

Intraoperative C-arm CT for Assessment of Syndesmotomic Reduction

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ABSTRACT

Anatomic syndesmotomic reduction is an important predictor of successful outcomes after ankle fracture fixation with associated syndesmotomic injury. Various methods to check syndesmotomic reduction range from mini-open technique and visualization to various radiographic parameters on standard C-arm to postoperative CT scans. Intraoperative CT scan will definitely be the best imaging modality and can avoid re-surgeries. With the advent of C-arm CT scans, the whole process of intraoperative CT scans can be cost-effective, compact, and easy portability between operation theaters.

Keywords: Ankle fracture, Intraoperative CT, Syndesmosis injury.

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INTRODUCTION

Syndesmotomic reduction is of paramount importance as any malreduction can grossly alter the congruity of the tibiotalar articulation, leading to early arthritis. Worse outcomes have been demonstrated when the syndesmosis is not anatomically reduced.¹⁻⁵ Leeds and Ehrlich¹ correlated syndesmosis malreduction with ankle arthritis at an average of 4 years after injury. Chissell and Jones² noted functional results to be worse with increasing tibiofibular diastasis or malreduction; as per Weening and Bhandari,³ the only significant predictor of functional outcome was the accuracy of syndesmosis reduction. Weening and Bhandari³ and Gardner et al.⁴ reported tibiofibular malreduction rates of 16% and 24%, respectively, with the use of standard radiographic criteria. Gardner et al.⁴ have shown in their study that many syndesmoses were malreduced on CT scan but went undetected by plain radiographs; they concluded that radiographic measurements alone do not accurately reflect the status of the distal tibiofibular joint and post-reduction radiographic measurements are inaccurate for assessing the quality of reduction. Sagi et al.⁵ have noted worse outcomes with syndesmotomic malreductions at a 2-year follow-up and have advocated surgeons to perform open visualization of syndesmosis to achieve reduction. They advocated that a postoperative CT scan with comparison to the contralateral extremity may be essential to gauge reduction.

Intraoperative CT scan is a novel modality, not easily available at all centers. However, the availability of the same can help in guiding the best syndesmotomic reduction intraoperatively and can avoid repeat surgeries. Immediate control of fracture and syndesmotomic reduction and ideal screw positioning in high image quality can reduce the need for secondary revision surgery. There are limited case reports^{6,7} in literature which have used intraoperative CT scans and demonstrated their utility in achieving anatomic syndesmotomic reduction. Intraoperative CT scans have assumed importance in spine surgeries and pelvic surgeries,^{8,9} where they can guide in adequate placement of screws. It can also be combined with navigation systems for improving accuracy.

During the past, intraoperative CT needed huge CT machines to be installed in the operation theaters which was very expensive and logistically difficult as they could not be shifted between operating rooms. However, at present, cone-beam computed

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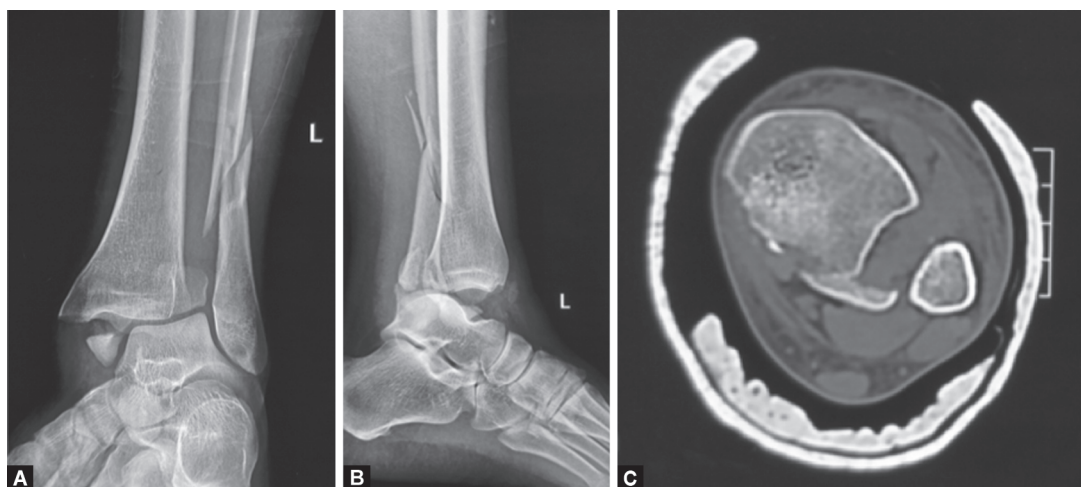
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tomography which can be acquired through flat-panel detectors has evolved as a breakthrough as this can be incorporated into C-arms or O-arms, which can make them mobile and can easily be shifted to different operation theaters. The advantage of flat-panel detector technology is high-image quality and lower dose when compared with conventional C-arms. The C-arm CT works on the principle of rotating and capturing multiple images after focusing on the area of interest. Thereafter, it creates a 3D volume-rendered image and multiple plane images (axial coronal and sagittal) can be assessed. Figures 1 and 2 depict a case of ankle fracture where intraoperative CT was used for assessing syndesmotomic reduction.

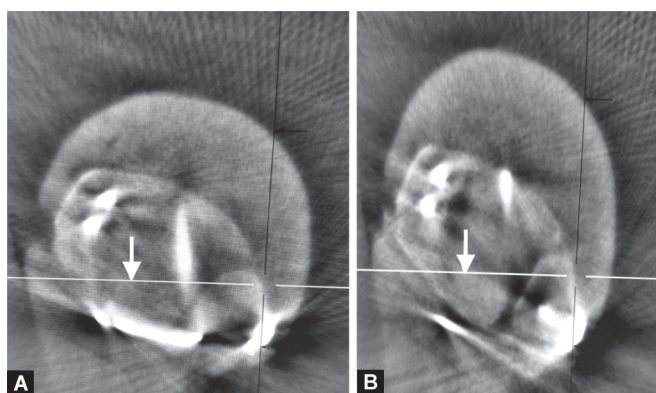
Limitations of the above technology are its high cost, and its non-availability in all centers; hence, it is equally important to rely on other easily available methods to achieve perfect syndesmotomic reduction. However, the C-arm CT which works on 3D volume rendering is still less costly than conventional CT scans and can be cost-effective with an added advantage of compactness and easy portability between operation theaters.

CONCLUSION

Intraoperative CT scans, an emerging imaging modality is probably the best evaluator of syndesmosis reduction and when available



Figs 1A to C: Preoperative X-rays (AP and lateral) of a trimalleolar fracture (PER 4 injury) and axial CT section depicting the syndesmotomic injury



Figs 2A and B: Intraoperative CT scan axial sections demonstrating anatomic syndesmosis reduction

should be used to confirm the syndesmosis reduction in complex ankle fractures.

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