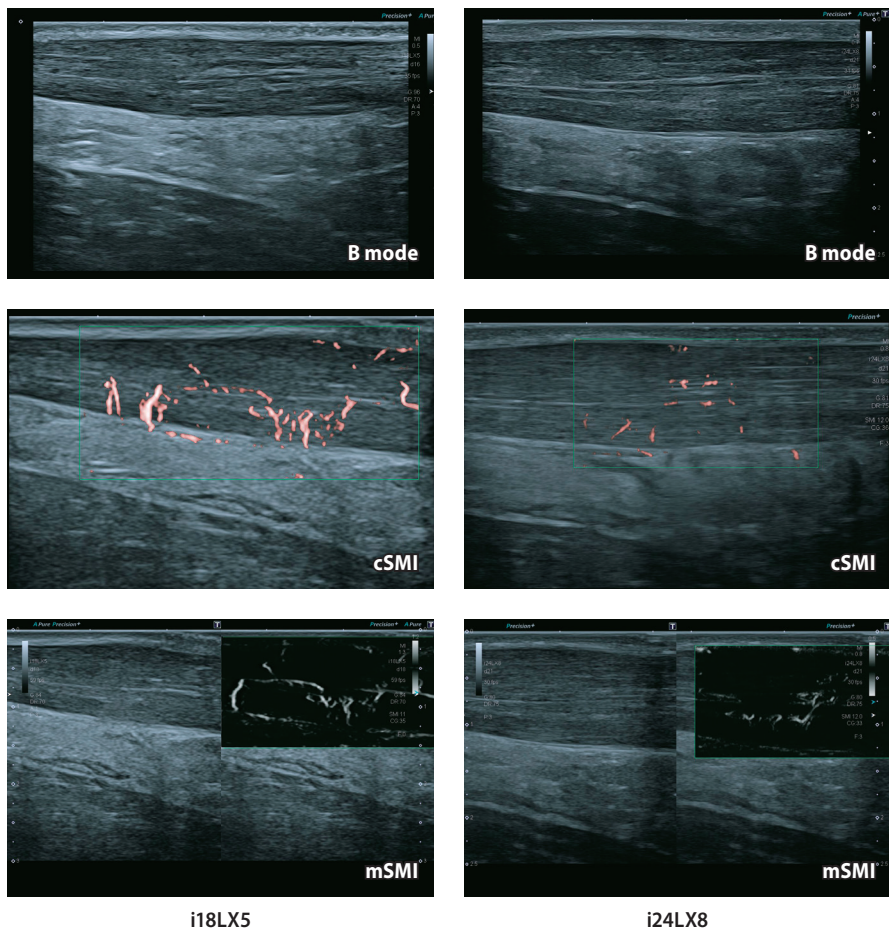
Case 3: Rheumatoid Arthritis

This female patient with known rheumatoid arthritis complained of mild tenderness in the left metacarpophalangeal joint (MCPJ) of her index finger. She was referred for an ultrasound scan of the joints in her hand to assess if there was any active synovitis. The detailed B mode of the i24LX8 probe shows a relatively normal joint with no synovial hypertrophy, effusion or erosions. However, vascular flow can be detected within the joint using SMI but not with Power Doppler (PD). Her other, non-symptomatic joints did not demonstrate any vascular flow with SMI or PD. Doppler ultrasound is currently the gold standard for denoting active synovitis in small joints. SMI can add information that can be even more effective in visualizing active inflammation in patients with arthritides, to assist in treatment planning.



Case 4: Mid-Substance Achilles Tendinopathy

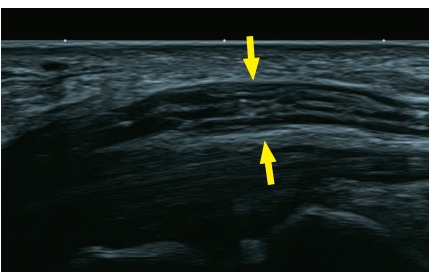
Both i-series linear transducers show good detail of the thickened Achilles tendon and also depiction of the neovascularity confirming the diagnosis. However, utilizing the ultra-high frequency transducer, the subtle fusiform thickening and tendon structure is better delineated with higher detail although there is slight reduction in the Doppler signal.



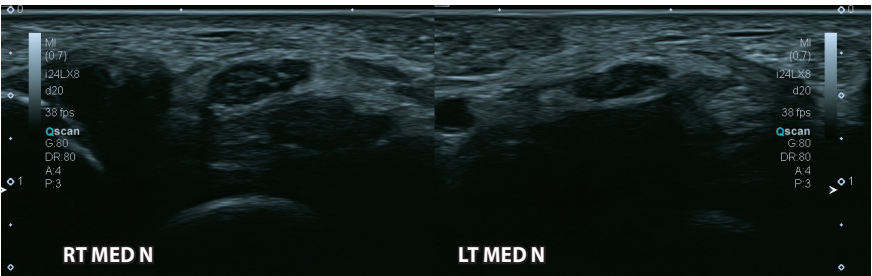
Peripheral Nerves

Case 1: Median Nerve

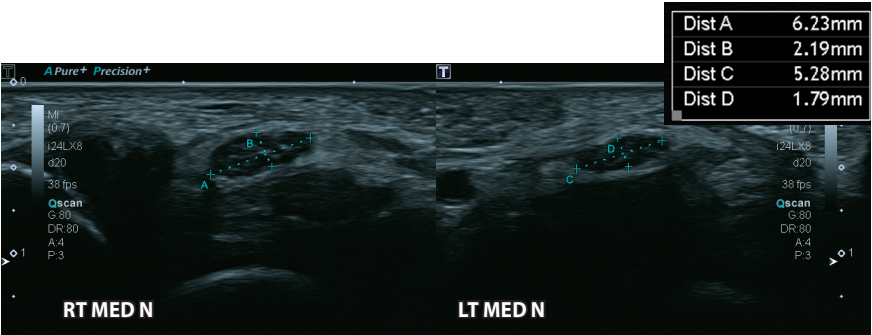
This case demonstrates a thickened right median nerve compared with the left median nerve at the level of the flexor retinaculum compatible with a diagnosis of right carpal tunnel syndrome. Using the i24LX8, the ultra-high frequency allows depiction of the neurofibrillar structures in great detail and appreciation of the subtle focal thickening. The measurements highlight the difference between the two median nerves adding to the diagnostic confidence.



Median nerve longitudinal view demonstrates focal thickening (between arrows)



Right median nerve compared to left median nerve

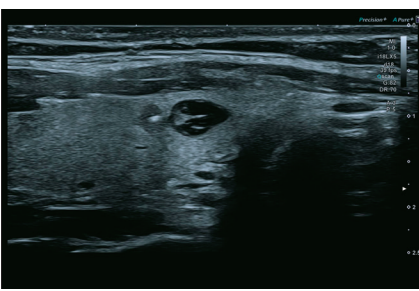


Right median nerve compared to left median nerve with measurements

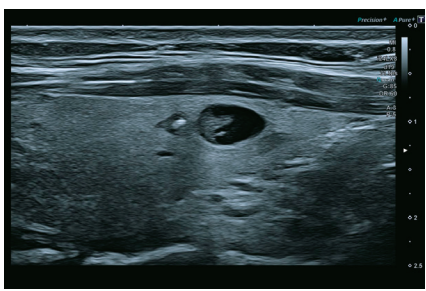
Thyroid

Case 1: Thyroid Nodules

These paired images are of a patient with hypothyroidism and multiple semicystic/solid nodules. Both i-series transducers outline the internal structures of the thyroid nodules well. However, with the i24LX8, the contour and border of the smaller nodule are sharper and there is no loss of penetration even working at this very high frequency. This greater clinical detail may aid diagnosis and better classification of thyroid nodules.



i18LX5



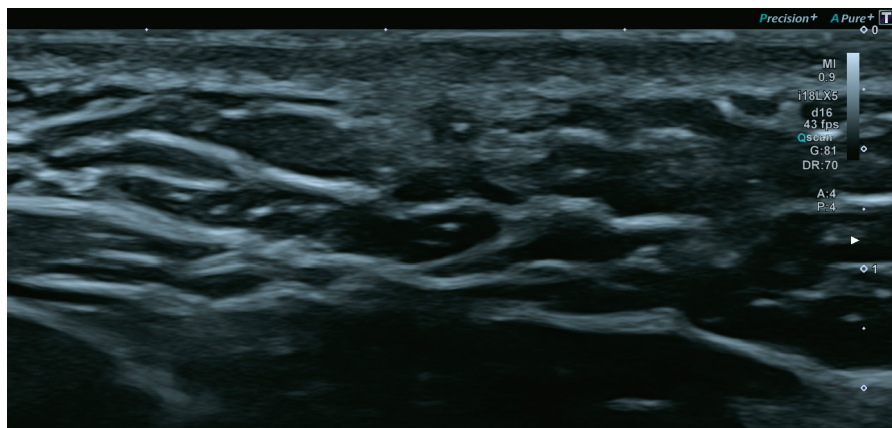
i24LX8



Dermatology

Case 1: Small Sebaceous Cyst

**Case 1a**  
This small, palpable three millimeter subcutaneous lesion can be easily detected using the i18LX5 probe. However, the subtle track leading to the skin can be clearly delineated when scanning with the i24LX8, confirming a sebaceous cyst. These paired images again show off the fine detail resolution from the ultra-high frequency probe, enabling accurate diagnostic capability which may reduce the need for further confirmatory intervention or follow-up interval scans. Note the subtle echogenicity around this tiny cyst suggesting edema and inflammation.



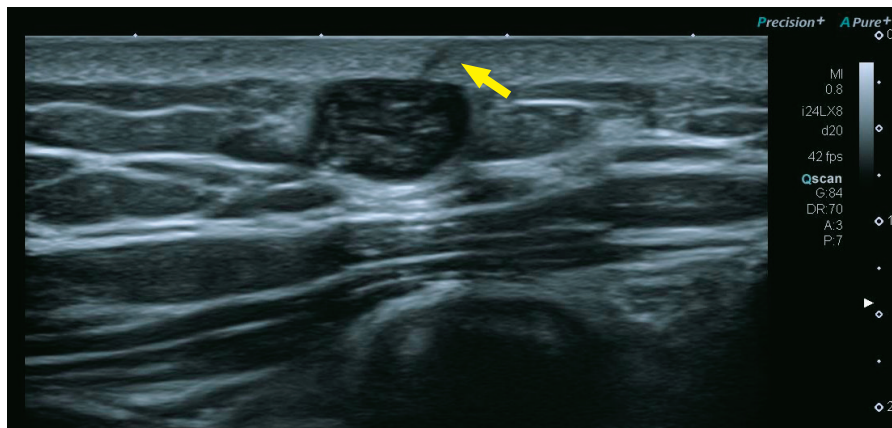
i18LX5



i24LX8

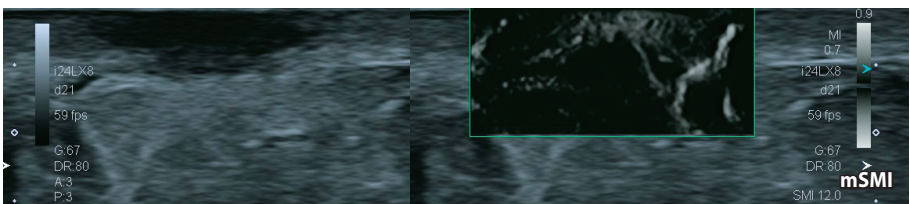
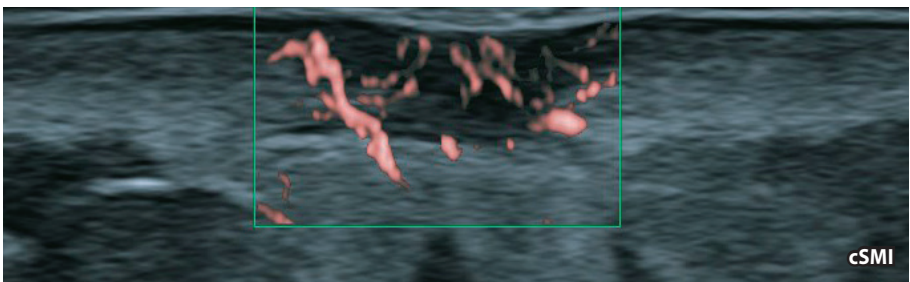
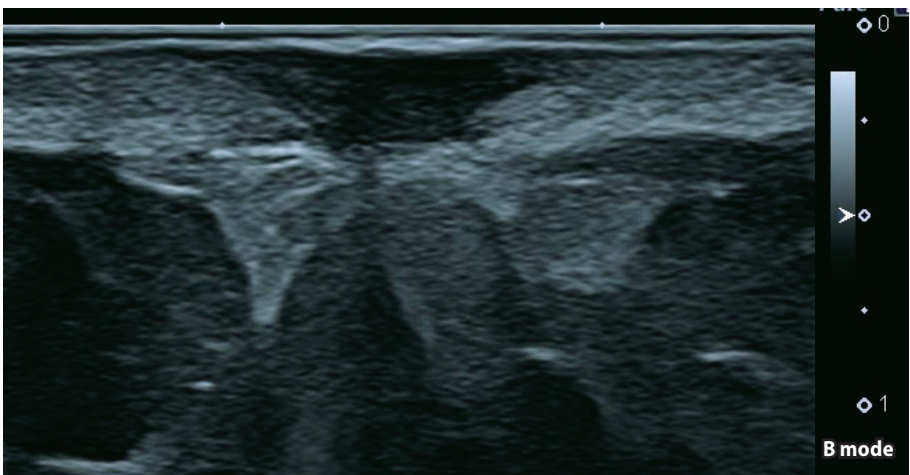
Case 1b

This is a male patient with a sebaceous cyst where the dermal track is shown on the i24LX8. The information allowed for an accurate and confident diagnosis without any further testing.



Case 1: Infected Malignant Skin Ulcer

The superb image quality of Doppler imaging on i24LX8 in the near field is demonstrated in this infected malignant skin ulcer. cSMI and mSMI denote the extensive and rich hypervascular network of capillaries. High resolution is not appreciated with lower frequency.



i24LX8

CONCLUSION

The Aplio i-series is equipped with two extraordinary transducers, the ultra-wideband frequency linear transducer i18LX5 (a two-in-one probe) and the ultra-high frequency 24 MHz linear transducer i24LX8. The Doppler sensitivity and grayscale resolution of both probes are a significant improvement on previous technologies. The combination of these probes allows greater diagnostic confidence as anatomical structures and vascularity are delineated in very high detail. The 24 MHz transducer offers high resolution images in the near field without the loss of penetration that might be expected at this ultra-high frequency. This has opened up a new horizon of clinical applications which are currently under evaluation.

The clinical results described in this paper are the experience of the author. Results may vary due to clinical setting, patient presentation and other factors.