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TECHNICAL REPORT

# Dual steristrip technique: a novel use of steristrips to reduce operator radiation dose during CT-guided intervention

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## Abstract

**Objective** We describe a novel and safe needle-holding method that we have termed the 'dual steristrip technique'. This technique can be used to stabilize the bone biopsy needle without the need for the radiologist's hand to be in close proximity to the X-ray beam during CT-guided intervention.

**Materials and methods** The dual steristrip technique uses steristrips to stabilize the bone biopsy needle and allows for accurate assessment of needle position and trajectory. This involves affixing one end of a steristrip to the skin 2 cm from the needle skin entry point, wrapping the mid-section of the steristrip around the biopsy needle and affixing the other end of the steristrip to the skin at the opposite side of the needle 2 cm from the needle skin entry point. A second steristrip is then applied in a similar fashion at 90° to the first steristrip.

**Results** In our institution, we have used the dual steristrip technique to stabilize the biopsy needle in certain cases where assessment of needle position/trajectory can be more challenging. This includes cases where there is a paucity of soft tissues overlying the bone or if the bone lesion is located in the superficial cortex. We have found it to be successful in 80% of cases.

**Conclusions** The dual steristrip technique is a safe and effective needle stabilization method that should be considered by the interventional radiologist in challenging CT-guided bone biopsy cases.

**Keywords** Dual · Steristrips · Technique · Intervention

## Introduction

The role of the radiologist has significantly expanded over the past two decades and image-guided interventional procedures are now firmly established in daily practice. In the musculoskeletal setting, computed tomography (CT)-guided bone biopsies have become routine procedure in the investigation of suspicious bone lesions.

A number of studies have shown that although radiation dose to both patient and radiologist during these procedures is generally low, significant exposure to the radiologist's hand can occur in cases where the biopsy needle needs to be held in position during scanning.

A variety of implements including surgical forceps, towel clamps, and sterile towels have been used to aid in needle stabilization and can be effective although disadvantages include limitations in achieving and maintaining the desired needle approach angle and the dose to the radiologist's hand remaining high as the forceps/clamp needs to be held in close proximity to the X-ray beam during scanning. Dedicated needle-holding devices have also been developed in an attempt to reduce radiation dose to the radiologist's hand during CT-guided intervention. Although these can reduce radiation dose, they can be impractical and expensive.

We describe a novel needle-holding method which we have termed the *'dual steristrip technique'*. This technique can be used to stabilize the biopsy needle without the need for the radiologist's hand to be near the X-ray beam during scanning. We believe this technique is a safe and effective alternative to previously described methods and allows the appropriate needle approach angle to be maintained during scanning (Figs. 1 and 2).

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**Fig. 1** Images **a** and **b** demonstrate the dual steristrip technique for stabilizing the bone biopsy needle

## Methods

In our institution, a standard CT-guided bone biopsy is performed under general anesthesia and involves a number of steps:

1. The patient is positioned on the CT table and a skin marker placed over the area of interest and a short planning CT acquired.
2. An appropriate biopsy path is identified by assessing the CT images and the skin entry point is marked on the patient.
3. Using aseptic technique, local anesthetic is instilled into the subcutaneous soft tissues superficial to the area of interest.
4. Using the angle estimated on the planning CT, a bone biopsy needle is advanced through the superficial soft tissues to the area of interest.
5. The inner trocar is removed once adequate bony purchase is achieved and the biopsy needle advanced through the bone lesion and a core biopsy is taken. Needle position/trajectory is assessed intermittently during the procedure by performing low-dose block scans though the region of interest using the dedicated biopsy scanning mode (during which the interventional radiologist stands to the side of the CT gantry).

In certain cases, assessment of needle position/trajectory can be more challenging. This most common occurs when there is a paucity of soft tissues overlying the area of interest (e.g., metacarpal, metatarsal, ulna, and fibula) to stabilize the needle or when bony purchase cannot be obtained prior to scanning as the bone lesion is in the superficial cortex. In order to ensure that the correct needle approach angle is maintained during scanning and that the radiation dose to the radiologist is minimized, we use the *'dual steristrip technique'* to stabilize the needle. This allows the exact position of the needle relative to the area of interest to be maintained during scanning (Fig. 3). We have found this technique to be particularly useful when a needle approach angle of the needle or greater than 90° relative to the skin surface is required.

*The 'dual steristrip technique'* uses steristrips to stabilize the needle as described below: (Fig. 3)

- One end of a steristrip is affixed to the skin approximately 2 cm from the needle entry point. The steristrip is then wound around the needle at a height of approximately 1 cm from the needle entry point and the other end of the steristrip affixed to the skin 2 cm away from the needle entry point, at 180° to the first fixture point.
- A second steristrip is then affixed to the skin (approximately 2 cm away from the needle entry point) at 90° to the first steristrip and wound around the needle and fixed to the skin at the opposite side.
- Once the position of the needle is confirmed on CT, the radiologist can safely advance the biopsy needle through the bone lesion.

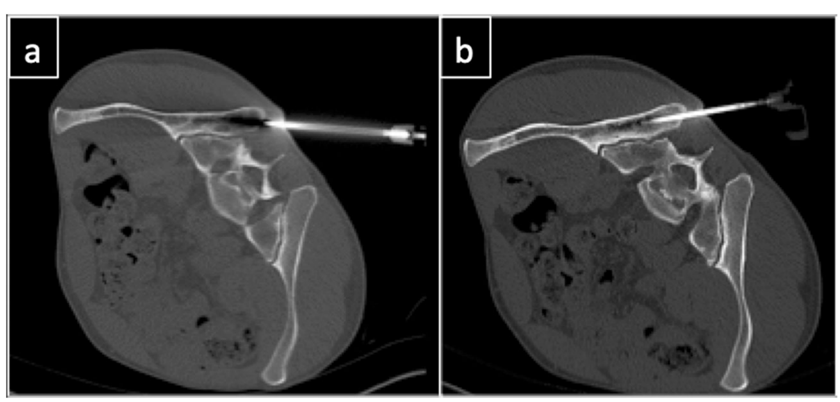


**Fig. 2** Biopsy of posterior ilium: stabilization of needle using dual steristrip technique (**a**) and subsequent advancement of the biopsy needle after removing the steristrips (**b**)

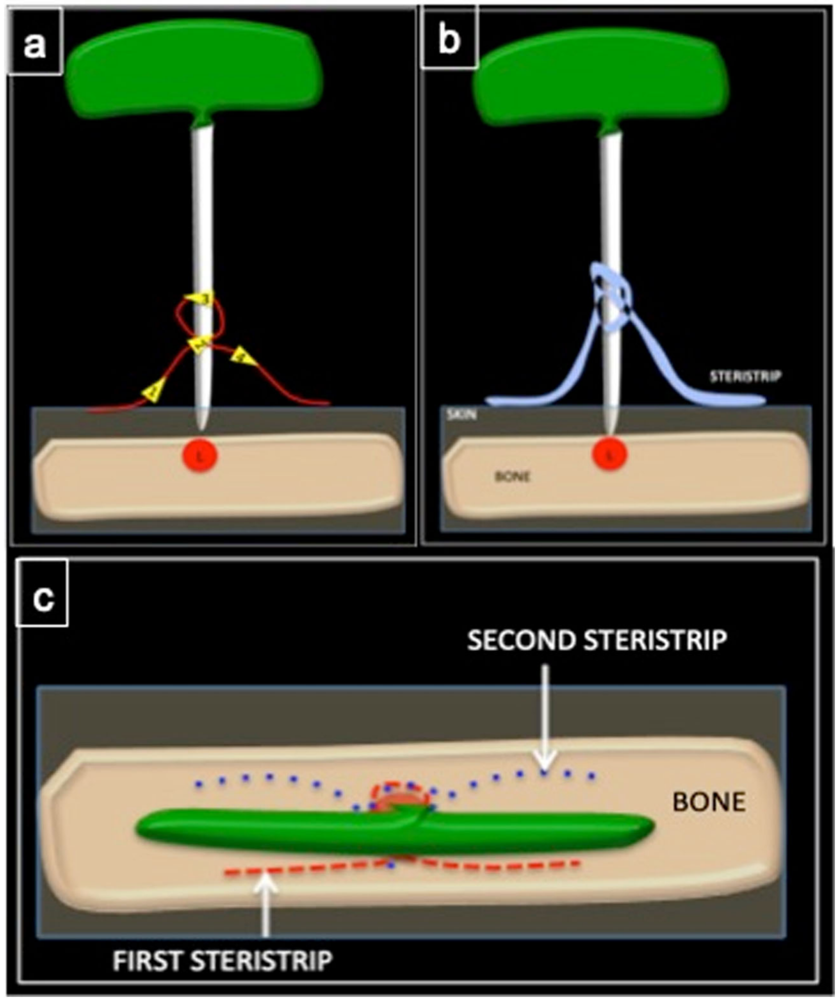


**Fig. 3** Diagrammatic representation showing the dual steristrip technique for bone biopsy of lesion (L)

- Supplementary steristrips at different angles to the initial steristrips can be used to further stabilize the needle if required.

Contraindications to this technique include a previous allergic reaction to adhesives/steristrips and patient allergies should be confirmed prior to the procedure as part of the routine pre-procedure WHO checklist.

## Discussion

CT-guided biopsy of suspicious bone lesions is a commonly performed procedure in the musculoskeletal setting. In our institution, a tertiary orthopedic oncology referral center, approximately 1000 CT-guided bone biopsies were performed in 2018. This technique has been utilized in ten selective bone biopsy cases in our department over the past 6 months and found to be effective in 80% of these cases.

Although CT-guided interventional procedures result in radiation exposure to the patient and the interventional radiologist, the radiation dose to the radiologist is generally very low [1]. Radiation doses remain within safe limits when the radiation rules of CT-guided intervention are applied [2]. This includes the use of personal protective equipment such as thyroid collars and lead aprons, positioning to the side of the gantry during scanning (away for the X-ray beam and the patient), and intermittent low-dose CT scanning of the region of interest after needle manipulation using a dedicated biopsy mode to assess needle position, when the radiologist's hands are outside of the X-ray beam.

Due to the increased demand for CT-guided intervention, the dose limits for occupational exposure of the extremities needs to be considered. The dose limit for the hand is 500 milliSieverts (mSv) per year. If the radiologist's hand is in the direct beam, the dose to the hand is approximately 5 mSv/s, but the radiation dose decreases with increasing distance from the X-ray beam [3]. Nawfel et al. and Stockelhuber et al. found that the dose rate rapidly decreased from approximately 3 mSv/s within the beam to 40–50 μSv/s at a distance of 10 cm from the X-ray beam [4, 5]. To avoid significant radiation exposure to the hands, intermittent scanning to assess needle position is performed when the radiologist in standing to the side of the CT gantry, away from the X-ray beam.

In certain circumstances, however, the radiologist must hold the biopsy needle in place during scanning. This most commonly occurs when there is a paucity of subcutaneous soft tissues overlying the area of interest (e.g., the hands, feet, and forearm) or if a bone lesion is located in the superficial cortex and the biopsy needle cannot be stabilized adequately at the desired angle in the imaging plane. Towel clamps are commonly used to stabilize the needle in difficult cases, however, this technique requires the interventionalist to hold the needle in place during scanning, which exposes the hand to scatter radiation from the patient. Sterile towels can also be used to bolster the needle in these cases, however achieving and maintaining the desired needle approach angle can be challenging. Surgical forceps can also be used but are liable to handling difficulties with needle angle difficult to maintain when the CT table moves in and out of the gantry. In our experience, maintaining the needle approach angle is less cumbersome and safer using the dual steristrip technique over the aforementioned methods.

A number of studies have evaluated the radiation exposure to the radiologist's hand in cases where the needle must be held in place during scanning. Schueler et al., Neeman et al., and Stocklehuber et al. found that radiation-attenuating surgical gloves and drapes provided significant protection from scatter radiation but only minimal protection when hands were placed in the primary X-ray beam [5–7].

Irie et al. developed a needle holder called the 'instant intervention device'. This prevented direct radiation exposure to the radiologist's hand but scatter radiation dose to the hand remained high (1 to 3 mSv per case) [8]. Silverman et al. used towel clamps to hold the needle in position [9]. Kim et al. used 22-cm surgical forceps to hold the needle [10]. Both techniques were found to be safe, effective, and inexpensive for holding and guiding the needle, however, limitations included the difficulty maintaining needle position when the CT table was moved out [10].

Dedicated needle holders such as Seestar (Apriomed) and Simplify (NeoRad AS) have been developed. Studies have shown that these can be useful in planning biopsy needle approach due to the linear metal artifact produced by the device and can also support the needle during imaging [11]. The results on the ability of needle holders to reduce operator dose have been equivocal. Magnusson et al. suggested that needle holders increase needle position accuracy and decrease the number of needle manipulations leading to a reduction in scanning time and radiation exposure to the patient [12]. In contrast, Kroes et al. found no statistically significant reduction on hand dose levels or fluoroscopy time when the needle holders were used over a freehand technique [13].

Biopsy needle stabilization using the dual steristrip technique is an effective alternative to previously described needle-holding devices owing to the widespread availability and low cost of steristrips and their ability to stabilize the biopsy needle without the need for the radiologist's hand to be close to the X-ray beam during scanning.

## Conclusions

The 'dual steristrip technique' should be considered by radiologists involved in CT-guided intervention. This technique ensures that needle position can be accurately assessed during biopsies where the paucity of subcutaneous tissues in the area of interest makes needle stabilization challenging or in cases where the bone lesion is located in the superficial cortex of a bone.

### Compliance with ethical standards

**Conflict of interest** There are no conflicts of interest.

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