Technical Note

Nano-Arthroscopic Ultrasound-Guided Excision of Unresolved Osgood–Schlatter Disease

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Abstract: The nano-arthroscopic ultrasound-guided ossicle excision technique is used in the management of an unresolved Osgood–Schlatter disease. The NanoScope is inserted slightly lateral to the proximal patella tendon and moved on between the ossicle and anterior surface of the proximal tibia under ultrasonographic guidance. The 5-mm skin incision is made as a working portal on the medial side of the proximal patella tendon. The proximal border of the ossicle is clearly identified after bursectomy. Then, the ossicles are removed piece by piece using a 2-mm arthroscopic punch. During the resection, the remaining ossicle is continuously confirmed by ultrasound. Finally, the complete excision of the ossicle is shown by the nano-arthroscopic view and ultrasound. The patient is allowed to have a full weight-bearing and an unrestricted range of motion on the day of surgery. Patients are permitted to resume their sports activities without any restriction after 6 weeks. This technique is recommended to athletes who suffer from painful unresolved Osgood–Schlatter disease because of the benefits of it being a minimally invasive surgery with an early postoperative recovery.

Osgood–Schlatter disease (OSD) is a traction apophysitis of the tibial tuberosity. This condition usually appears between the ages of 8 and 14 years in girls and 10 and 15 years in boys, especially in children and adolescents who participate in sport activities.[1] It was reported that the precise risk factors for OSD were increased, namely the quadriceps femoris muscle tightness and strength during knee extension and the flexibility of the hamstring muscles.[2] Although the symptoms disappear in most patients after the closure of the growth plate, only one-half of patients recover entirely, according to ultrasonography results 2 years after diagnosis.[3]

Like adolescents, most adult patients also respond to conservative treatment. However, surgical intervention has been required in cases of unresolved OSD to relieve symptoms.[4] We present the nano-arthroscopic ultrasound-guided ossicle excision technique for persistent symptomatic OSD.

Fig 1. The view of the standard lateral radiograph of the patient's left knee. Ossicle is identified in the anterior surface of the tibial tuberosity.

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The authors report that they have no conflicts of interest in the authorship and publication of this article. Full ICMJE author disclosure forms are available for this article online, as supplementary material.

Received January 17, 2021; accepted February 15, 2021.

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2212-6287/2178

https://doi.org/10.1016/j.eats.2021.02.026

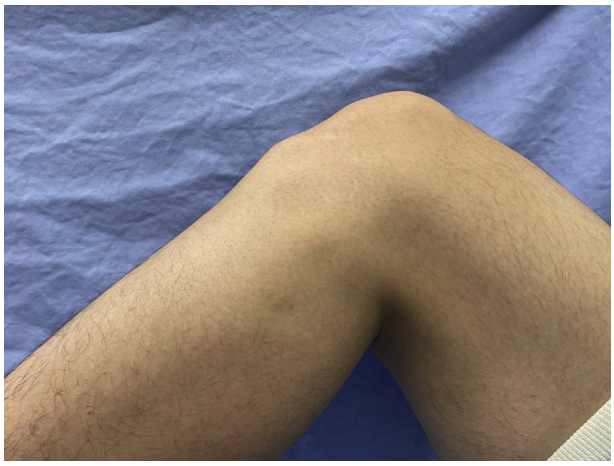

Fig 2. Appearance of lateral aspect of the patient's left knee. Protrusion of the tibial tuberosity is shown.

Surgical Technique (With Video Illustration)

Preoperative Workup

OSD is diagnosed on a standard lateral radiograph (Fig 1). Protrusion of the tibial tuberosity is also identified in appearance (Fig 2). Computed tomography and magnetic resonance imaging scans are available to identify the location of ossicles in details (Fig 3). Patients whose pain is not reduced by conservative treatment are required to undergo surgical treatment.

Patient Position and Preparation of the Device

The patient is placed in the supine position on the operating room table with the knee extended at 0°, and a tourniquet applied to the thigh. Then, the knee is prepared and draped in the sterile manner. We use the portable ultrasound scanner (Synergy MSK; Arthrex, Naples, FL) and NanoScope (Arthrex) to perform the excision of the ossicles. This cordless ultrasound scanner is wrapped into a sterile plastic bag, and is used to visualize the ossicles. NanoScope is a 1.9-mm diameter chip-on-tip imaging system that provides a field of view similar to a traditional 4-mm endoscope.

Access to the Ossicle

First, a longitudinal image of the ossicle and patella tendon is visualized by ultrasonography (Fig 4). The NanoScope is inserted slightly lateral to the proximal patella tendon (Fig 5). Then, the scope is moved on between the ossicle and the anterior surface of the proximal tibia under ultrasonographic guidance (Fig 6). The posterior aspect of the ossicle and anterior surface of the tibial tubercle are viewed with the NanoScope (Fig 7). Next, the ultrasonographic image is transformed to the medial aspect of the patella tendon. The 5-mm skin incision and portal is made of the medial side of the proximal patella tendon. This medial portal is used as a working portal. The arthroscopic device gains access to the working location via ultrasound guidance.

Fig 3. Computed tomography (A) and magnetic resonance imaging (B) of the patient's left knee. Details of the ossicle is shown on these sagittal imaging. The ossicle is closed to the patella tendon.

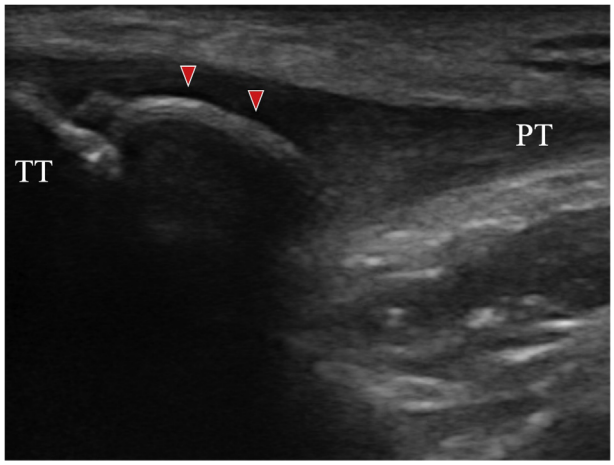

Fig 4. Preoperative ultrasound image of the patient's left knee. The tibial tuberosity (TT) and patella tendon (PT) are shown on longitudinal view. The red markers indicate the ossicle. Ossicle of the Osgood–Schlatter disease is found beneath the patella tendon.

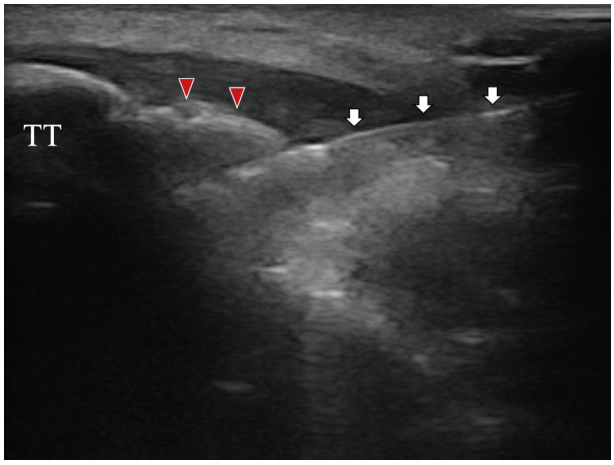

Fig 6. Ultrasound image while NanoScope is inserted. NanoScope (white arrows) is moved between the ossicle and the anterior surface of the proximal tibia. The red markers indicate the ossicle.

Resection of the Ossicle

A 2.9-mm bladed mini-motorized shaver (DYONICS POWERMINI Blade, 2.9 mm INCISOR Plus ELITE; Smith & Nephew, Andover, MA) is brought to the view of the NanoScope. Bursectomy is performed to improve the view of the ossicle's outline (Fig 8). After bursectomy, a mini-radiofrequency probe (Vulcan RF; Smith & Nephew) is used to clearly identify the proximal border of the ossicle (Fig 9). Then, ossicles are removed in a piece-by-piece manner using the 2.0-mm arthroscopic punch (Fig 10). During the resection, the remaining ossicle is continuously confirmed using the ultrasound (Fig 11). After excision of all of the ossicles, the debridement was performed posterior to the patella tendon. Finally, complete excision of the ossicles is performed, and the posterior surface of the patella tendon is able to be identified by the nano-arthroscopic view (Fig 12). Ultrasonography also shows the

Fig 5. Appearance of the patient's left knee during surgery. NanoScope is inserted slightly lateral to the proximal patella tendon under ultrasonographic guidance.

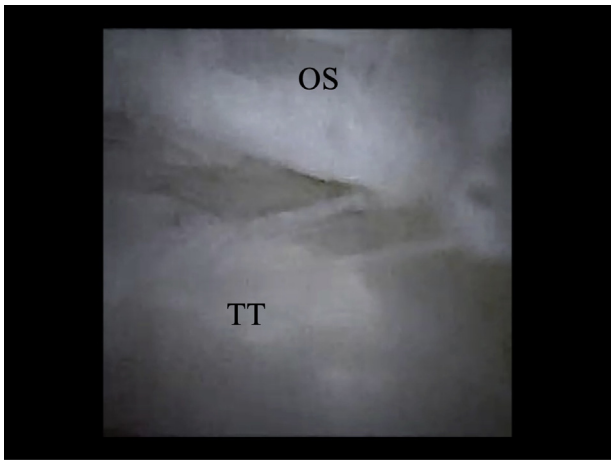

Fig 7. Nano-arthroscopic view of the patient's left knee. The tip of the NanoScope is placed on between the ossicle (OS) and anterior surface of the proximal tibia. Posterior aspect of the OS and tibial tuberosity (TT) are shown in this view.

Fig 8. Nano-arthroscopic view of the patient's left knee during bursectomy. A 2.9-mm bladed mini motorized shaver is inserted from the medial working portal. The outline of the ossicle (OS) and tibial tuberosity (TT) are identified after this procedure.

disappearance of the ossicles (Fig 13), as well as the radiograph and computed tomography images (Fig 14).

Postsurgical Care

The medial portal is closed with a single subcutaneous suture. In contrast, a skin suture is unnecessary to close the insertion site of the NanoScope (Fig 15). The patient is allowed full weight-bearing and an unrestricted range of motion on the day of surgery. Strengthening activities were allowed in the first week after surgery. Patients are allowed to resume their sports activities without any restriction after 6 weeks.

Discussion

This technique of nano-arthroscopic ossicle excision under ultrasound guidance is applicable to patients suffering from unresolved OSD. Nano-arthroscopic treatment has an advantage in that it is a minimally invasive technique. Satisfactory functional recovery following arthroscopic ossicle resection in young athletes with unresolved OSD has been reported.[5] The advantages of this arthroscopic technique include less damage to the patellar tendon and early postoperative recovery. In case of resection using a NanoScope, the invasion of the infrapatellar fat pad and patella tendon is lowest. Therefore, the early resumption of sports activities might be expected.

Recently, the ossicle of OSD was clearly visualized using ultrasonography.[6] It is important to confirm the residual ossicle frequently during surgery. The 2.0-mm arthroscopic punch gains access via a 5-mm medial working portal. The ossicles is not removed as a single block because of tiny working portal. In addition, a mini-motorized shaver and radiofrequency probe also are inserted from medial portal. The damages to the patella tendon should be avoided during the excision of the ossicles, bursectomy, and debridement.

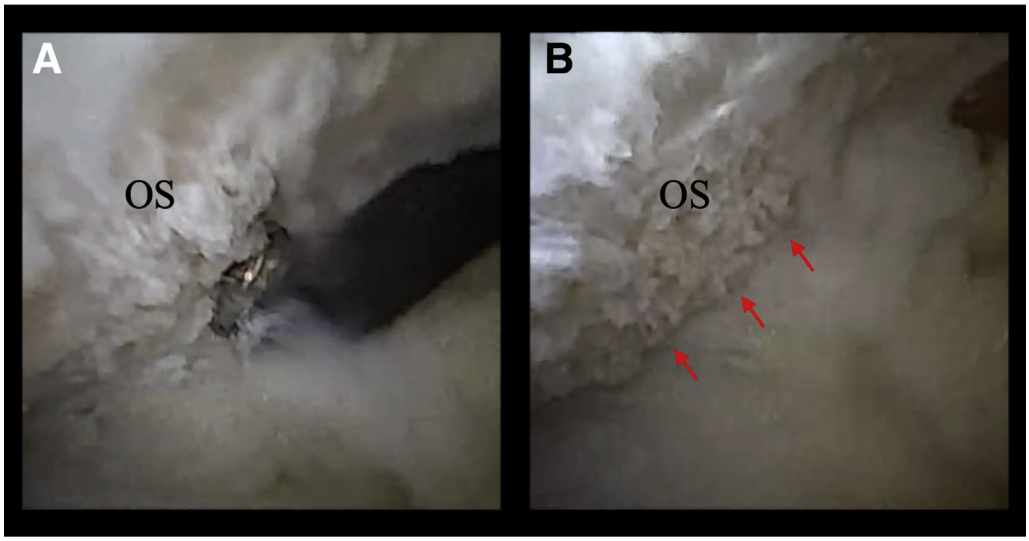

Fig 9. Nano-arthroscopic view of the patient's left knee. A mini-radio frequency probe is inserted from the medial working portal. To identify the accurate edge of the ossicle (OS), this probe is useful (A). The proximal border of the OS (red arrows) is clearly identified after this procedure (B).

Fig 10. Nano-arthroscopic view of the patient's left knee during excision of ossicles (OS). A 2.0-mm arthroscopic punch is inserted from the medial working portal. OS is resected in a piece-by-piece manner using the arthroscopic punch.

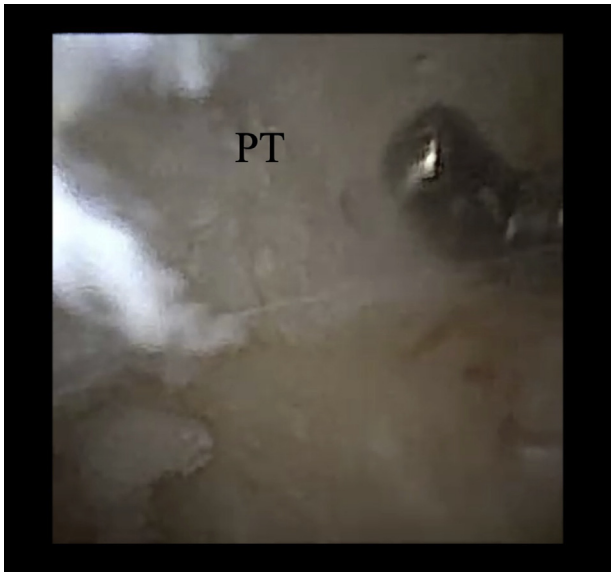

Fig 12. Nano-arthroscopic view of the patient's left knee after removal of ossicles. Disappearance of the ossicles and the posterior surface of the patella tendon (PT) are clearly identified.

In the previous reports, excision of the ossicle has been shown to yield better results than other methods.[1] Therefore, ossicle excision is a popular procedure for unresolved OSD. It was reported that the outcomes after an open excision of ossicles with a vertical 5-cm incision was 51% excellent, 34% good, and 15% of poor.[4] Eun et al.[7] noted delayed resolution of pain and swelling at the surgical sites following the open surgical technique. Furthermore, the surgical scar located in the anterior knee can cause irritation during kneeling.[7] A skin suture is unnecessary to close the insertion site of the NanoScope. Therefore, there are no incisional scar in front of the tuberosity that may cause discomfort when kneeling, with a better cosmetic result.

A cordless ultrasound device such as Synergy MSK is useful during this arthroscopic surgery. This scanner is wrapped into a sterile plastic bag and available during the operation. Tsakotos et al.[8] reported that fluoroscopic control was necessary after the arthroscopic

Fig 11. A scene while the arthroscopic ossicle excision of the left knee is being performed. NanoScope is inserted slightly lateral to the proximal patella tendon. The medial portal is made of the medial side of the proximal patella tendon as a working portal. The cordless ultrasound scanner is continuously used to confirm remaining ossicles.

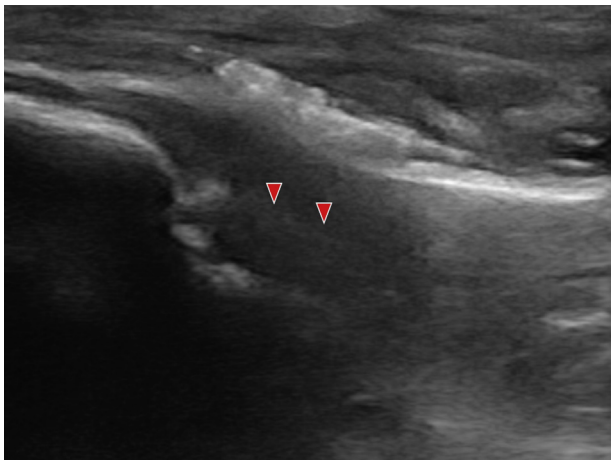

Fig 13. Ultrasonographic image of the patient's left knee after resection of the ossicles. The red markers indicates the disappearances of the ossicles.

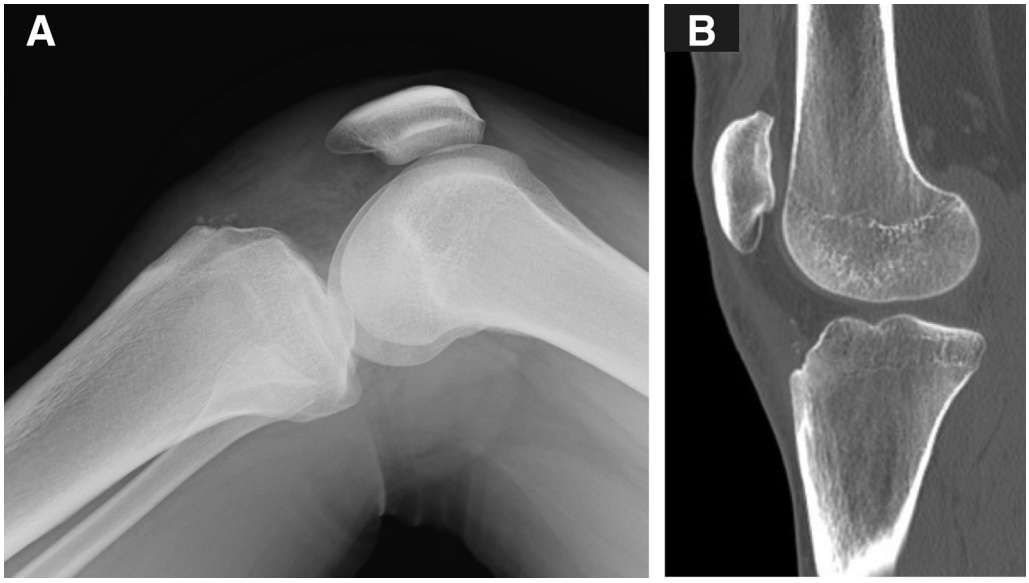

Fig 14. The view of the standard lateral radiograph (A) and computed tomography (B) of the patient's left knee after surgical treatment. Disappearance of the ossicle is identified in the anterior surface of the tibial tuberosity.

excision of the osscle. This technique using ultrasonography is also superior compared with past reports in terms of radiation exposure.

Fig 15. Appearance of the patient's left knee after operation. The red arrow and red marker indicate the insertion of the NanoScope and the 5-mm medical working portal respectively. The insertion site of the NanoScope does not require skin sutures.

One of the disadvantages of this technique is that the view of NanoScope is slightly narrow. It is important to maintain the ossicles in the nano-arthroscopic view continuously during resection. However, it does not take long to get used to performing this technique. The advantages and disadvantages as well as the pearls and pitfalls are listed in Tables 1 and 2.

Nano-arthroscopic resection of the ossicles is a minimally invasive technique. In addition, the combination of cordless ultrasonography is useful to confirm the residual ossicle and to avoid patella tendon damage without radiation exposure. We recommend this technique for athletes who are suffering from painful unresolved OSD.

Table 1. Tips, Pearls, and Pitfalls

Tips and Pearls
The tip of NanoScope is moved between the ossicle and anterior surface of the proximal tibia under ultrasonographic guidance.
The ossicles are removed in a piece-by-piece manner using a 2.0-mm arthroscopic punch.
During the resection, the remaining ossicle is continuously confirmed using the ultrasound.
A skin suture is unnecessary to close the insertion site of the NanoScope.
Pitfalls
The view of the NanoScope is slightly narrow. Therefore, it is important to view the ossicle constantly.
Bursectomy should be carefully performed to avoid the invasion of the infrapatellar fat pad or patella tendon.

Table 2. Advantages and Disadvantages

Advantages
The early resumption of sports activities might be expected.
This technique is less damaging to the patellar tendon and infrapatellar fat pad.
There are no incisional scars in front of the tuberosity causing kneeling discomfort.
The combination of cordless ultrasonography is able to avoid radiation exposure.
Disadvantages
The ossicle is not removed as a single block.
The view of the NanoScope is slightly narrow.

References

1. Circi E, Atalay Y, Beyzadeoglu T. Treatment of Osgood–Schlatter disease: Review of the literature. *Musculoskelet Surg* 2017;101:195-200.
2. Nakase J, Goshima K, Numata H, Oshima T, Takata Y, Tsuchiya H. Precise risk factors for Osgood–Schlatter disease. *Arch Orthop Trauma Surg* 2015;135:1277-1281.
3. Kaya DO, Toprak U, Baltaci G, Yosmaoglu B, Ozer H. Long-term functional and sonographic outcomes in Osgood–Schlatter disease. *Knee Surg Sports Traumatol Arthrosc* 2013;21:1131-1139.
4. Pihlajamäki HK, Mattila VM, Parviainen M, Kiuru MJ, Visuri TI. Long-term outcome after surgical treatment of unresolved Osgood–Schlatter disease in young men. *J Bone Joint Surg Am* 2009;91:2350-2358.
5. Circi E, Beyzadeoglu T. Rusults of arthroscopic treatment in unresolved Osgood–Schlatter disease in athletes. *Int Orthop* 2017;41:351-456.
6. Nakase J, Oshima T, Takata Y, Shimozaki K, Asai K, Tsuchiya H. No superiority of dextrose injections over placebo injections for Osgood–Schlatter disease: A prospective randomized double-blind study. *Arch Orthop Trauma Surg* 2020;140:197-202.
7. Eun SS, Lee SA, Kumar R, et al. Direct bursoscopic ossicle resection in young and active patients with unresolved Osgood–Schlatter disease. *Arthroscopy* 2015;31:416-421.
8. Tsakotos G, Flevas DA, Sasalos GG, Benakis L, Tokis AV. Osgood–Schlatter lesion removed arthroscopically in an adult patient. *Cureus* 2020;12:e7362.