

# Digital Tomosynthesis: An Innovative Tool for Challenging Diagnoses in Urology

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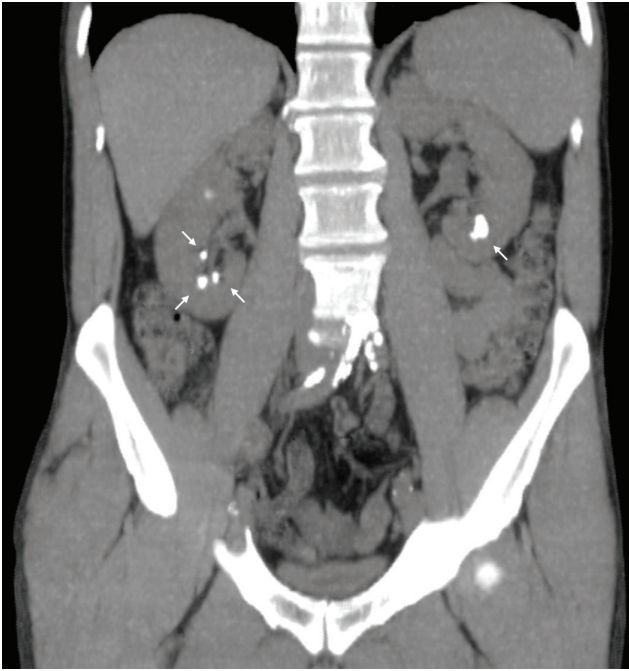
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## INTRODUCTION

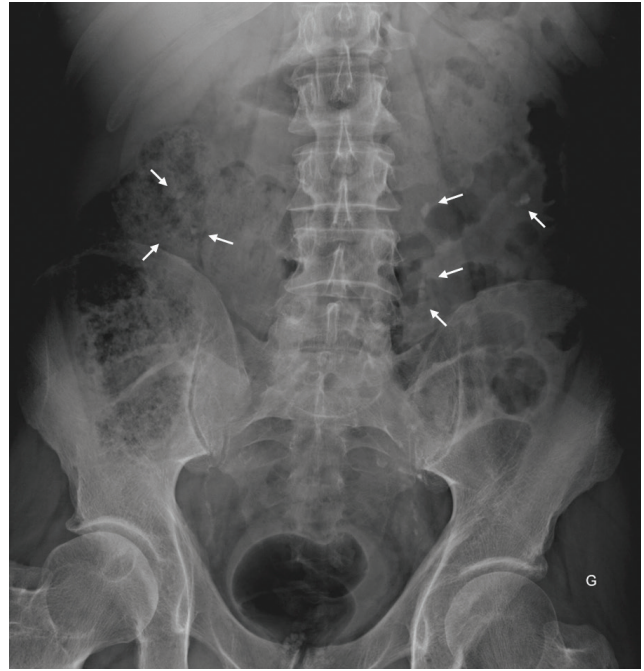
Digital tomosynthesis (DTS) allows the visualization of dilated renal cavities without need of contrast medium injection and better shows ureteral and kidney stones than standard abdominal X-ray. From now on, digital tomosynthesis is indeed revival of the old 'conventional' tomography technique that progressively has become obsolete. The strong growth and development of digital radiology and plane sensors has led to give birth to this innovative imaging technique, which may soon be part of the standard initial work up and follow-up of patients with ureteral and kidney stone.

## CASE REPORT

A 60 year-old man was referred to our institution for left flank pain assessment occurring after a left renal stone lithotripsy (Figure 1). Ultrasonography (US) examination revealed the presence of bilateral intra-renal stones as well as a dilation of the left renal pyelocalyceal cavities. However, no obstacle was shown on the urinary tract. Conventional X-ray examination (Figure



**Figure 1.** Computed tomography scan, frontal 11 mm thick maximum intensity projection reformation performed before lithotripsy, showing bilateral renal stones (arrows).



**Figure 2.** Supine abdominal radiograph performed after lithotripsy of the left renal stone showing renal stones (arrows). Note the anatomical superimpositions of colonic gas and faces.

2) suggested the presence of kidney stones. DTS (SonialVision Safire; Shimadzu Co., Kyoto, Japan) (Figure 3) examination of the abdomen confirmed the intra-renal location of the stones that were already shown on US and also formally disclosed the presence of three other obstructive stones into the left ureter lumen. Although DTS has been performed without contrast medium injection, this innovative technique was prone to demonstrate the dilation of the left pyelocalyceal cavities.

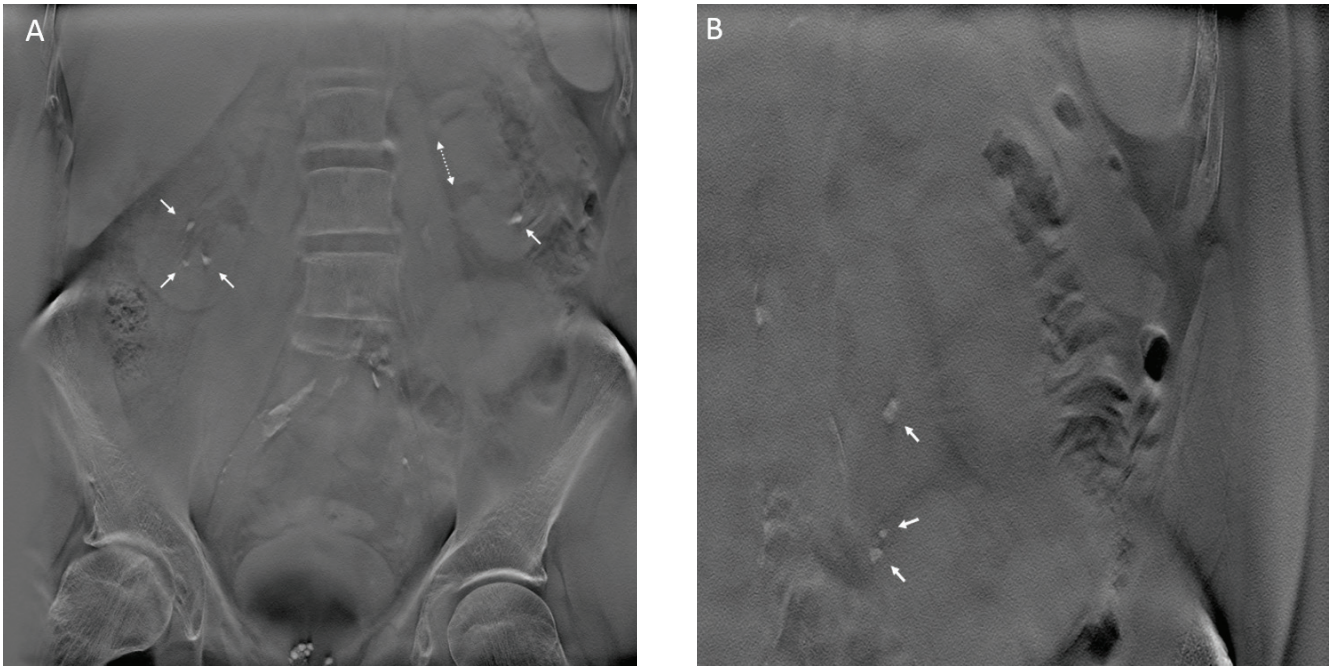
## DISCUSSION

DTS is a technical evolution of conventional geometric tomography. It allows the production of as many high spatial resolution slice-images (200  $\mu\text{m}$  in the acquisition plane) as necessary following a single low-dose acquisition.<sup>(1)</sup> This technique uses a flat-panel detector and a computer-controlled moving X-ray tube. The patient is laying on the table, in the desired position (supine or prone position when frontal views are required, lateral position if sagittal views are needed). Breath hold is required to avoid motion artifacts of the patient. During acquisition, the X-ray tube moves through a 40-degree (-20 to +20 degrees) circular arc symmetric over

the patient. At the same time, the plane sensor synchronously moves inside the table. Several parameters can be modified: kV, mA, the number of pulses per second (X-ray emission is discontinuous or “pulsed”), the duration (2.5 to 5 s), center and total thickness of the volume acquisition. Median slice thickness is not precisely quantifiable (about ten millimeter) but can be roughly modified (++ , + ,  $\pm$  , - , --). Interestingly, specific algorithms allow reconstruction of slice-images parallel to the central projection throughout the entire volume of the patient. A posteriori post-processing reformations can be produced at different places in the acquisition volume, decreasing or increasing the number of slices at will.

DTS allows an accurate exploration with low radiation dose exposure i.e. lower than with computed tomography (CT) scan,<sup>(2)</sup> equivalent to two standard X-ray procedures.<sup>(3)</sup> According to the literature data, an effective dose is in the order of 0.85 millisieverts (mSv), to be compared to 0.5 mSv with digital radiography, and 2.5 mSv with low-dose CT scan, and 12.6 mSv with high-dose CT scan.<sup>(4)</sup>

However, major drawbacks include low resolution in density of tomosynthesis compared to CT scan, and inability to produce multiplanar (plane to plane) reformations. Indeed, the



**Figure 3.** Abdominal digital tomosynthesis performed after left renal stone lithotripsy; (A) showing intra-renal stones (arrows) and the dilation of the left pyelocalyceal cavities (double arrow), (B) magnification shows three persistent obstructive ureteral stones despite previous left renal stone lithotripsy fragmentation (arrows).

higher performances of DTS compared to standard X-ray in the evaluation of renal stones include its very high spatial resolution and the absence of anatomical superimpositions of feces.<sup>(3)</sup> In the near future, DTS may thus replace conventional X-ray, at initial work up and in some cases at follow-up, thus limiting excessive irradiation exposure. In addition, DTS may be more advantageous than CT scan examination from a medico-economic point of view.

### CONFLICT OF INTEREST

None declared.

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