Endoscopic Stalk Resection of a Toe Ganglion With Color-aided Visualization

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Abstract: Ganglion cysts are common cystic lesions filled with a jelly-like substance and originate from a joint capsule or tendon sheath through a stalk. Ganglion cysts mostly occur in the hand region, for which surgical excision usually results in good outcomes. In contrast, toe ganglions are relatively rare, and surgical treatment is associated with a high recurrence rate because of unidentifiable ganglion stalks, requiring large skin incisions. We have treated toe ganglion cysts using endoscopy in the ganglion cyst by injecting methylene blue into the tendon sheath that connects to the ganglion stalk. The result has been favorable, without recurrence. The advantages of our technique include the following: (1) Endoscopy using a color aid can show the location of a ganglion stalk, and removing the stalk can prevent recurrence. (2) Endoscopic stalk-only resection is minimally invasive, allowing early mobilization and reducing surgical-site complications. The purpose of this Technical Note is to describe our endoscopic stalk resection technique with color-aided visualization, and we have included a video presentation.

A ganglion cyst is a common soft cystic tumor, which mostly occurs in the dorsal wrist; a ganglion cyst in the foot is rare.1 Surgical treatment includes open resection of the ganglion cyst. Although surgical treatment for a ganglion cyst in the hand usually produces favorable results,2 a high recurrence rate exists for foot ganglions because the foot ganglion stalk is often difficult to identify.3 Several authors have indicated that the surgical excision of the stalk is paramount; thus, large skin incisions are required.4,5

We report an endoscopic stalk resection technique for toe ganglions using a color aid. The purpose of this Technical Note is to describe our minimally invasive endoscopic approach for the detection and resection of a flexor hallucis longus (FHL) tendon sheath ganglion stalk with a step-by-step video presentation (Video 1).

Technique

Step 1: Preoperative Planning and Patient Positioning

The clinical diagnosis of a toe ganglion is made by aspirating the jelly-like fluid from the ganglion cyst. If the viscosity is too thick for the contents to be aspirated, the jelly-like substance is squeezed out. Preoperative magnetic resonance imaging is useful for confirming the origin of the ganglion stalk (Fig 1). A swollen FHL tendon sheath adjacent to the ganglion indicates that the ganglion stalk originates from the extended tendon sheath (Fig 2). Surgery is performed with the patient under spinal or general anesthesia and in the supine position. The patient’s feet are placed off the end of the bed, and the operative leg is draped in a standard manner (Fig 3).

Step 2: Fluid Aspiration and Portal Placement

Prior to creation of an endoscopic portal, the jelly-like substance is drained from the ganglion cyst and replaced with endoscopic fluid, allowing a clearer view. The first portal is established on top of the ganglion to ensure an adequate working space (Fig 4). Then, a 2.7-mm 30° endoscope (Smith & Nephew, Andover, MA) is
inserted into the cyst to visualize the inside of the ganglion (Fig 5).

**Step 3: Visualization of Ganglion Stalk**

With movement of the patient’s toe passively, the FHL tendon at the level of the first metatarsal phalangeal joint is identified. Next, 0.05% methylene blue (Pyoktanin Blue; Wako Pure Chemical Industries, Tokyo, Japan) is injected into the FHL tendon sheath at a sufficient distance from the ganglion cysts (Fig 6A). Injecting methylene blue correctly into the tendon sheath is important; the loss-of-resistance technique is useful for precise methylene blue injection. A difference in the density between the FHL tendon and tendon sheath cavity enables our technique. A hard elastic feeling is noted as the needle is inserted into the tendon body. The needle is then pulled back slowly with continuous gentle pressure applied to the plunger of the syringe. Once the tip of the needle is pulled out of the tendon body and into the tendon sheath, the resistance of the injection abruptly diminishes and the contents of the syringe can flow into the tendon sheath. After the color injection, the leakage of methylene blue can be detected on the endoscopic view (Fig 6B). The FHL...
tendon at the plantar foot is milked, and the toe is moved to promote leakage of the methylene blue from the stalk connected to the tendon sheath.

Step 4: Stalk Resection

A needle is used to localize the position of the portal from which the stalk can be approached, and another portal is established (Fig 7). Because the exact stalk location is unpredictable, additional portals are required as the surgical procedure progresses. Unused portals should be temporarily closed to prevent cyst shrinkage and maintain a sufficient working space. The portals are all interchangeable as viewing and working portals. The leakage site is then enlarged with an endoscopic shaver (Smith & Nephew) (Fig 8). As shaving of the stalk progresses, additional milking or movement of the toe can promote further leakage of the methylene blue from the stalk when the location of the stalk must be

Fig 4. Portal placement. (A) The patient is in the supine position. The jelly-like substance inside the ganglion is drained through the first portal. The arrow indicates the endoscopic portal, and the arrowhead shows the jelly-like substance squeezed out of the endoscopic portal. (B) The first portal (arrow) is placed on top of the ganglion to obtain a sufficient endoscopic view.

Fig 5. Endoscopic view inside of the ganglion. Insertion of endoscope into ganglion cyst. (A) The patient is in the supine position. The arrow shows the endoscope inserted into the ganglion cyst. (B) The plantar ganglion portal is the viewing portal. The smooth inside wall of the ganglion can be visualized.

Fig 6. Methylene blue injection. (A) The patient is in the supine position. Methylene blue is injected (arrow) into the flexor hallucis longus tendon sheath at the level of the first metatarsal phalangeal joint. (B) The dorsal ganglion portal is the viewing portal. The arrowhead indicates the leakage of methylene blue from the stalk.
reidentified. Injecting the methylene blue also enables the obvious visualization of the stalk. The stalk should be resected until the FHL tendon is adequately exposed. The stalk connected to the FHL tendon is usually opened up to 10 mm in diameter, and the width of the opened stalk is confirmed by use of the length of an endoscopic probe (Fig 9). After the tendon is exposed, the methylene blue should be sufficiently drained by milking and moving the toe. Once the fluids inside the cyst are adequately aspirated, the portals are closed.

**Step 5: Postoperative Protocol**

Postoperatively, an elastic bandage is applied around the first toe and forefoot for 1 month. The patient is allowed full weight bearing and is discharged 1 day after the surgical procedure.

**Discussion**

We have introduced an endoscopic ganglion stalk resection technique using a color aid in the FHL tendon sheath and provided a step-by-step video presentation (Video 1). The pearls and pitfalls associated with the procedure are noted in Table 1. The advantages of our method include the following: (1) Endoscopy using

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**Fig 7.** Additional working portal placement. (A) The patient is in the supine position. The stalk is visualized with endoscopy. The needle is inserted (arrow) into the ganglion to localize the position of the portal from which the stalk can be approached. (B) The plantar ganglion portal is the viewing portal. The arrowhead indicates the ganglion stalk. The arrow shows the needle inserted in the appropriate position to access the ganglion stalk.

**Fig 8.** Ganglion stalk resection. (A) The patient is in the supine position. The stalk is resected with an endoscopic shaver (arrow). (B) The plantar ganglion portal is the viewing portal. The arrow shows the endoscopic shaver inserted into the ganglion cyst, and the arrowhead indicates the ganglion stalk.

**Fig 9.** Flexor hallucis longus tendon exposure. (A, B) The plantar ganglion portal is the viewing portal. Resection of the stalk is performed until the flexor hallucis longus (FHL) tendon is adequately exposed. The stalk is opened to 10 mm in diameter, confirmed with an endoscopic probe.
methylene blue as a color aid can show the location of a ganglion stalk. (2) Endoscopic stalk-only resection is a minimally invasive surgical procedure, allowing early mobilization and minimizing surgical-site complications (Fig 10).

Pathologically, a ganglion stalk acts as a one-way valve allowing fluid to flow into the ganglion cyst. Therefore, removing this one-way valve mechanism prevents recurrence. Although endoscopic surgery for wrist ganglions has been well described and the sensitivity of ganglion stalk detection is 49%, the stalk is only identified with endoscopy in 6% of foot and ankle ganglions. Thus foot and ankle ganglion cysts have a high recurrence rate because of insufficient stalk resection, and some authors have reported that large skin incisions are required to reduce the risk of recurrence.

To identify the stalk, we used methylene blue, which has been used in other ganglion operations and has known safety in humans. It is important to note that the loss-of-resistance technique is necessary to inject the color aid into the FHL tendon sheath appropriately. In addition, the swollen tendon sheath cavity eases the injection of the color aid.

We report the endoscopic resection of a multilocular ganglion cyst. In this technique, a single methylene blue injection into the FHL tendon sheath can allow visualization of the FHL tendon sheath transparently behind the ganglion wall on the endoscopic view. However, even if the FHL tendon sheath cannot be detected on the endoscopic view, injecting methylene blue several times helps to identify the ganglion stalk, which connects to the FHL tendon sheath. Furthermore, if the ganglion consists of multilocular cysts, endoscopically resecting only the stalk could treat the entire ganglion cyst without damaging the other cyst walls. This is because, in our experience, most multilocular ganglion cysts connect continuously inside each other. This is known because aspirating the ganglion from one location simultaneously shrinks the entire ganglion. Therefore, resection of the stalk alone can adequately treat a multilocular ganglion cyst.

Our procedure can be applied when the ganglion cysts are of adequate size to perform the procedure with endoscopy and an endoscopic shaver. Therefore, we estimate a required minimum ganglion size of 15 mm in diameter. Another indication for our procedure is other ganglions originating from the tendon sheath or joint, as determined by injecting color into the tendon sheath or joint adjacent to the ganglion. A non-ganglion tumor is contraindicated for our technique, and a small ganglion cyst is relatively contraindicated because of an inadequate working space. Potential complications include tendon and peripheral nerve or vessel injury. To avoid nerve or vessel complications, the surgeon should perform blunt dissection through
the portals and keep track of the ganglion stalk with the use of adequate color aid.

Acknowledgment

The authors thank Editage (www.editage.jp) for providing professional English-language editing and proofreading services.

References