APPLICATIONS OF DIGITAL TOMOSYNTHESIS IN THE MUSCULOSKELETAL SYSTEM

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BACKGROUND

Tomosynthesis (DTS) addresses one of the primary weaknesses of conventional single-projection X-ray imaging, which is the superposition of objects that may result in obscuring of an object of interest and/or production of pseudo-objects that mimic disease. DTS decreases superposition by generating slice images of the body from a series of projections taken at a limited range of angles, which are then reconstructed to produce a 3D set of images.

DTS in the MSK system can be used to:

- Improve visualization of overlapping bones and articular surfaces.
- Increase the sensitivity of occult fracture diagnosis.
- Improve anatomical localization of normal bony structures and abnormal findings.
- Eliminate radiographic pseudo-findings such as pseudo-fractures created by superimposition of structures.
- Provide, in some cases, sufficient information at a fraction of the radiation and reading time compared to CT.
- Reduce the dependency on patient's positioning and cooperation.
- Significantly improve imaging of the bones and joints in patients with metal, casts, splints and bracing.

METHODS

All DTS images were acquired using Nanox.ARC, a stationary, floor-mounted, cold cathode, multi-source DTS system.

RESULTS AND FINDINGS

The above benefits and applications of DTS are demonstrated in a series of clinical cases obtained using Nanox.ARC.

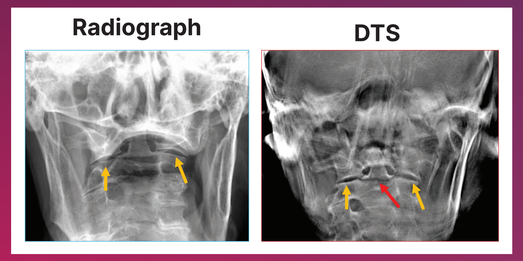

FIG 1: IMPROVED VISUALIZATION OF OVERLAPPING BONES AND ARTICULAR SURFACES.

The fracture is obscured by the overlying bones on the radiograph, while on the DTS a fracture at the base of the odontoid process is clearly seen (red arrow) and C1-C2 articulation is better visualized (yellow arrows).

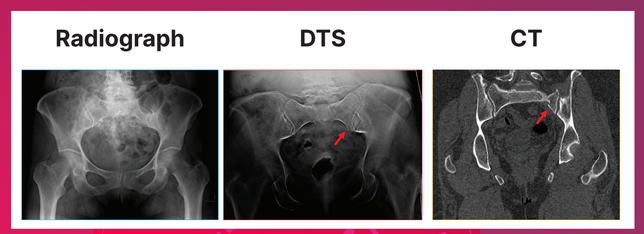

FIG 2: INCREASED SENSITIVITY OF RADIOGRAPHICALLY OCCULT FRACTURE DIAGNOSIS.

No fracture is seen on the radiograph and the sacrum is obscured by bowel content, while a left sacral fracture (red arrow) is clearly seen on the DTS and confirmed on the CT.

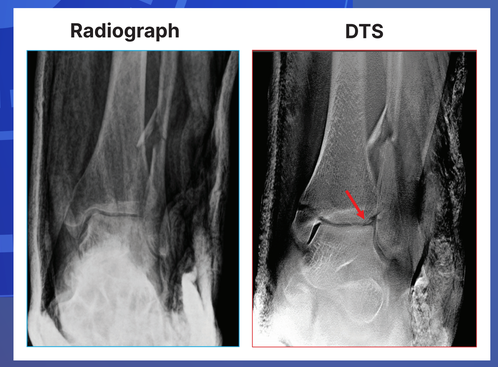

FIG 4: IMPROVED IMAGING OF THE BONES AND JOINTS IN PATIENTS WITH CASTS.

On the radiograph the cast is obscuring fine soft tissue and bony details. On the DTS an avulsion fracture of the anterior tibiofibular ligament is depicted (red arrow).

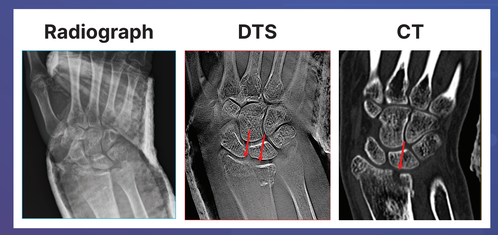

FIG 5: IMPROVED EVALUATION AND ADDITIONAL INFORMATION TO THE SURGEON ON INTRAARTICULAR INVOLVEMENT.

On the radiograph an intraarticular extension of a distal fracture fragment is seen, but nor gap neither step-off are depicted. On the DTS there is a discontinuity (between the red arrows) and a step off in the articular surface that should be treated surgically. The CT did not add important information.

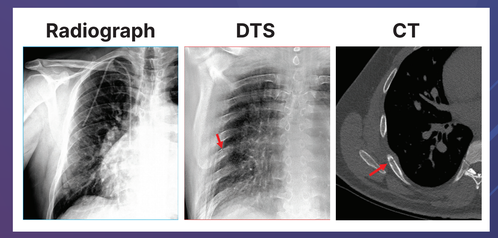

FIG 6: INCREASED SENSITIVITY OF FRACTURE DETECTION.

On the radiograph no fracture is not seen. On the DTS a rib fracture is clearly seen (red arrow). The fracture is barely seen on CT.

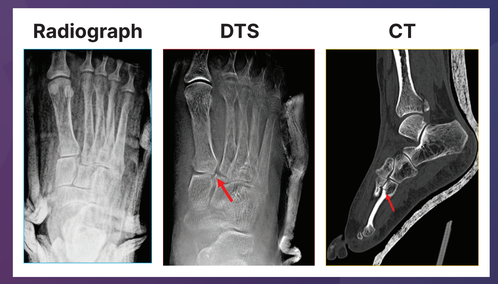

FIG 7: IMPROVED SENSITIVITY OF FOOT FRACTURES DETECTION.

On the DTS a Lisfranc ligament avulsion fracture (red arrow) and a 4th metatarsal (MTT) fracture (green arrow) are noted, despite the cast. The fractures are barely seen on the radiograph. On the CT the 4th MTT fracture is seen on the sagittal view only (red arrow).

CONCLUSION

DTS is a modality that has vast applications in the MSK system. Its growing utilization and radiologists' reading experience can improve the sensitivity and specificity of conventional radiography, improve cast and metal imaging, eliminate the need for CT in some cases while at the same time reducing the patient radiation exposure and radiologist reading time.