Article published online: 2022-12-15

Endoscopic Ultrasound Biopsy Needle

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J Digest Endosc 2022;13:240–242.

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Abstract

In the past few years, endoscopic ultrasound (EUS)-guided fine-needle biopsy (EUS-FNB) has superseded EUS-fine-needle aspiration (EUS-FNA) for EUS-guided tissue acquisition. EUS-FNA does not retain the stroma as well as the surrounding tissue architecture and therefore had limitations in achieving a definitive diagnosis. Development of EUS-FNB needles had improved the diagnostic ability of EUS by providing core tissue sample that not only preserves surrounding tissue architecture but also provides adequate material for molecular typing and gene profiling of sampled lesions. At present, there are three commercially available third-generation EUS-FNB needles with unique needle tip designs. In this review, we aim to elucidate the technical aspects of the available EUS-FNB needles.

Keywords

- Endoscopic ultrasound (EUS)
- Fine needle aspiration (FNA)
- Fine needle biopsy (FNB)
- Tissue
- Pancreatic

Introduction

Endoscopic ultrasound (EUS)-guided tissue acquisition has become an important tool to establish diagnosis of various intra-abdominal diseases.[1] In recent years, its use has been extended to sampling of tissues from liver, biliary tract, peritoneum as well as the mediastinum.[2–5] EUS-fine-needle aspiration (EUS-FNA) needles were designed to enable only aspiration of cellular material. However, this posed difficulties in definitive diagnosis due to distortion of the architecture of the aspirated cells and surrounding tissues.[6] This diagnostic limitation was more marked in hypocellular samples, marked desmoplastic background, well-differentiated malignancies and clinical situations where diagnosis is made by looking at tissue architecture such as lymphoma and autoimmune pancreatitis or by performing immunohistochemistry.[3,7] These limitations of traditional EUS-FNA needles propelled the development of newer fine-needle biopsy (FNB) needles that had an ability to obtain a reasonable histological specimen with preserved cellular architecture for both standard cytological diagnosis as well as immunohistochemistry as well as molecular diagnostics. These FNB needles allowed the tissue core to be collected by shearing tissue from the target lesion.

The earliest attempts to develop a EUS-FNB needle involved a spring-loaded biopsy needle that was used for tissue acquisition in hard indurated pancreatic lesions where the standard FNA needle could not penetrate and the tissue cores were obtained in 50% patients.[8] The first-generation FNB needle, Quick-Core needle, was designed by Cook Medical (Bloomington, Indiana, United States). This needle comprised of a cannula, a tissue penetrating stylet and a handle mechanism to advance the cannula over the stylet.[9] Although the flexibility of Quick-Core was a major advantage, various technical issues like challenges in deploying the spring-loaded tray, especially when in difficult positions like when in duodenum, as well as tendency to lose the biopsy specimen when the needle was withdrawn were major limitations in its widespread use. To overcome some of these limitations, Cook Medical designed second-generation FNB needle, the Procore needle, which had a reverse bevel design so as to scrape the tissue in the lesion within the hollow bore

DOI https://doi.org/10.1055/s-0042-1756483.
ISSN 0976-5042.

Thieme Medical and Scientific Publishers Pvt. Ltd., A-12, 2nd Floor, Sector 2, Noida-201301 UP, India

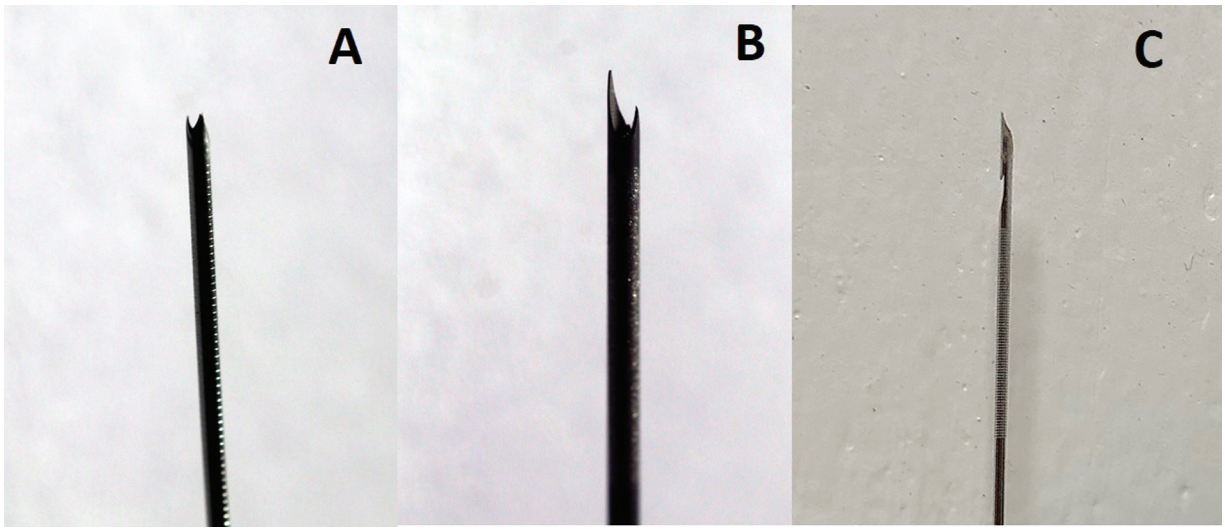

Fig. 1 Endoscopic ultrasound-fine-needle biopsy needles tip design: (**A**) Acquire needle, (**B**) SharkCore needle, and (**C**) Procore needle with reverse bevel design.

of the needle during actuation movements of the needle.[10] The development of this needle was a pathbreaking event in the design of EUS-FNB needles and this triggered the development of the current third-generation EUS-FNB needles.

Newer Third-Generation EUS-FNB Needles

Currently, three new third-generation EUS-FNB needles with differing design are available (►**Fig. 1**).[11] The FNB needles are broadly classified as side type cutting and end type cutting. The Procore needle is a side type cutting needle and the SharkCore needle as well as Acquire needle is an end type cutting needle. SharkCore needle, developed by Beacon Medical (Newton, Massachusetts, United States) has a fork-tip design with beveled cutting edges. This design allows for slicing through tissue and thus capturing the tissue within the needle core. The Acquire needle, developed by Boston Scientific (Natick, Massachusetts, United States), has a Franseen tip design with three symmetrical cutting edges. Redesigned Procore needle, developed by Cook Medical (Bloomington, Indiana, United States), is a 20G needle with a forward bevel instead of a reverse bevel design.

Basic Design and Technique

The basic design of a FNB needle resembles EUS-FNA needle, which consists of three parts an outer sheath, an inner needle with stylet, and a handle that can individually control the movement of sheath and needle.[12] A beveled end cut FNB needle has two components to the effective cutting angle namely the raking and inclination angles. Rake angle is the angle of the cutting edge in relation to the tissue and inclination angle is the angle at which the needle is being advanced toward the tissue target (►**Fig. 2**).[13] Ideally, an acute raking angle and a perpendicular inclination angle would theoretically ensure adequate core specimen. However, the efficacy of the FNB needles depends on multiple other mechanical properties as well as needle tip configuration.

ProCore Needle, Cook Medical

Procore FNB needle is a side cutting needle with two separate cutting surfaces. These cutting surfaces are the tip and a forward bevel (20G) or a reverse bevel (19G, 22G and 25G) near the tip that promotes collection of a core sample during movement of the needle within the lesion. The Procore needle is made up of stainless steel and has a nitinol stylet.[14] These needles have a lateral opening of varying length depending on the needle size (4mm in 19G needle, 2.9 mm in 20G needle, 2mm in 22G needle, and 2mm in 25 G needle) with a bevel to cut and thereafter trap the tissue into the needle. The redesigned EchoTip ProCore 20 G has a Menghini bevel and a forward bevel along with a coiled sheath that facilitates needle flexibility. Also, the redesigned Re-Coil stylet system aids in easy management of the stylet and thus minimizes the risk of contamination. The minimum diameter of the accessory channel of the echoendoscope required to pass 19, 22, and 25G needles is 2.8 mm, whereas Procore 20G needle, because of wider sheath size, requires a minimum of 3.7mm accessory channel. The needles with a reverse bevel design have a slot cutting edge directed backward and this design enables tissue collection during retrograde movement of the needle. On the

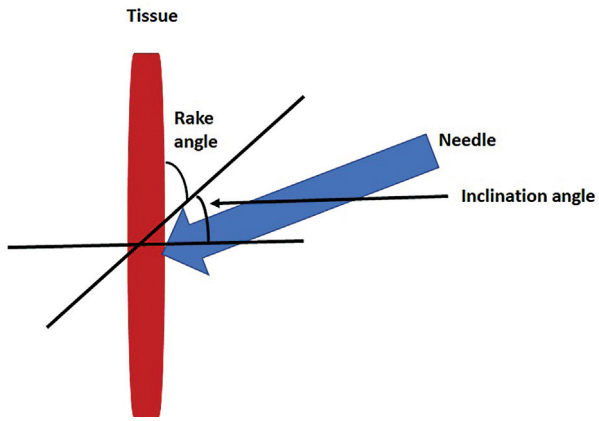

Fig. 2 Rake and inclination angle of a beveled end cut needle.

other hand, the 20G needle with a forward bevel design has a slot cutting edge directed forward and this design enables tissue cutting during antegrade movement of the needle.

Acquire Needle, Boston Scientific

The Acquire needle is an end type cutting needle that has Franseen needle tip design. A symmetrical multi-plane needle is formed by bevel planes oriented symmetrically and a three-plane symmetric tip design is called a Franseen needle tip design.[15] This needle has crown-tip needle design with three symmetrical surfaces that represent three cutting edges. The three symmetrical cutting surfaces with fully formed heels at the needle tip result in enhanced penetration, minimal fragmentation, and precise cutting. These needles do not have a side slot. The 22 and 25G needles are made up of cobalt-chromium alloy that is claimed to have less needle deformation than stainless steel. The recently launched 19 G (Acquire 19ga Flex) is made up of nitinol. The echogenic pattern on the needle extends to the tip and this results in enhanced visibility of the needle tip in the lesion.

SharkCore Needle, Medtronic

The SharkCore needle has a multifaceted opposing bevel with two protruding sharp points ("fork-tip") along with six cutting-edge surfaces in an asymmetric design. This design attempts to capture cohesive units of tissue with maintenance of its cellular architecture. It is made up of steel and has a stylet made up of nitinol. It is available in 19G, 22G, and 25G sizes.

Conclusions

The evolution of EUS-FNB needles has obviated the need for onsite cytological evaluation. It also enables procurement of tissue for molecular and genetic tumor gene profiling that is essential to identify candidates for targetable anticancer therapy. Its application is further being extended to sampling of various extra pancreatic lesions. However, there is a need for randomized studies evaluating the efficacy of the different needle types and appropriate indication for the use of a particular needle design.

Authors' Contributions
Nikhil Bush contributed to collection and interpretation of data and drafting of manuscript.

Surinder Singh Rana was involved in collection and interpretation of data, drafting as well as critical evaluation of manuscript for intellectual content.

Conflict of Interest
None declared.

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