Inserted foreign bodies. A survival guide.

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Learning objectives

The purpose of this study is to demonstrate the experience of a University Hospital Radiology department with foreign bodies (FB) and describe also hints and tips regarding the recognition and identification of different types of foreign bodies in both plain films and ultrasound.
Background

Referrals for identification and exact localisation of FBs is very common in a radiology department of a trauma centre. The identification and exact localization of a FB can be sometimes challenging, especially for radiologist with limited experience. Although a plain film is almost invariably requested as a first line examination, in a significant number of cases further imaging with ultrasound is required, either for identifying radiolucent FBs or for exact localization of a FB, thus facilitating surgical exploration and removal. Identification and removal of FBs is clinically significant as they can serve as an unrecognized source of persisting infection. The percutaneous removal of a FB under ultrasound guidance is also an alternative treatment to a surgical approach.
Findings and procedure details

During the last year 402 patients were referred to our department for either a plain film or an ultrasound scan for suspected inserted or swallowed foreign bodies. From these 72 plain films and 32 ultrasound scans were positive for an inserted FB at the extremities. The patients’ age ranged from 8 to 74 with an average age of 57. The vast majority of patients were males.

In our group of patients a variety of different foreign bodies were encountered such as metallic, wooden, glass, plastic and gravel with the wooden FBs to constitute the vast majority.

Metallic FBs:

Metallic foreign bodies larger than 2mm are obvious on plain films and rarely require further imaging before removing them, unless they are to small and deep-seated and exact localization is essential before removal or involvement of a major structure is suspected. In our series various types of metallic FBs were found such as drills (Fig. 1 on page 7), paper clips (Fig. 2 on page 7), sewing needles (Fig. 3 on page 8), nails (Fig. 4 on page 9), earrings (Fig. 5 on page 10) and fishhooks (Fig. 6 on page 11).

On ultrasonography metallic FBs appear like hyperechoic reflective structures with posterior acousting shadowing and reverberation and comet-tail artefact (Fig. 5 on page 10). Thin metallic FBs like needles are difficult to be identified on ultrasound as they cast minimal focal acousting shadowing, if any, due to their small diameter. Placing the probe parallel with the FB in these cases facilitates its recognition and localization.

Wooden FBs:

Wooden FBs (splinters, thorns) are not radiopaque and thus not apparent on plain radiographs (Fig. 7 on page 12 and Fig. 8 on page 13). Ultrasonography is the gold standard for their identification. They can cast acousting shadowing (Fig. 9 on page 14 and Fig. 10 on page 14), although not infrequently they do not (Fig. 11 on page 15). Please not also that they can penetrate and migrate far from the initial wound and careful scanning is required not just underneath the wound itself but also of the adjacent areas. For thin and long wooden splinters due to their small axial diameter close scrutiny is required for their identification and multiple planes of imaging with rotation of the probe (Fig. 12 on page 16).

Glass FBs:
Detection of glass FBs depends mainly on their size and not if they contain or not lead (Fig. 13 on page 17 and Fig. 14 on page 18). On sonography they appear as reflective hyperechoic structures casting acoustic shadowing and reverberation artefact (Fig. 15 on page 19).

**Gravel FBs:**

Stones are radiopaque and hyperechoic on ultrasound scan casting significant acoustic shadowing and occasional with minimal reverberation artefact (Fig. 16 on page 20).

**Plastic FBs:**

They are radiolucent and not demonstrated on radiographs. They can be isoechoic and difficult to visualize on ultrasonography. They can appear however as slightly hyperechoic structures casting mild acoustic shadowing or no shadowing at all (Fig. 17 on page 21 and Fig. 18 on page 22).

**Complications:**

FBs can remain undetected and asymptomatic for a long time (Fig. 19 on page 23) or they can become the source of ongoing and persisting infection, abscess formation, fistula formation and even septic tenosynovitis or septic joint. Ultrasound can also demonstrate, apart from the retained foreign body, complications from the initial injury such as muscle, tendons or nerve/vessel injuries (Fig. 20 on page 24).

A complete report of an ultrasound scan regarding a retained FB should include the size of the FB, its depth from the skin, its relation with significant adjacent structures (vessel, nerves, tendons etc) and any associated changes of the surrounding soft tissues (granuloma/abscess formation, fistula).

**Summary:**

General rules applying to a successful scanning for all types of FBs are:

1. Always look for bright echoes around the wound site but look mainly for structures producing acoustic shadowing or reverberation artefact.
2. Look for a reflective structure surrounded by a hypoechoic vascularised halo, which represents the inflammatory changes of the adjacent soft tissues.
3. Regardless the nature of the foreign body, a large area around the obvious skin wound should be examined with scrutiny as all FBs can potentially migrate due to muscle contraction.
4. Some of the FBs are thin and demonstrate a linear configuration (such as needles) and scanning in multiple levels is essential in order to identify this type of FBs.

5. Ultrasound underestimates the size of FBs as only the reflective surface is illustrated. The true size of the FB can be significantly larger than the one demonstrated.

6. Do not look only for a retained FB. Sequela of the initial injury can also be very important. Look careful around the wound site and the deep soft tissues for co-existing post-traumatic changes.
Images for this section:

**Fig. 1:** Male patient (builder) with drill through his distal thigh. No obvious bony involvement.

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Fig. 2: AP plain film of the hand: Multiple inserted paperclips. Patient with mental disorder.

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**Fig. 3:** Plain film of the forearm of a patient with mental disorder. Multiple paperclips, two sewing needles and the tip of a pen are demonstrated.

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**Fig. 4:** Lateral and AP radiographs of the left hand. A nail is demonstrated through the second inter metacarpal space.

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**Fig. 5:** Lateral plain film of the left forearm and ultrasound of the wound area. Earring inserted into the soft tissues after a fight. An ultrasound scan was requested for exact localisation. The reflective metallic earring with reverberation artefact is noted along with coexisting inflammatory changes of the adjacent soft tissues.

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Fig. 6: Thumb radiographs. A fishhook is noted trough the pulp of the thumb.

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Fig. 7: Plain film of the little finger negative for a foreign body. Ultrasound revealed a wooden splinter at the medial aspect of the distal phalange.

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**Fig. 8:** Plain films negative for a foreign body at the base of the thumb. Ultrasound revealed a wooden splinter within the subcutaneous tissues with inflammatory changes of the surrounding tissues but no significant vascularity.

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**Fig. 9:** Wooden splinter within the subcutaneous tissues of the buttock. Please note the posterior acousting shadowing.

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**Fig. 10:** Wooden splinter in the pulp of the middle finger. The typical appearance of a linear reflective structure casting acoustic shadowing is shown. There are associated hypo echoic inflammatory changes of the adjacent soft tissues with increased vascularity.
**Fig. 11:** Wooden splinter with associated inflammatory changes of the surrounding structures. Please note the absence of accosting shadowing in this case.

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**Fig. 12:** Short axis (upper) and long axis (lower) illustration of a wooden splinter. Note the minimal reflective structure within the subcutaneous soft tissues casting some accosting shadowing. By turning the probe parallel to the splinter, it becomes much more obvious. Please note the almost complete absence of soft tissue reaction in the case.

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Fig. 13: Tiny fleck of glass at the ulnar side of the wrist.

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Fig. 14: Sizeable piece of glass at the medial aspect of the elbow.

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Fig. 15: Small piece of glass suspected at the anterior aspect of the tibiotalar joint on the lateral view. Ultrasound revealed a linear reflective FB within the subcutaneous tissues with reverberation artefact.

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Fig. 16: Young child after a fall. Piece of gravel inserted into the soft tissues of the palm.

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Fig. 17: Patient with mental disorder. The ink cartridge of a ballpoint pen is clearly demonstrated. Further FBs were suspected and the patient referred for an ultrasound scan. Look Fig 18

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**Fig. 18:** Same case as Fig 17. Within the deep soft tissues two parallel linear hyperechoic lines producing accousting shadowing are noted. This is the biro of the plastic ballpoint pen inserted into the forearm soft tissues. Please note that the plastic biro was not demonstrated at the plain film (Fig 17).

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**Fig. 19:** Patient with slightly tender lump at the anterior aspect of the thigh. An obvious FB is noted within the subcutaneous tissues with granuloma formation and mild vascularity. The patient could not recall any recent injury. Wooden splinter proved on surgery.

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**Fig. 20:** Recent injury with glass removed from patient on site. Although the plain films are negative for a retained glass fragment, on ultrasound scan few small glass fragments are noted along with a complete tear of the extensor tendon of the middle finger.

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Conclusion

The identification and exact localization of a FB can be challenging and a thorough examination is essential. A plain film should always be the first imaging modality if a metallic, glass or gravel FB is suspected. For wooden and plastic FBs plain radiographs have no diagnostic value and an ultrasound scan is the gold standard modality. Ultrasound is also useful for the assessment of FBs' complications such as granulomas, abscesses and injury of adjacent significant anatomical structures.
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