Lumbar puncture technique

Lumbar puncture is typically performed under local anesthesia and aseptic technique. A needle is used to access the subarachnoid space and fluid collected. Fluid may be sent for biochemical, microbiological, and cytological analysis.

The patient is positioned lying on their side with their knees pulled up to their chest.

The skin over the lower back is cleaned with antiseptic solution.

Local anesthesia is given to numb the area where the needle will be inserted.

A thin, hollow needle is inserted between two lumbar vertebrae, usually between the 3rd and 4th or the 4th and 5th lumbar vertebrae.

Once the needle is in place, the healthcare provider will use a special device to measure the pressure of the CSF.

Then, a small amount of CSF is collected for testing, and sometimes medications are injected.

The needle is then removed, and a bandage is applied to the puncture site.

<html><iframe width="560" height="315" src="https://www.youtube.com/embed/7tcrSd5lLoc" title="YouTube video player" frameborder="0" allow="accelerometer; autoplay; clipboard-write; encrypted-media; gyroscope; picture-in-picture" allowfullscreen></iframe></html>

Once CSF flows, the needle is connected to a manometer through a 3-way stopcock, the pressure is measured and recorded (see below), and CSF is drained into sterile tubes (1–2 ml for each tube) for laboratory analysis (see below). The practitioner should also note the color of the fluid (clear, blood tinged, xanthochromic…) and the clarity (clear, cloudy, purulent…). At the end of the procedure, the stylet should be replaced before the needle is withdrawn (to reduce post-LP H/A).

In lumbar puncture surgery, compared with the conventional methodologies like computed tomography and magnetic resonance imaging, ultrasound imaging offers the advantages of being low cost, no radiation and real-time image generation. However, the use of ultrasound equipment in lumbar puncture involves a cumbersome and time-consuming process for the subjective imaging of the overall structure of the lumbar spine in order to determine the exact puncture point and path. Meanwhile, the robotic arm puncture system has the advantages of high precision, good stability and simple and efficient operation. As a result, robotic-assisted ultrasound scanning is valuable for the assessment of a puncture path in spinal tap surgery. In this pursuit, based on the official URSDK development package for a robot arm and the Transmission Control Protocol/Internet Protocol, the system proposed in the present study involves a program to control the robot arm to clamp down

onto an ultrasonic probe to enable automatic scanning and acquisition of images. A three-dimensional reconstruction program based on the visualization toolkit was designed, and a lumbar spine experiment was conducted with this system. A total of 136 two-dimensional ultrasound images were collected in the lumbar spine model experiment by enhancing contrast of and denoising the original ultrasound images, and a linear interpolation algorithm was used to perform the three-dimensional reconstruction of the lumbar spine model. The reconstructed structure was defective, but the location of the spinous process gap was determined with the sagittal and coronal images. The feasibility of the system was verified by the reconstruction results, which can provide a reference for determining the puncture point and path planning in the lumbar puncture surgery [1)].

1)
Zhang W, Ma Z, Wang H, Deng J, Li P, Jia Y, Dong Y, Sha H, Yan F, Tu W. Study on automatic ultrasound scanning of lumbar spine and visualization system for path planning in lumbar puncture surgery. Math Biosci Eng. 2023 Jan;20(1):613-623. doi: 10.3934/mbe.2023028. Epub 2022 Oct 12. PMID: 36650781.