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# ROLE OF REAL TIME STRAIN ELASTOGRAPHY IN MUSCULOSKELETAL SYSTEM: PICTORIAL ESSAY

Radiodiagnosis


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## ABSTRACT

Sono-elastography is an ultrasound-based newer imaging technique that is currently being used for the evaluation of breast, thyroid, prostate, pelvic masses, lymphnodes, cervix and hepatic pathology. Musculoskeletal applications are a relatively new field where it is being tried.We are presenting a pictorial essay of various musculoskeletal conditions seen in our rural based tertiary care centre.



## KEYWORDS

Elastography, Musculoskeletal, Achilles tendon, Supraspinatus, Synovium, soft tissue tumors


**Introduction: -**

Elasticity of soft tissues is defined as tissue deformability, which is determined by the structure and composition [1] Elastography is a method that can ultimately generate several new kinds of images, called elastograms. As such all properties of elastograms are different from familiar properties of sonograms. While sonograms convey information related to the local acoustic backscatter energy from tissue components, elastograms relates it to its local strains, Young's moduli or poisson's ratios. In general, these elasticity parameters are not directly correlated to sonographic parameters i.e.elastography conveys new information about internal tissue structure and behaviour under load that is not otherwise obtainable. [2] Throughout history, the stiffness of tissues has been used as a marker of disease, through palpation. Generally, malignant tissues are stiffer or harder than benign tissues, a feature which can be distinguished through direct palpation, corresponding to manual compression. This concept has been extended within the field of ultrasound, with maps of tissue stiffness generated alongside anatomical images. [3] There are several sonoelastography methods available depending on the method of stress application and the objectives. The main techniques used include compression elastography, shear-wave elastography, and transient elastography. Each of these techniques takes advantage of different physical performance properties, artifacts, limitations, and suitability for specific clinical applications. [4]

**Tsukuba scoring system: -** Itoh et al in 2006 gave a scoring system. A score of 1 indicated even strain for the entire hypoechoic lesion (i.e., the entire lesion was evenly shaded in green). A score of 2 means strain in most of the hypoechoic lesion, with some areas of no strain (i.e., the hypoechoic lesion had a mosaic pattern of green and blue), A score of 3 implies that strain at the periphery of the hypoechoic lesion, with sparing of the center of the lesion (i.e., the peripheral part of lesion was green, and the central part was blue). A score of 4 shows no strain in the entire hypoechoic lesion (i.e., the entire lesion was blue, but its surrounding area was not included. A score of 5 indicated no strain in the entire hypoechoic lesion or in the surrounding area (i.e., both the entire hypoechoic lesion and its surrounding area were blue). BGR represents typical artifactual three layered aspect (blue-green-red) encountered with cystic lesions. In strain patterns, score 1, 2 and 3 emphasized benign features whereas masses with scores of 4 and 5 were considered as malignant. [5]

**Strain Ratio Measurement**

A semi quantitative method of lesion assessment, termed as strain ratio (SR) measurement, has also been developed. Calculation of the SR value is based on determining the average strain measured in a lesion and comparing it to the average strain of a similar area of adjacent tissue. Using proprietary software, the average strain of the lesion is determined by selecting a region of interest (ROI) encompassing the lesion; the value of strain ratio increases as a function of the relative stiffness of the target lesion. As the Strain Ratio increases, the likelihood of cancer is also higher. [6]

**Achilles Tendon**

The Achilles tendon is the largest tendon in the body and it is easily accessible for imaging. Tendons in young healthy people usually demonstrate a predominant blue color, suggesting a hard nature with less deformability. [7] In case of tendinitis blue colour is replaced by red and green indicating soft nature of the tendon.

**Supraspinatus tendon**

The supraspinatus tendon can be very well assessed by high resolution ultrasound. The supraspinatus tendon is commonly injured and it is also affected by tendinosis. The tendons in asymptomatic young individuals showed a predominant blue color that represented hardness while those with tendinosis showed a predominant green to red color indicating varying degrees of softness.

**Synovium**

Synovial hypertrophy is commonly seen in inflammatory and infective disorders. The synovium shows a predominant firm to soft consistency in infective synovitis, i.e., a predominant red color with patchy green areas and firm consistency (a predominant green color) in inflammatory synovitis. Lipoma arborescence is seen as villous lipomatous proliferations in predominant red color with few areas of green suggesting soft to firm consistency. [8]

**Tumors and Tumor like processes**

Soft-tissue elasticity is thought to correlate with malignant potential; malignant tumors are commonly harder than benign tumors. [9] Blue variations predicted malignancy more accurately. Sonoelastography helps clarify ambiguous soft tissue lesions identified using conventional ultrasound techniques. [10] In 2010 Bhatia et al concluded that in non nodal neck masses lesion stiffness was high for neurogenic tumors/neuromas, epidermoids and metastasis and low for lipomas, lymphatic/venous vascular malformations, thyroglossal duct cyst and branchial cleft cysts. [11]

**CONCLUSION**: -

Real time strain elastography is a useful adjunct to sonography for diagnosis of musculoskeletal lesions and may help clinicians to improve the patient care.

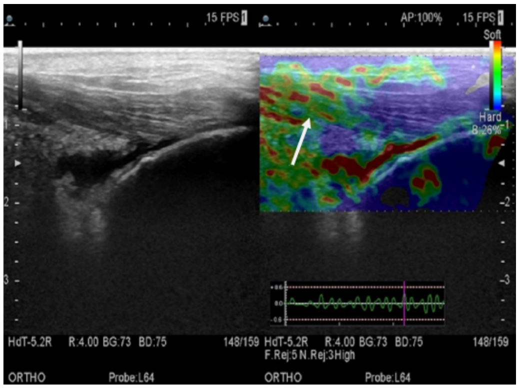


**FIG1] Tendo Achilles at insertion shows normal stiff blue colour. In its proximal part red and green colour is seen suggestive of tendinitis (white arrow). Retrocalcaneal bursitis is also seen.**

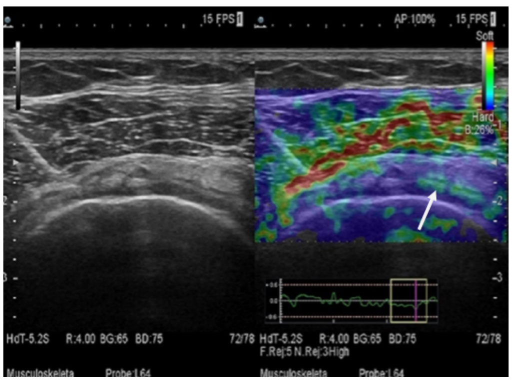


**FIG2] Supraspinatus tendon showing normal stiff blue colour. Few small green areas (soft colours) within tendon indicating tendinosis (white arrow).**

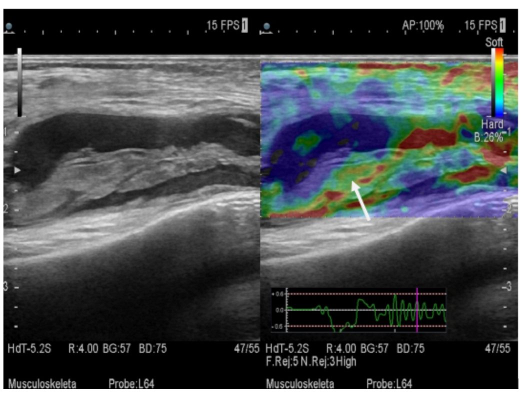


**FIG3] USG elastography of suprapatellar bursa showing thickend hypertrophied synovium (showed hypervascularity on doppler). On elastography soft colours are seen in synovium (white arrow) suggestive of synovitis later on confirmed as Tuberculosis.**

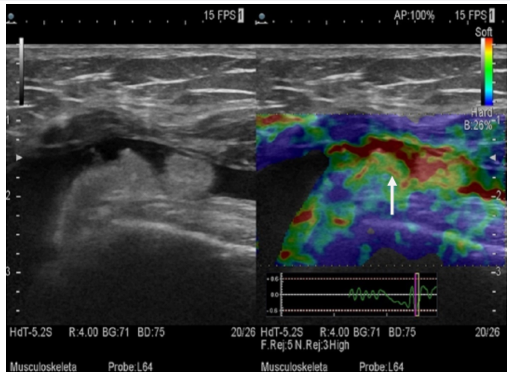


**FIG4] A frond like fatty mass in suprapatellar bursa with surrounding effusion. On elastography soft colours are seen suggestive of lipoma Arborescence (white arrow) confirmed later on MRI.**

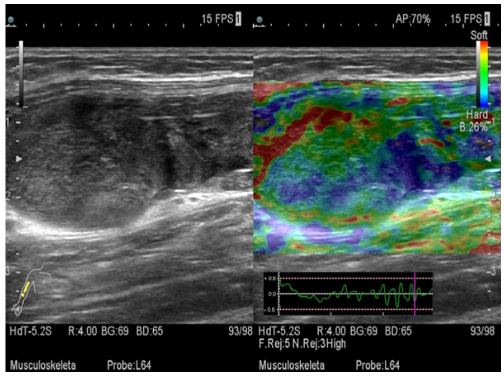


**FIG5] A Schwannoma of forearm showing stiff colours (blue) on elastography scale whereas cystic areas within tumor showing soft colours(Green and red).**

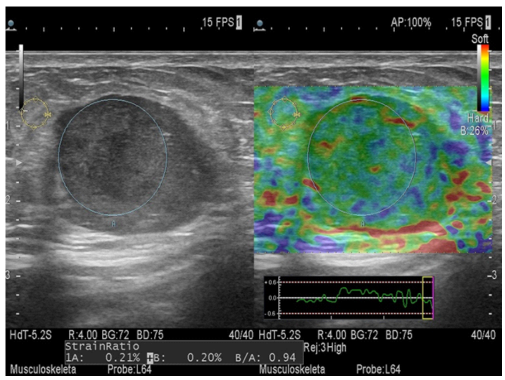


**FIG6] Desmoid tumor of anterior abdominal wall showing green and red colour (soft to firm) on elastography score. Strain ratio was 0.94 indicating benign nature of the lesion.**

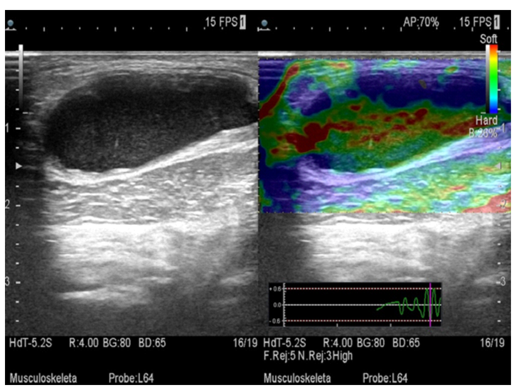


**FIG7] Bakers cyst in left popliteal fossa showing debris and on elastography typical BGR (Blue-Green-Red) appearance is seen.**

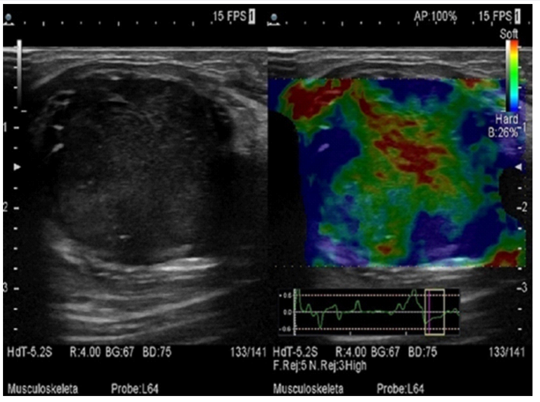

**FIG8] Biopsy proven synovial sarcoma of forearm showing stiff tissue in periphery and centrally soft colours due to cystic changes.**

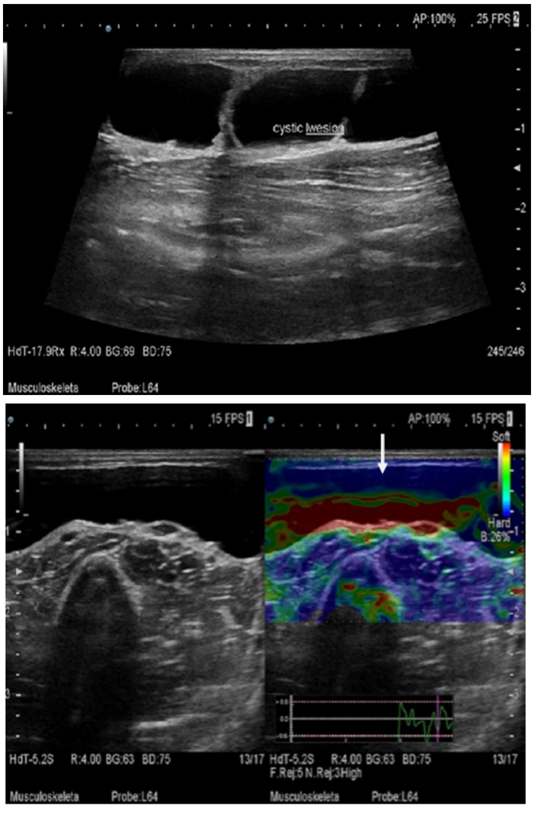


**FIG9a and b] A large cystic lesion with septa on medial side of arm in a newborn baby, suggestive of cystic hygroma giving typical BGR appearance on elastography (white arrow).**

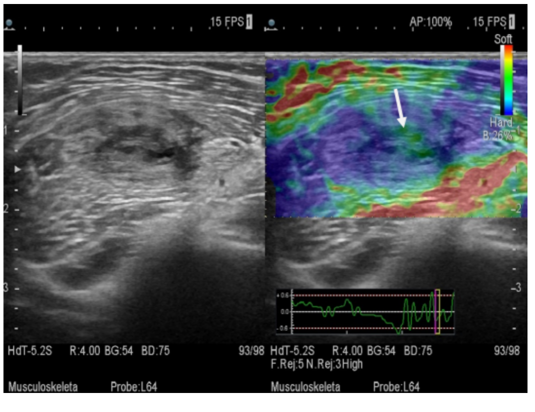

**FIG10] Isolated cysticercosis of calf muscle seen on elastography as soft colour in the central area (cystic part) (white arrow) surrounded by stiff muscle. (Blue)**

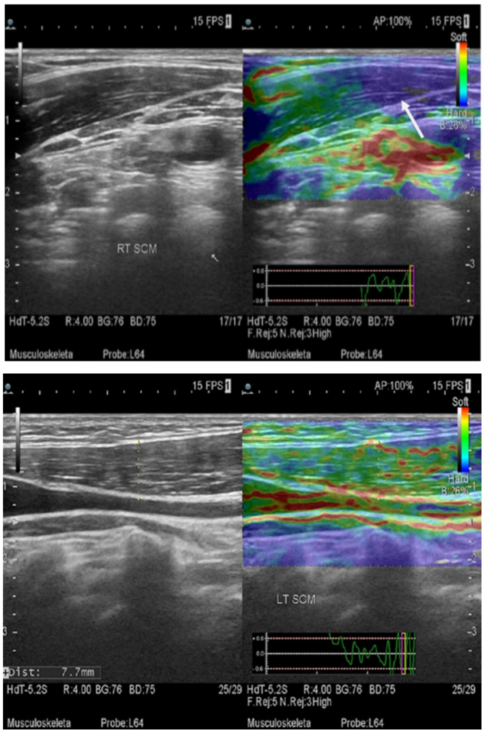


**FIG11a and b] A case of Torticollis showing a stiff colour of right strenocleidomastoid (white arrow) and normal strenocleido-mastoid on left side showing soft colours (red and green).**

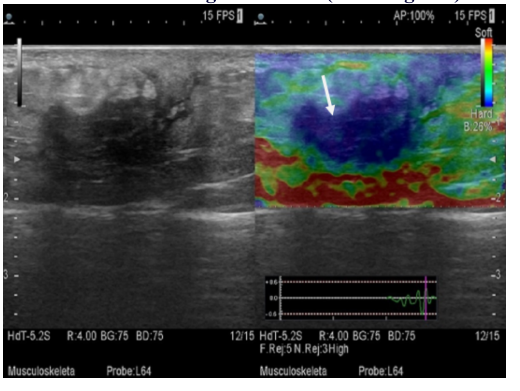

**FIG12] Patient presented with a hard mass on left gluteal region where she received multiple injections. Elastography showing a hypoechoic mass which is stiff (Dark blue) suggestive of fat necrosis (white arrow) confirmed on FNAC.**

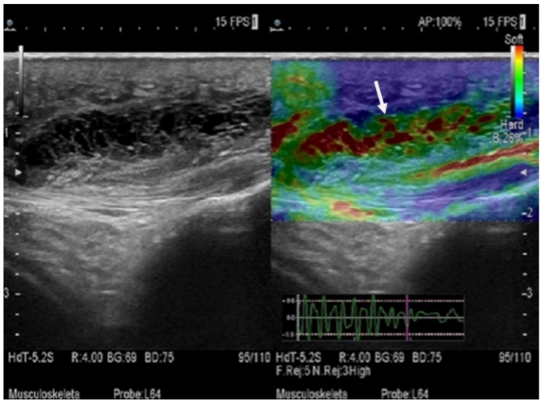

**FIG13] Patient with a history of fall on knee presented with a swelling. On sonography a multiseptate hypoechoic lesion with thin septation seen suggestive of resolving hematoma. Elastography shows typical BGR appearance of cystic lesion (white arrow).**

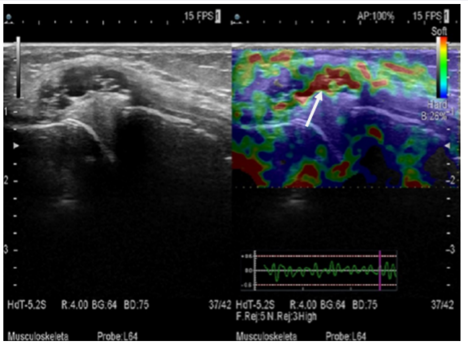


**FIG14] Patient with history of knee trauma presented with a swelling. A multiseptate perimeniscal cyst is seen adjacent to medial meniscus giving typical BGR appearance on elastography (white arrow).**

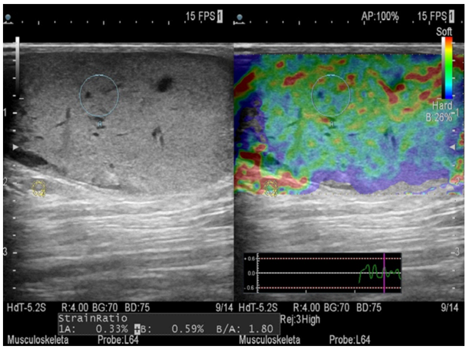


**FIG15] A patient presented with a gluteal swelling in subcutaneous plane (No vascularity was seen on doppler). On elastography soft colours were seen (red and green). Strain ratio was 1.8 suggestive of benign lesion. Sebaceous cyst was found on FNAC.**

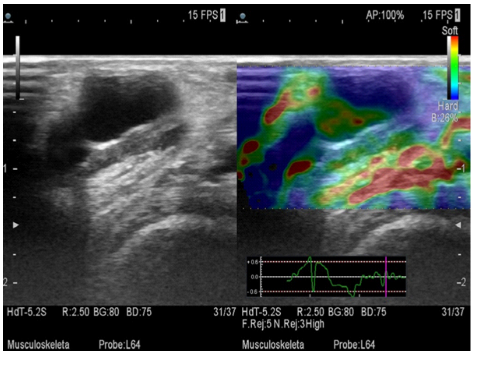


**FIG16] Patient presented with firm to hard swelling on medial side of ankle. On USG a multiseptate lesion with internal echoes was seen. On elastography typical BGR pattern of ganglion cyst was seen.**

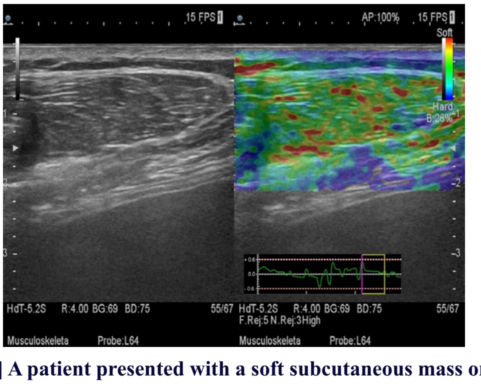


**FIG17] A patient presented with a soft subcutaneous mass on left thigh. USG showed a hyperechoic encapsulated lesion with hyperechoic strands within. On elastography, soft colours (red and green) were seen. FNAC revealed a lipoma.**

## References:-

1. Shiina T,NittaN,Ueno E,Bamber JC Real time tissue elasticity imaging using the combined autocorrelation method J Med Ultrason2002;29(3):119-28.
2. Ophir J,Alam SK,Garra BS,Kalle IF,KonofagouEE,KrouskopT et al Elastography: Imaging the elastic properties of soft tissues with ultrasound J Med Ultrason2002; 29(4):155.
3. Naomi Winn, Radhesh Lalam, Victor Cassar-Pullicino Sonoelastography in the musculoskeletal system: Current role and future directions World J Radiol 2016 November 28; 8(11): 868-879.
4. Andrea S. Klauser, Hideaki Miyamoto, Rosa Bellmann-Weiler, Gudrun M. Feuchtner, Marius C. Wick, Werner R. Jaschke, Sonoelastography: Musculoskeletal Applications Radiology 2014; 272(3):622-633.
5. Itoh A, Ueno E, Tohno E, Kamma H, Takahashi H, Shiina T, et al. Breast disease: Clinical application of US elastography for diagnosis. Radiology. 2006; 239:341-50.
6. Zhi H, Xiao XY, Yang HY, et al. Semi-quantitating stiffness of breast Solid lesions in ultrasonic elastography. Acad Radiol. 2008; 15(11):1347-1353
7. De Zordo T, Fink C, Feuchtner GM, Smekal V, Reindl M, Klauser AS. Real-time sonoelastography findings in healthy Achilles tendons. AJR Am J Roentgenol 2009; 193:W134-W138.
8. Palle Lalitha. Balaji Reddy, K.Jagannath Reddy, Musculoskeletal Applications of Elastography: a Pictorial Essay of Our Initial Experience Korean J Radiol 2011; 12(3): 365-375.
9. Krouskop TA, Wheeler TM, Kallel F, Garra BS, Hall T. Elastic moduli of breast and prostate tissues under compression. Ultrason Imaging 1998; 20(4):260–274.
10. Magarelli N, Carducci C, Bucalo C et al Sonoelastography for qualitative and quantitative evaluation of superficial soft tissue lesions: a feasibility study Eur Radiol 2014; 24(3):566-73.
11. Bhatia KS,Rasalkar DD,Lee YP et al Real time qualitative ultrasound elastography of miscellaneous non nodal neck masses: applications and limitations Ultrasound Med Biol 2010;36(10):1644-52.