GE Healthcare

Clinical impact of Volume Ultrasound for Musculoskeletal imaging

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Introduction

Three-dimensional multi-planar ultrasound in combination with high-frequency transducers improves the understanding of complex anatomical relationships, assists in surgical planning of tendon and muscle tears, and measures the true volume of soft tissue masses. Volume Ultrasound is an important, non-invasive adjunct to two-dimensional (2D) imaging for musculoskeletal applications.

The Volume Ultrasound toolset includes Virtual Organ Computer-aided Analysis (VOCAL), which is a semi-automated measurement tool that is especially useful in calculating the volume of complex lesions. The volume is automatically calculated by the trackball tracing of a region of interest. By means of a step-by-step approach, VOCAL calculation builds its accuracy by adjusting the measurement to the shape of the target structure. Assumptions about the object's shape are no longer necessary.

Soft tissue masses are easily identified and quickly diagnosed with Volume Ultrasound. The 4D16L volume transducer displays the anatomy in real time multi-planar mode. The coronal plane, unavailable with conventional ultrasound imaging, enables visualization of a mass and its relationship to surrounding vital structures in a fascinating new imaging plane. A surface rendering can also be created, allowing better characterization of the capsule of a mass.

The following cases demonstrate the clinical impact of Volume Ultrasound on the LOGIQ®9 ultrasound system (GE Healthcare, Wauwatosa, WI) for musculoskeletal imaging in the Henry Ford diagnostic radiology clinic.

Case 1

A young female presented with focal pain in the upper arm.

Figure 1
While scanning in the transverse plane, real-time transverse, coronal, and sagittal images of the median nerve are displayed. Coronal images (bottom left), which can only be obtained by volume scanning, show the relationship of the mass relative to the long axis of artery and median nerve, a pathologic display unique to Volume Ultrasound.

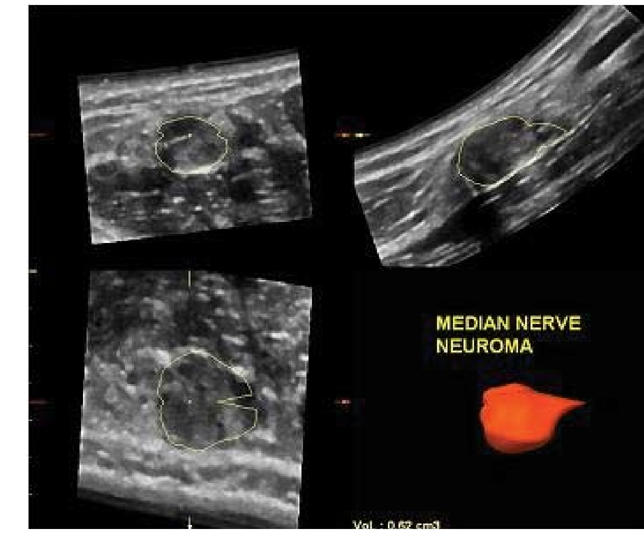

Figure 2
VOCAL was used to determine the volume of the median nerve neurilemoma. The unusual shape of the mass demonstrates the physiopathology of the neurilemoma, which is a tumor originating from the nerve sheath; therefore, not surprisingly, the mass appears as if pasted against the nerve (image bottom right).

Case 2

A female neonate presented with a left hip click.

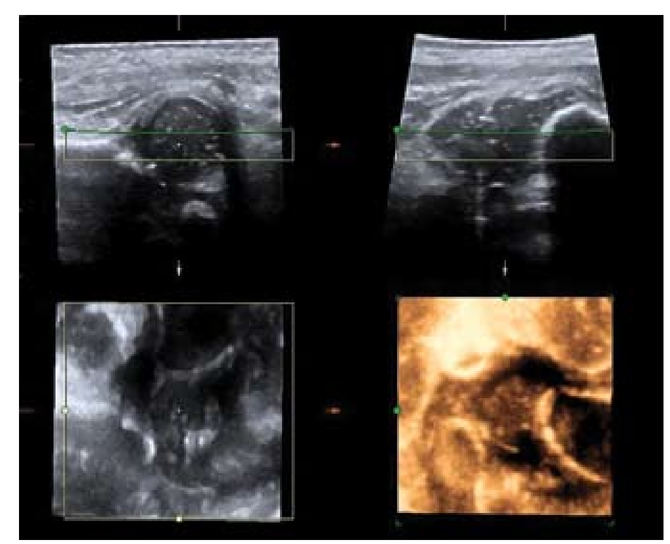

Figure 3
Hip Dysplasia is characterized by an abnormal relationship in the hip joint. An unstable hip joint can cause abnormal wear and tear on the femoral head and acetabulum.[1] Coronal, sagittal and axial views, which have been obtained simultaneously, illustrate a normal anatomic relationship of the femoral head to the acetabulum in this neonate and demonstrated no hip dislocation.

Case 3

A newborn presented with sacral dimple.

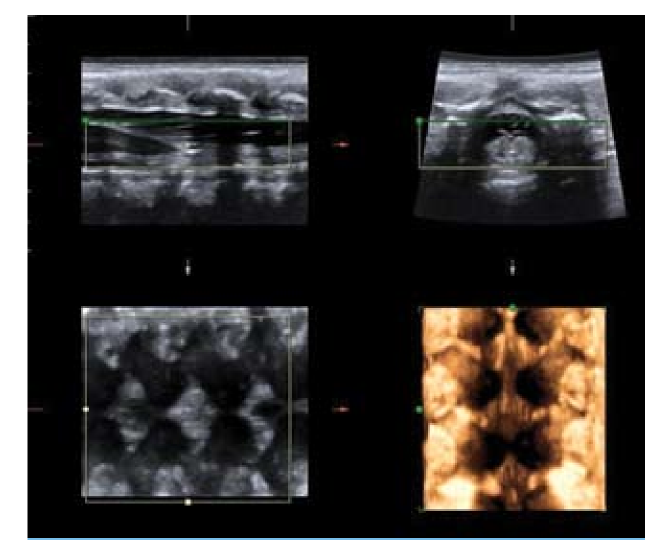

Figure 4
Pediatric spine anatomy illustrates the location of the conus medullaris at the level of the first lumbar vertebra.[2] The sagittal image in the left upper quadrant demonstrates the conus, spinal fluid and nerve roots. The 'doughnut shape' of the conus is shown on the axial image in the right upper quadrant. Images in the lower half of the composed image depict cartilage of the laminae. No abnormality was detected.

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Case 4

A nineteen year-old soccer player has difficulties kicking the ball after hitting a fire hydrant.

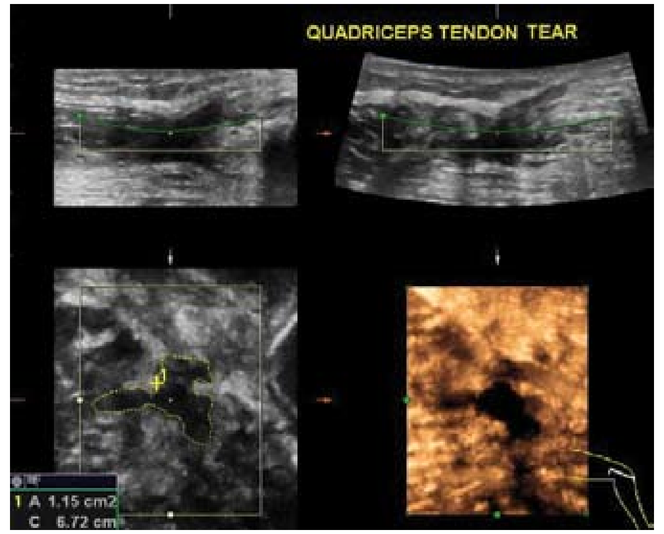

Figure 5
Volume Ultrasound allows for the measurement of complex tears, such as the incomplete quadriceps tendon tear shown in this figure, providing the surgeon a roadmap for surgical planning and follow-up. This tear affected the vastus medialis obliquus only. The lesion was treated conservatively and with a positive result.

Case 5

A 42-year-old consults the orthopedic surgeon for pain in the arm while lifting. The supraspinatus tendon showed a partial tear. The subscapularis was assessed because of weak internal rotation of the arm.

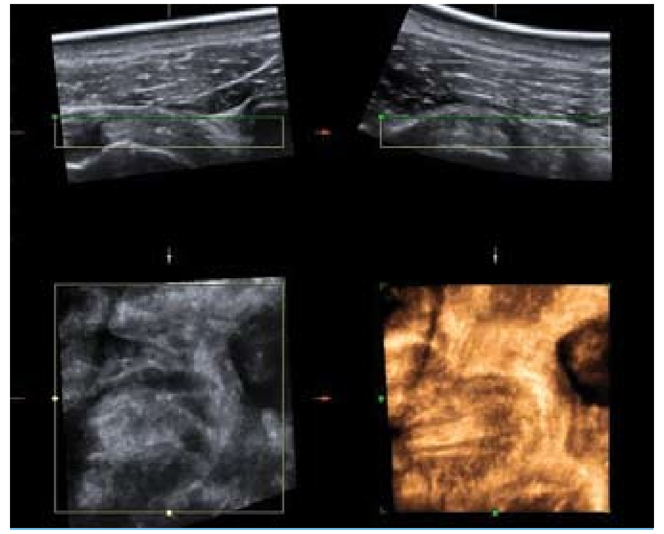

Figure 6
Normal subscapularis anatomy can be displayed in true coronal views with Volume Ultrasound. Bottom images show the true coronal image of the subscapularis (left) and the surface rendering of the subscapularis showing the different bundles of the tendon (right). This image can only be obtained with volumetric scanning as illustrated here. Prior to rotator cuff surgery and in the assessment of shoulders prior to joint replacement, the intactness of this cone-shaped muscle is critical information for the surgeon.

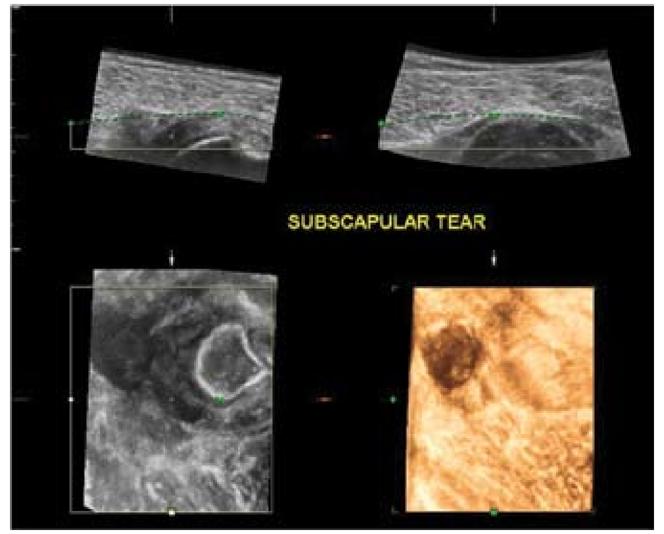

Figure 7
Subscapular tear is easily recognizable and can be readily measured and quantified using the VOCAL volume calculation tool. In this 66-year-old patient, the cone shaped subscapular tendon is totally absent.

Conclusion

Volume Ultrasound provides significant clinical benefits to musculoskeletal imaging applications. By re-assembling the region of interest in its totality, the three-dimensional view makes recognition far simpler than traditional 2D methods. The 4D16L transducer allows for real-time coronal, sagittal, and transverse images that can be pushed to an independent workstation seconds after initiation of the study. Complex studies can be scanned and a virtual rescan can be used through raw data capability. Tracing of lesions results in accurate volume calculation of tumors, as well as precise measurement of complex tears. Such data show the anatomy in a simplified and summarized form to surgeons prior to intervention.

Marnix T. Van Holsbeeck, M.D.

Dr. van Holsbeeck received his medical degree from Catholic University of Leuven, and post graduate training in Musculoskeletal Radiology from the University Hospital Gasthuisberg in Belgium. He has authored and co-authored more than 75 peer-reviewed papers on orthopedic radiology, and has presented over a hundred scientific lectures both nationally and internationally. Dr. van Holsbeeck has published three editions of his book entitled Musculoskeletal Ultrasound. The International Skeletal Society awarded him the Presidents Medal in 1995. Recently, he has been a guest editor for the bimonthly Radiologic Clinics of North America, lending his expertise on the subject of musculoskeletal ultrasound. Dr. van Holsbeeck is currently a member of the Department of Diagnostic Radiology at Henry Ford Hospital in Detroit, Michigan.

References

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2. Hill, CA, Gibson, PJ. Ultrasound determination of the normal location of the conus medullaris in neonates. AJNR. American journal of neuroradiology. 1995 16: 469-472.

Acknowledgement

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