

# A New Application in Dermatological Ultrasound

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## Introduction

As the high-resolution multifrequency transducers and multi-channel color Doppler machines have been developed, dermatologic ultrasound imaging has been rapidly growing in recently years [1]. Joint Ultrasonography (US) in psoriasis [2] and hair morphology by US in androgenetic alopecia [3] have been also studied in current dermatologic ultrasound. Now, acoustic coupler, namely SF-001 for superficial or proximal observation has been developed [4]. The usefulness of the acoustic coupler, SF-001 has been reported in the joint US of rheumatoid arthritis [4]. We have experienced the use of acoustic coupler for the dermatologic lesion for panniculitis due to the venous insufficiency condition in the lower extremity and superficial lipoma in the thigh location. We have described the advantages of this procedure in detail.

## Dermatologic Ultrasound and Acoustic Coupler

The international working group, namely DERMUS (Dermatologic Ultrasound) was formed and provided the guidelines [1] and proposed for an assessment training program [5]. The minimum frequency recommended for performing dermatologic examinations by DERMUS was 15 MHz [5]. Peripheral joint/entheseal US in patient with psoriasis [2] and hair morphology by US in patient with androgenetic alopecia [3] have been done in current dermatologic ultrasound. We usually perform US studies for dermatologic fields with a high-resolution, broad-band (5MHz-18MHz) linear transducer (Nobulus Hitachi, Ltd.Tokyo, Japan). We have also provided several reports of the dermatologic lesion [6-15]. While, Carra et al. [16] recommended a high-frequency (12-17 MHz) linear transducer for superficial masses because of its high spatial resolution. They suggest that only light pressure should be used to avoid

compressing small vessels and missing flow. They prefer use of a copious amount of gel rather than a standoff pad. They noted that the pad can be cumbersome and limit some dynamic maneuvers. Now, acoustic coupler, namely SF-001 for superficial or proximal observation has been developed [4]. The usefulness of the acoustic coupler, SF-001 has been reported in the joint US of rheumatoid arthritis [4]. We describe the experience using the acoustic coupler, namely, SF-001 for the dermatologic lesion for panniculitis due to the venous insufficiency condition in the lower extremity and superficial lipoma in the thigh location. We performed US study for the lesion with a high-resolution, broad-band (5MHz-18MHz) linear transducer equipped with acoustic coupler SF-001. In result, the author will also recommend the observation for dermatologic superficial lesion, especially, rough, unevenness part in hand, foot, and joint location. Because the characteristic of acoustic coupler has been recognized as stableness state, equipped condition, and satisfactory observation for vasculature status due to the low attenuation material.

## Anatomy in Dermatologic Ultrasound

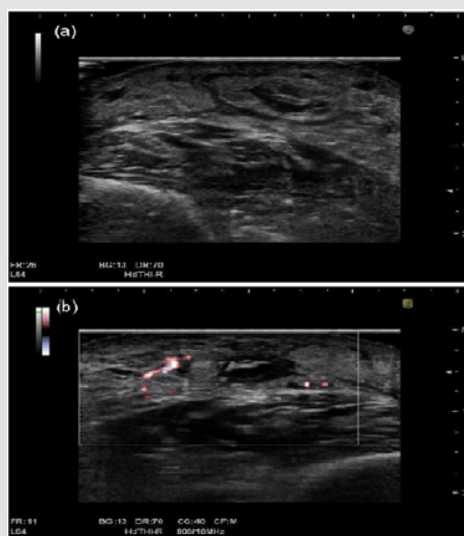
The US features of healthy skin is a layer of variable thickness depending on the site, the age and constitutional habitus of the patient. It has been suggested that the distinction between the layers of the skin is important because different skin diseases occur in different layers [17]. According to the Mandava's report [18], normal skin is consist of three layers: The epidermis (thickness 0.06-0.6 mm) on the most external surface; the underlying dermis (thickness 1-4 mm) containing of connective tissue, nerves, blood, and lymphatic vessels, gland, mast cells, fibroblasts, histiocytes, etc;

and the subcutaneous tissue (thickness 5-20 mm), mainly made of adipose cells. The epidermis appears as a hyperechoic line in nonglabrous skin, while it is shown as bilaminar hyperechoic and parallel lines in glabrous skin. The dermis appears as a hyperechoic band, usually less bright than the epidermis, whereas subcutaneous fat layer appears as a hypoechoic with hyperechoic fibrous septa in between [19]. The smooth distinction between the deep dermis and the superficial dermis begins to be possible. Especially in case of photoaging skin, the superficial dermis is slightly more hypoechoic [20]. Wortsman [21] also suggested that the upper dermis in adults may show lower echogenicity, namely the subepidermal low-echogenicity band due to deposits of glycosaminoglycans produced by photoaging. More deeply, the superficial fascia covering the muscular tissues can be seen as a hyperechoic regular line [18].

### Panniculitis in Dermatology

Stasis dermatitis commonly occurs in older age. It is attributed to the venous hypertension. Poorly demarcated erythematous plaques of the lower legs bilaterally, was initially present in stasis dermatitis. Stasis dermatitis is regarded as one of the spectrum of cutaneous findings that may result from chronic venous insufficient condition. It mimics cellulitis, contact dermatitis, and pigmented purpuric dermatoses [22]. Meanwhile, sclerosing panniculitis or Lipodermatosclerosis (LDS) [23,24] is a chronic fibrosing status that usually occurs in middle-aged or elderly woman, often accompanying with venous insufficiency or arterial ischemia [23]. The early lesion of LDS resemble other diseases such as cellulitis, Erythema Nodosum (EN), stasis dermatitis, and medium-sized vasculitis [23-25]. Choonhakarn et al. have noted that the combination of histopathologic features that was the most reliable for the acute stage of LDS was septal and lobular panniculitis with lymphatic infiltration, extravasation of erythrocytes, and adipocyte

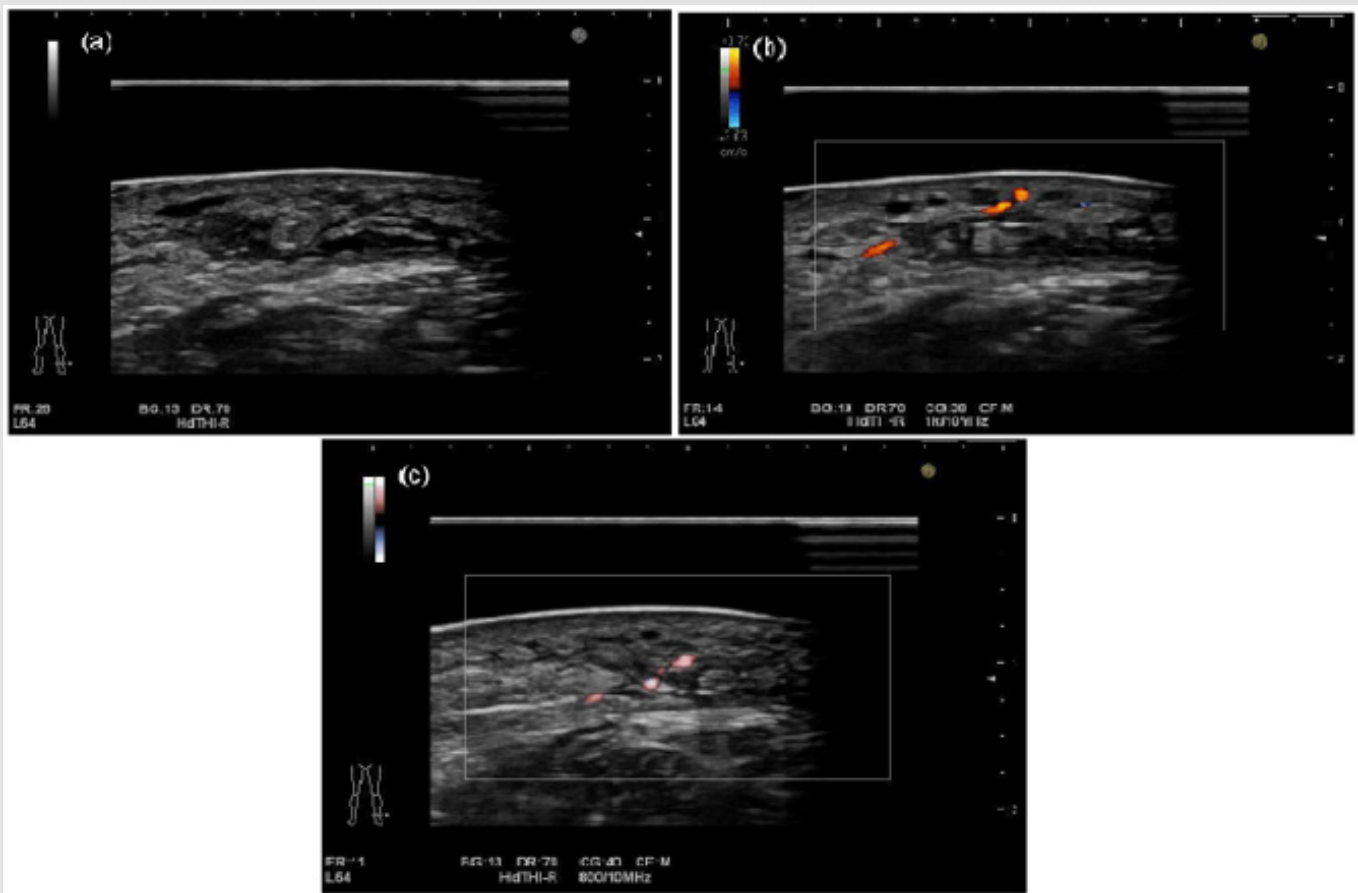
necrosis. It is suggested that histopathological features in acute stage can mimic with EN. However, EN shows a predominantly septal panniculitis, not a mixed septal and lobular involvement as seen in LDS. While, in chronic stage, lipomembranous fat necrosis with microcyst formation, vascular stasis changes in subcutaneous tissue, and septal fibrous were predominant features. Furthermore, iron deposition or hemosiderin was also seen in subacute and chronic stages [23]. With respect to the panniculitis on US, a few English reports have been studied bibliographically [21,26,27]. It has been suggested that this entity is an inflammatory process of the fatty tissue of the hypodermis. It is classified into lobular, septal, and mixed forms according to the main location of the inflammatory compositions. Mainly lobular panniculitis is shown in lupus and neonatal fat necrosis. The most common type of mainly septal panniculitis is erythematous nodosum, mainly involving the anterior part of the legs. It has been reported that lobular panniculitis appears as a diffuse increased echogenicity of the fatty lobules on US. With respect to the septal panniculitis, it is suggested that hypoechoic thickening of the septa between the hyperechoic fatty lobules are recognized [21]. It is suggested that stasis dermatitis is accompanied with panniculitis in dairy dermatologic practice. Figure 1 shows panniculitis comprehensively diagnosed in the lower extremity location in a 62-year-old woman. The septal, showing thickening of the hypodermis with fatty lobules and thick hypoechoic septa in between the fatty tissues were shown on gray scale US (Figure 1a). There are a few blood flows signals on Fine Flow (Figure 1b). Figures 2a- 2c demonstrates US features including gray-scale US, color Doppler US, and Fine Flow in the same case using equipped with the acoustic coupler (SF-001). Particularly, the depiction of the superficial location in Figure 2 images can be seen more clearly than US features in Figure 1.



**Figure 1:** Panniculitis comprehensively diagnosed in the lower extremity location in a 62-year-old woman.

(a) The septal, showing thickening of the hypodermis with fatty lobules and thick hypoechoic septa in between the fatty tissues were shown on gray-scale US.

(b) There are a few blood flow signals on Fine Flow.



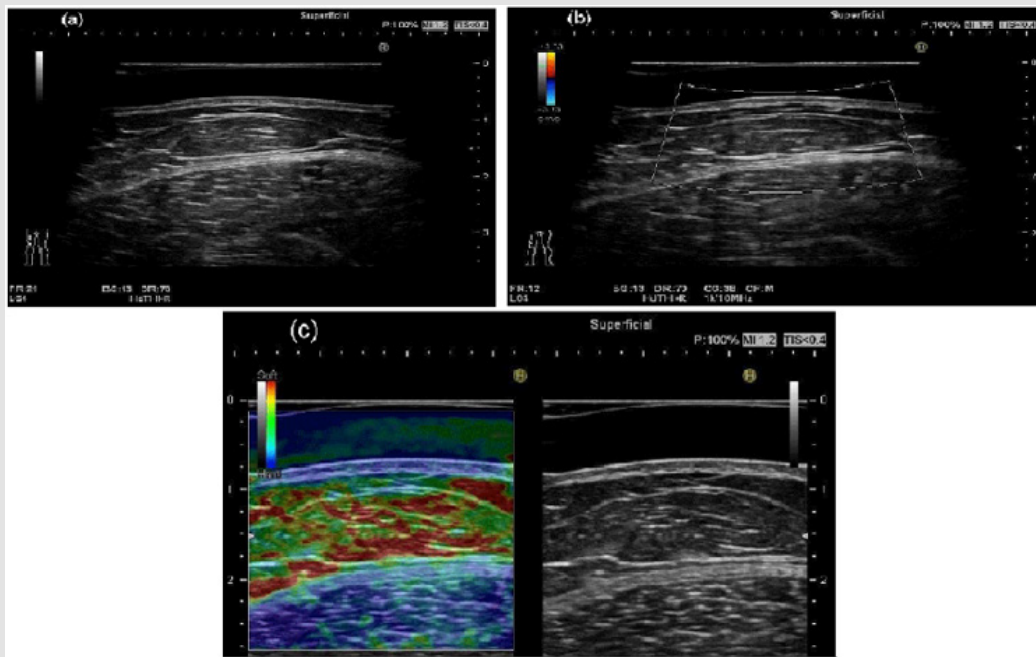
**Figure 2:** Panniculitis comprehensively diagnosed in the lower extremity location in a 62-year-old woman. Figure 2 demonstrated US features using equipped with acoustic coupler (SF-001).

- (a) The septal, showing thickening of the hypodermis with fatty lobules and thick hypoechoic septa in between the fatty tissues were shown on gray-scale US.
- (b) There are a few blood flows signals on color Doppler US.
- (c) The blood flow signals on Fine Flow were also shown.

### Superficial Lipoma

The author has previously reported the article of the entitled “A comparison between superficial and deep-seated lipomas on high-resolution ultrasonography: with RTE and MRI appearances” [14]. The author has also mentioned the conclusions as follows: The superficial lipoma is usually hyperechoic solid mass without posterior echo enhancement on the gray-scale ultrasonography. It is plausible that both superficial and deep-seated lipomas show echogenic lines in the mass on gray-scale ultrasonography. The superficial lipoma shows soft nature, having high elasticity and deep-seated lipoma shows moderately soft nature, having moderately high elasticity on Real-Time Tissue Elastography. Ultrasound

elastography is a technique used to depict an image of the strain on a tissue imposed by a force. Elastography is being considered as an adjunctive mode of noninvasive image in the estimation of prostate, breast, thyroid, liver tumors, and lymph nodes [28]. Figure 3 show superficial type of lipoma comprehensively diagnosed in the thigh location in a 38-year-old woman. The oblong shape with echogenic lines in the mass was detected on gray-scale US (Figure 3a). Substantial blood flow signals were not seen on color Doppler US (Figure 3b). Green color with a red color, suggesting soft nature, high elasticity on Real-Time Tissue Elastography. This figure was depicted more clearly, especially in superficial location with the acoustic coupler (SF-001) due to the stableness state, equipped condition, and low attenuation material status.



**Figure 3:** Superficial type of lipoma comprehensively diagnosed in the thigh location in a 38-year-old woman. Figure 3 demonstrated US features using equipped with acoustic coupler (SF-001).

(a) Gray-scale US shows the oblong shape with echogenic lines in the mass.

(b) There are no substantial blood flow signals on color Doppler US.

(c) Superficial lipoma shows green color with a red color, suggesting soft nature, high elasticity on Real-Time Tissue Elastography.

### Perspective in Dermatologic Ultrasound

Soft-tissue masses in dermatology have the occurrence forms with characteristic lesion-located features. Palmar fibromatosis, peripheral nerve sheath tumor, and Giant Cell Tumor of the Tendon Sheath (GCTTS) tend to occur in wrist or hand, while plantar fibromatosis, peripheral nerve sheath tumor and Morton neuroma have tendency of occurrence in ankle or foot [16]. In addition to these diseases, Fibroma of the Tendon Sheath (FTS) mostly occurs in fingers, hand, and wrists location[29]. The author will also recommend the observation with acoustic coupler for dermatologic superficial lesion, especially, rough, unevenness part in hand, foot, and joint locations. Because the usefulness of the acoustic coupler has been shown as stableness state, equipped condition, and satisfactory observation for vasculature status due to the low attenuation material.

### Conclusion

1. We have described the experience using the acoustic coupler for panniculitis due to venous insufficiency and superficial lipoma.
2. The features of US image with the acoustic coupler condition is more clearly depicted, particularly in superficial location.
3. The author will also recommend the observation with acoustic coupler for dermatologic superficial lesion, especially,

rough, unevenness part in hand, foot, and joint location without copious amount of gel.

4. Evaluation of the superficial location, especially for hand, foot, and joint with the acoustic coupler will be useful procedure due to the stableness, equipped, and low attenuation material conditions.

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