Case Report

The Use of Medulloscopy for Localized Intramedullary Lesions: Review of 5 Cases

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Abstract: We report 5 cases of a localized lesion (4 with osteomyelitis and 1 with an intraosseous ganglion cyst) that were treated successfully by medulloscopy. Medulloscopy is a standard arthroscopic technique for visualizing the intramedullary canal of the tibia. Two portals were created to allow easy access and triangulation to the lesion, one for the 5-mm arthroscope and the other for the instrument. Debridement, irrigation, and resection of the sequestrum were performed for the cases with osteomyelitis, and the intraosseous ganglion cyst was treated with biopsy, debridement, and autogenous bone grafting. All cases were treated successfully with medulloscopy and did not show recurrence at the last follow-up. In addition, there were no complications related to the procedure.

Key Words: Chronic osteomyelitis—Medulloscopy—Intramedullary lesion—Intraosseous ganglion—Saucerization—Sequestrum.

Roberts et al.1 examined the intramedullary canal of the tibia using a standard arthroscopic technique and referred to this as “medulloscopy” to treat medullary lesions. They performed medulloscopy after opening the intramedullary canal of the femur or tibia by removing the intramedullary nail and reaming the canal. The nail or reamer entry site was used to introduce the endoscope. They used the same entry portal regardless of the location of the pathologic lesion in both the femur and tibia. However, it is difficult to access lesions by use of a standard endoscope when they are located at the distal portion of the femur or tibia. We report the use of medulloscopy for treating localized intramedullary lesions located in the metaphysis of the long bone.

REVIEW OF CASES

We encountered 5 cases in which medulloscopy had been performed. Four cases had chronic osteomyelitis. Among these 4 cases, 1 was in the distal femur, 2 in the proximal tibia, and 1 in the distal tibia. One case had an intraosseous ganglion cyst near the lateral epicondyle of the distal femur. The precise location and extent of the lesion were assessed preoperatively by a standard radiograph and magnetic resonance imaging (MRI) scan. Once the pathologic lesion was confirmed to be a localized lesion, 2 portals were created according to the following guidelines to allow easy access and triangulation to the lesion while minimizing the biologic and biomechanical damage to the bone. One portal was made for the 5-mm arthroscope (Stryker, Kalamazoo, MI), and the other was made for the instrument. Each portal was made after a guide pin was placed toward the center of the pathologic lesion. The distance between the portals should be separated with enough distance to allow easy instrumentation.
and prevent stress fractures connecting the 2 portals. The preferred angle between the 2 guide pins is 90°. In addition, the medial cortex was not considered to be a site for portal placement so as to avoid an increase in stress that might result in fractures. The major neurovascular structures should be avoided during portal placement. Debridement, irrigation, and resection of the sequestrum were performed in the chronic osteomyelitis cases. Biopsy, debridement, and autogenous bone grafting were performed to treat the intraosseous ganglion cyst.

Osteomyelitis

A 63-year-old man had been injured by fragments from a hand grenade during the Vietnam War. These fragments were removed from the left distal femur. He visited our hospital 2 months earlier complaining of painful swelling with localized warmth and erythema in his left thigh. The white blood cell (WBC) count, erythrocyte sedimentation rate (ESR), C-reactive protein (CRP) level, radiographs, 3-phase bone scan, and MRI scan were evaluated for suspicion of chronic osteomyelitis. The WBC count, ESR, and CRP level were 12.24 × 10^9/mm³, 34 mm/h, and 6.25 mg/dL, respectively. The radiographs showed thickening of the cortex, reactive sclerosis, and focal destruction of the medullary portion. A 3-phase bone scan showed increased uptake in all 3 phases (Fig 1). MRI showed a lesion with patchy enhancement with a central non-enhancing portion that suggested a sequestrum and thickened bony cortex with surrounding inflammatory extension (Fig 1). The lesion was well localized at the metaphysis of the distal femur on the radiographs and MRI scan.

The patient was placed under general anesthesia in the supine position without a tourniquet to distinguish the vascularized tissue from the avascularized tissue. Fluoroscopy was used to identify the lesion. An incision was made on the lateral thigh, and the vastus lateralis muscle was split. Although there was substantial skin and fascial incision, the muscle was split slightly to expose the site for portal opening. It is believed that open exposure would be advantageous in cases of infection because contamination by flowing pus would be minimal and instrumentation, such as an osteotome or curette, can be used easily. In addition, there will be less bone loss because there is no need to use a cannula, which requires more reaming for its adaptation and would be necessary if the percutaneous approach were used. The lateral cortex of the distal femur was exposed without detachment of the periosteum to preserve the periosteal blood supply. Two guide pins were inserted into the center of the lesion under fluoroscopic guidance. A cannulated reamer was used to create 7-mm-diameter portals. One portal was used for the arthroscope, and the other was used for the instrument (Fig 2). The endoscopic findings showed pus and granulation tissue. After irrigation, the pathologic soft-tissue material was taken for biopsy. The sequestrum was easily identified during medulloscopy because it appeared white and lacked vascularity. The fibrotic tissues and sequestrum were
removed with a curette, small-sized osteotome, and arthroscopic bur. It is believed that the pathologic lesion had been removed completely because the whitish, nonviable sequestrum was removed until viable, bleeding bone appeared and removal of the sequestrum was confirmed by fluoroscopy (Fig 3).

The dead space was filled with gentamicin–poly-methyl methacrylate antibiotic-loaded beads mixed with 2 g of vancomycin. The intraoperative culture showed the growth of methicillin-susceptible *Staphylococcus aureus*. The patient was administered a 6-week supply of cefazolin intravenously. Full weight bearing was allowed immediately after surgery. The antibiotic-loaded cement beads were removed 6 weeks after surgery (Fig 4). The patient returned to work 3 months after surgery. The laboratory findings at 3 months after surgery, including WBC count, ESR, and CRP level, were within normal ranges, $4.57 \times 10^3/\text{mm}^3$, 6 mm/h, and 0.09 mg/dL, respectively, and were maintained within normal ranges until 9 months after surgery. In the other 3 cases with chronic osteomyelitis, 2 were caused by methicillin-susceptible *Staphylococcus aureus* and treated in a similar manner to that described previously, followed by a 6-week course of intravenous cefazolin administered postoperatively. The other case was diagnosed with tuberculosis, as confirmed by biopsy, and received antituberculous medication postoperatively.

The mean follow-up period ranged from 9 months to 7 years, and there were no complications associated with the procedure, such as recurrence or fracture, at last follow-up. The CRP level was maintained within the normal range. Therefore it is believed that the chronic osteomyelitis had been cured.

**Ganglion**

A 55-year-old man was admitted to the hospital with intermittent pain in his left knee that he noticed 2 weeks earlier. The radiographs showed an oval, eccentric radiolucent lesion that was well localized in the distal femur close to the site of attachment of the lateral collateral ligament (Fig 5). The MRI findings showed spherical and well-marginated signal intensity characteristics of a fluid-filled structure surrounded by...

**Figure 3.** (A) Nonbleeding bone covered by fibrous tissues. (B) Removal of fibrotic tissue with a shaver. (C) Removal of sequestrum with a mini-sized osteotome. (D) Bleeding bone after removal of sequestrum.

**Figure 4.** (A) Antibiotic-loaded cement beads were inserted and removed 6 weeks after surgery. (B) There was no recurrence after medulloscopy.

**Figure 5.** (A) Radiographs showing an oval, eccentric radiolucent and well-defined defect of the distal femur close to the site of attachment of the lateral collateral ligament. (B) MRI findings showing spherical and well-margined signal intensity characteristics of a fluid-filled structure surrounded by a rim of sclerotic bone.
a rim of sclerotic bone (Fig 5). A tourniquet was used with the patient under general anesthesia in the supine position. The lesion was identified by fluoroscopy. Two guide pins were inserted into the center of the lesion. Care was taken to avoid injuring important structures, such as the lateral epicondyle attached to the lateral collateral ligament. After the precise location was confirmed, 2 openings were made with a 6-mm cannulated reamer. The endoscopic findings showed yellowish gelatinous fluid and fibrotic tissue (Fig 6).

Biopsy, debridement, and curettage of the cyst were performed, and the defect was filled with allogeneic bone graft through the portal (Fig 6). The histopathologic examination showed cystic space without an epithelial lining that was filled with gelatinous, mucoid material and macrophages. The cyst was identified as an intrasosseous ganglion (Fig 6). Full weight bearing was allowed immediately after surgery. Two years after surgery, the patient reported no pain or recurrence.

**DISCUSSION**

Roberts et al. suggested an application to the intramedullary canal and called it “medulloscopy.” They reported that medulloscopy allowed direct visualization, irrigation, and decompression of an infection to treat intramedullary osteomyelitis. Bone debridement and grafting were performed to treat nonunion. Many authors have used arthroscopy to treat extra-articular intramedullary lesions. The application of medulloscopy was recently extended. Medulloscopy can be used in cases of localized lesions, such as debridement and irrigation for chronic osteomyelitis, curettage of benign bony tumors, debridement and bone grafting for delayed union or nonunion, removal of foreign bodies, and physeal bar resection.

The aim of surgery for chronic osteomyelitis is to eradicate infection by achieving a viable and vascular environment. Saucerization, such as adequate radical debridement and sequestrectomy, has been accepted as the standard procedure. However, saucerization often leaves a large bone defect that may cause a pathologic fracture. In addition, extensive debridement and a large bony window can also disturb the peristomial circulation. An injury to the bone circulation may inhibit the healing process of the infection.

In cases of localized osteomyelitis, it is believed that medulloscopy could be more effective against infection than saucerization because it can remove the sequestrum selectively and cause less damage to the adjacent healthy bone. In addition, medulloscopy might decrease the incidence of stress fractures because of the small-sized openings compared with saucerization. Therefore it is believed that medulloscopy has mechanical and biologic benefits compared with saucerization. In addition, medulloscopy can be performed without injuring the important structures, such as the collateral ligament, cruciate ligament, muscle, and tendon. The vascularity of the bone can be observed easily to distinguish it from the sequestrum as a result of continued irrigation. Hence localization of the sequestrum can be done without difficulty. After removal of the sequestrum, viable, bleeding bone can be observed directly and the adequacy of the procedure can be recognized easily. However, medulloscopy will not be adequate for treatment if the pathologic lesion is spread throughout the medullary canal because of limited visibility and inaccessibility of the instrument. Overall, it is believed that medulloscopy is unsuitable for diffuse intramedullary lesions.

Roberts et al. used the nail or reamer entry site to introduce the endoscope. Sometimes, an endoscope cannot access the lesions far from the entry site because a standard arthroscope is rigid. Instead of using a standard arthroscope, some authors used a flexible endoscope or a longer rigid endoscope, such as a rhinolaryngoscope, cystoscope, laparoscope, or endoscope for varicotomy. A long telescope may be needed and the visible field may be narrow because of the long distance from the entry site to the working site. In addi-
tion, there may also be some probability of contaminating the healthy tissues in the case of an infection.

Our technique for medulloscopy is unique compared with that reported by Roberts et al. because it allows more direct access to intramedullary lesions and uses the instrument effectively with good visibility. Moreover, it can remove a pathologic lesion through the working portal located in close proximity to the lesion. Meticulous preoperative planning regarding the insertion site of the guide pin is essential to avoid mechanical weakness of the bone and perform surgery effectively.

The use of our technique will be limited in the following cases. If a localized lesion is placed in the diaphysis, medulloscopy will be limited because a stress fracture can occur through the relatively large portal. In this situation, it is believed that medulloscopy through the nail or reamer entry site would be better. In addition, if there is some suspicion that the pathologic lesion is malignant, there is the risk of spreading the tumor into the adjacent soft tissue. Treatment with medulloscopy will be limited in cases in which the lesion is diffuse throughout the medulla. Early in our clinical experience, a relatively large incision was necessary because it helped make small portals for medulloscopy to minimize damage to the lateral femoral cortex and made the passage and use of the instrument easier. Without soft-tissue exposure, the size of the portal will be larger. It is believed that with the accumulation of clinical experience, the substantial incision will become smaller and the use and development of a flexible instrument will expand the use of medulloscopy.

Although medulloscopy is not a popular procedure, it has several advantages, such as the preservation of vascularity and viability because of less damage to the endosteal vasculature and safe access without soft-tissue injury to the ligament, muscle, and tendon, as well as easy visualization of a localized pathologic lesion. Overall, it is believed that medulloscopy will be a useful technique for treating localized intramedullary lesions.

REFERENCES