3D Needle Guidance using C-arm Cone Beam CT and Fluoroscopy for Lung and Vertebral Biopsies: Technique and Initial Results

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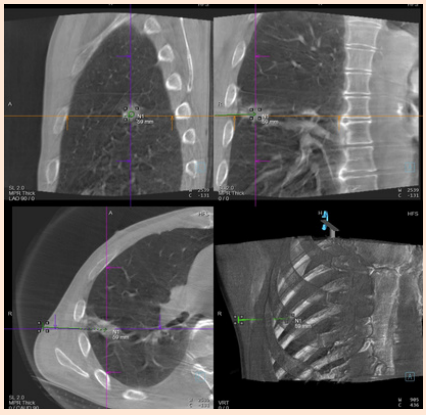
Objective:

3D needle guidance systems using C-arm cone beam CT and fluoroscopy are gaining popularity in interventional procedures. The objective of this exhibit is to introduce this technique and evaluate its initial results in lung and vertebral biopsies.

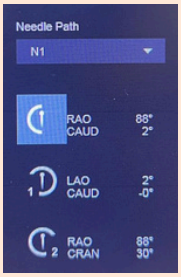
Materials and Methods:

First ten cases of percutaneous biopsies using 3D needle guidance system were analyzed. myNeedle Guide (Siemens Healthineers) was used as the planning and guidance software. myNeedle Laser was used as the laser guidance system.

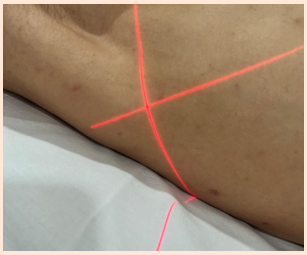
Technique



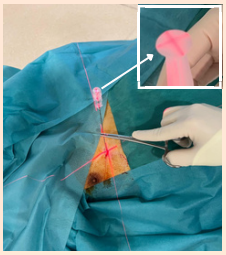
Initial cone beam CT acquisition is performed by a flat panel C-arm system (ARTIS pheno, Siemens Healthineers). A multiplanar reconstruction is performed from the rotational acquisition. The operator draws a needle path within this multiplanar reconstruction from the target to the skin surface.



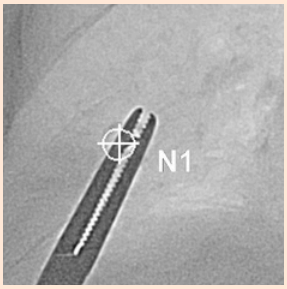
Fluoroscopic imaging angulations (bull's eye view and progression view) are subsequently calculated and sent to the C-arm. Needle entry location is also sent to laser guidance system (myNeedle Laser, Siemens Healthineers) at the same time.



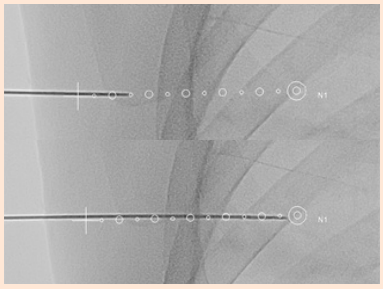
The C-arm is first moved to the bull's eye view position. Initial needle entry site is at the center of the laser crosshairs projected onto the patient's skin surface.



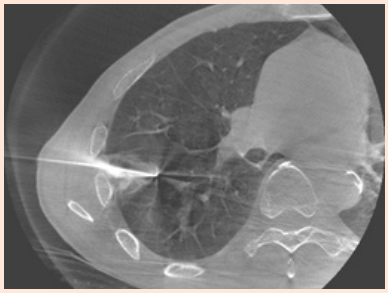
To ensure accurate trajectory of the needle, the center of the laser crosshairs should be at the center of the flat hub side of the coaxial needle.



A single dot should be seen in **bull's eye view**, which indicates optimal angulation of the needle path.



The C-arm is then moved to the **progression view** position. The angle of the needle should be fixed and advanced towards the target along the planned path (visualized in progression view fluoroscopy).



Subsequent cone beam CT acquisitions can be made to confirm needle position and look for complications.

Initial Results

	In-time to Out-time (mins)	Fluoroscopy time (mins)	DAP (Gy cm^2)	No. of Cone beam CT acquisitions	Success rate (%)	Pneumothorax (%)	Major complications (%)
Lung (8/10)	45.0 (35.0-65.0)	1.9 (0.2-4.1)	121.4 (34.7-218.5)	4.0 (2.0-6.0)	100.0	25.0*	0.0
Vertebral (2/10)	58.5 (40.0-77.0)	3.3 (3.0-3.6)	138.7 (126.1-151.2)	3.5 (3.0-4.0)	100.0	0.0	0.0

Note: Data from first four columns are presented as median (range).

* Reported pneumothorax rate for transthoracic percutaneous needle biopsy is 12-45%.
(Gupta S, Wallace MJ, Cardella JF, et al. Quality improvement guidelines for percutaneous needle biopsy. J Vasc Interv Radiol. 2010;21(7):969-975. doi:10.1016/j.jvir.2010.01.011)

Potential advantages of this technique include real-time visualization of needle advancement, easy operation (omits the need for needle angle adjustments in more than one plane) and shorter procedure time.

Main limitation of this technique is that patient movement will cause misregistration of the planned needle path. Real-time adjustments can be made for lesions that can be readily visualized in fluoroscopy.

Conclusion:

3D needle guidance using C-arm cone beam CT and fluoroscopy is a promising technique for percutaneous lung and vertebral biopsies.