

# Double Posteromedial Portals for Excision of a Symptomatic Os Trigonum With Ankle Arthroscopy in Supine Position

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## Research article

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# Abstract

**Background:** The existence of abnormal os trigonum often causes posterior ankle impingement syndrome, the commonly used method for excision of symptomatic os trigonum is standard arthroscopic approach when posterior and anterior abnormalities appear in one patient. However, the arthroscopy of posterior and anterior compartment of the ankle joint must be undertaken in one surgical position. In most cases, when adopting the standard arthroscopic approach, the patient has to be firstly positioned supine to perform the anterior procedure, and then re-positioned prone to operate on the posterior compartment.

**Material and Methods:** To simplify this process and shorten operation time, we describe a double posteromedial ankle portals procedure, which provides access to reach both the posterior and anterior compartment without changing position, to exam both symptomatic compartment. Standard operation are conducted by changing position to reach both compartment. Standard operation and double posteromedial ankle portals procedure were conducted to 46 patients (standard approach 23, 2 posteromedial portals 23). Operation time, AOFAS score, KAF score and VAS score were analyzed.

**Results:** It shows operation time reduced from  $69.78 \pm 5.24$  min to  $36.61 \pm 3.63$  min ( $P < 0.05$ ) and postoperative recovery index of novel method including AOFAS score, KAF score and VAS score were better than that in standard way one month after operation, but there was no significance difference after one month.

**Conclusion:** The figures strongly suggest that the double posteromedial portals approach is better than the standard procedures in operation time, short-term postoperative recovery.

## Background

Posterior ankle impingement syndrome (PAIS) means a pathological phenomenon that results from repetitive or acute forced plantar flexion of the foot<sup>(1, 2)</sup>. The existence of abnormal os trigonum causes PAIS<sup>(3)</sup>. In 1885, Bardeleben used the term os trigonum for the ossicle, previously referred to as os intermedium tarsi<sup>(4)</sup>. The incidence of symptomatic posterior talus deltoids in the normal ankle joint is 1.7% -7%<sup>(5)</sup>. PAIS has been extensively described in classical ballet dancers and sporty individuals<sup>(6-8)</sup>. The symptoms of PAIS include pain with stiffness, tenderness, and soft-tissue swelling in the posterior ankle developing osseous and soft-tissue injuries<sup>(9)</sup>. During plantar flexion, the os trigonum or enlarged lateral tubercle and surrounding soft tissue become impinged between the superior surface of the calcaneus and the posterior distal surface of the tibia<sup>(10)</sup>.

There are lots of treatments but arthroscopic technique is ideal. Activity modification, immobilization and non-steroidal anti-inflammatory agents are recommended initial treatments<sup>(11)</sup>. If conservative treatments for PAIS fail, surgical treatment is essential. It is also suggested that the visible scar after open excision might preclude a professional career for a dancer<sup>(12)</sup>. So to minimize the surgical wound

and infection rate, arthroscopic technique for excision of the os trigonum has been introduced. The new method called posterior endoscopy was described by Van Dijk et al to manage posterior ankle pathology firstly<sup>(13)</sup>. The methods of arthroscopic procedures provides less recovery time and are less invasive<sup>(14-18)</sup>.

It is possible that one patient may has trouble both anterior and posterior ankle when PAIS happens, so it is necessary to check both posterior and anterior compartement of the ankle joint<sup>(19,20)</sup>. But the arthroscopy of posterior and anterior compartement of the ankle joint must be undertaken in one surgical position. However, traditional surgery can not access both compartement without changing position. As a result, patients are asked to turn over during the surgery for excision of a symptomatic os trigonum. To avoid repositioning, we have developed a procedure that allows access to the posterior compartment of the ankle in supine position. The aim of the study was therefore to compare the therapeutic effect of the two different surgical methods by operation time, VAS score, KAF score and AOFAS score.

## **Materials And Methods**

### **Patients**

Retrospective analysis of clinical data of 46 patients for excisions of os trigonum from January 2018 to December 2019. This study was approved by the local Ethical Committee, and performed on the basis of the 1964 Helsinki declaration as well as its later amendments or comparable ethical standards. All patients knew and agreed the the letter of consent.

Inclusion criteria of patients were: 1) The age was 18-55 years old; 2) a symptomatic os trigonum verified by examination, imaging, and diagnostic injection. 3) symptomatic os trigonum with ineffective conservative treatment; 4) the absence of any previous surgical procedures on the same or contralateral ankle; 5) Patients were followed up regularly for more than 1 years.

Exclusion criteria of patients were: 1) the absence of an os trigonum; 2) the presence of Outerbridge grade 3 or 4 osteoarthritic changes in the ankle; 3) and those patients unwilling to undergo surgical treatment.

### **Methods**

The patients were randomly divided into 2 groups with 23 cases in each group. 23 patients in group A were performed in standard way and 23 patients in group B were performed by the method of double posteromedial portals in supine position. We retrospectively studied these 46 patients (20 men and 26 women; average age 49.5 at the time of surgery, range, 36–52 years, 18 left ankles, 28 right ankles).

The diagnosis of PAIS was made on the basis of the accurate clinical examination. A history of an ankle sprain or other minor trauma was reported in all 46 cases. All the patients showed reproduction of the

typical pain during exercise and forceful plantar flexion. Physical examination shows pain in the posterior malleolus when palpated. Osteochondral lesion was excluded by MRI.

## **Standard way**

The patient was placed in a supine position after general or regional anesthesia. A tourniquet was placed proximal to the knee. A padded support was put under the distal tibia, and then the ankle was put at the distal end of the operating table. A 4.5-mm, 30° arthroscope was used with standard anterior ankle arthroscopy in supine position. The biggest difference between the two groups is that the patients in standard group were asked to turn over to perform arthroscopy in the prone position after the examination was finished. The skin was cut through firstly by a sharp knife, and then subcutaneous blunt separation was conducted with mosquito clamp. A posterior-lateral blunt arthroscopic introducer was placed in horizontal direction, pointing between the first and second metatarsal bone. Then inserted the arthroscope through the first portal. By the same manner, the posterior-medial portal was produced, then an arthroscope shaver should be put in it. All adipose tissue behind the ankle joint should be cleaned. The os trigonum was found in the middle of the talus and the calcaneus, and laterally to flexor hallucis longus (FHL). All soft tissues attached to the os trigonum were excised, and then the os trigonum was removed either block with a grasper. After the surgery, the arthroscopic portals should be sutured with general methods. Then a cotton and crepe bandage were used to drape the ankle. The duration of the total operation time was recorded by a circulating nurse.

## **Double posteromedial portals in supine position way**

There are some important anatomical structures in the posterior medial foot: the tendons of flexor digitorum longus (FDL), of tibialis posterior (PT) and of FHL, and all of them are close to each other and the posterior neurovascular bundle, with the pulsation of the posterior tibial artery palpable at the midpoint between the medial malleolus and Achilles tendon. The medial calcaneal nerve originates from the posterior tibial nerve 3.3 cm proximal to the tip of the medial malleolus on average (21). It distributes to medial heel, the skin of footplate, and soft tissue of heel, after passing through flexor retinaculum. These structures are at risk during operation. An anatomic triangular which covers an area of nearly 25 cm<sup>2</sup> was located in the posteromedial aspect of ankle, its borders are easily palpated subcutaneously: the tendon of FHL, the upper calcaneal tuberosity as well as anterior margin of Achilles tendon. This area has no neurovascular structures during surgery, introducing surgical instruments into this area allows to access the lateral malleolus, the space defined between the upper talus and the posterior side of the fibula and the tibial of the ankle without disturbing the neurovascular bundle. (Fig. 1)

Under spinal anesthesia, the procedure was conducted by one surgeon (FA) or continuous epidural anesthesia in supine position. Tourniquet was used at the root of affected thigh. A small pillow was put under ankle joint.

The patient was positioned first in supine position for anterior arthroscope. The anterolateral approach was identified as operative approach. After accurate positioning was implemented, a 5 mm cut was made

in the skin with a sharp knife. Then arthroscope was inserted to make an observation channel. The anterior medial approach was used to establish the operating channel.

After the anterior ankle arthroscopy was finished, the operating instruments removing should be removed. The operating table is tilted slightly toward the homolateral leg, rotating the hip 15 to 20 degrees externally and flexing 30 to 35 degrees. The consequence of these three measures was to maintain the operated leg in externally rotated, allowing instruments to the place in which the posteromedial arthroscopic portal is made. Since the tibial malleolus are more anteriorly than the peroneal malleolus, the direction of the transmalleolar axis helps to further disclose the posteromedial area, thanks to its physiological rotation of about 10 to 15 degrees. By doing this, it is convenient to place, insert, move and withdraw the instruments in the triangular area between the posterior aspect of the tibia and the anterior margin of the Achilles tendon. (Fig. 2)

Two arthroscopic portals were made by the nick and spread technique in the posterior ankle arthroscopy, which are anterior to the Achilles tendon, and the distance between them is 45 to 50 mm. One is distal, and it is just medial and anterior to the Achilles tendon, along a horizontal line parallel to the calcaneal tuberosity passing through the proximal end of the medial malleolus. The second portal is placed 45 to 50 mm proximal to the first, also just medial and anterior to the Achilles tendon.

This setting of the portals anterior to the medial side of the Achilles tendon is secure, as the portals are at least 12 to 15 mm posterior to the posteromedial neurovascular bundle, and 15 to 20 mm from the calcaneal sensory branch of the tibial nerve. This allows safe insertion of the arthroscope and the instruments advancing them through the portals toward the posterior edge of peroneal malleolus.

While operating at the distal portal, a 5 mm cut was made in skin with a sharp knife. Then subcutaneous layer was split gently using mosquito forceps to move nervous sensitive branches. A blunt rod is advanced anteriorly and laterally through the inferior portal, pointing to the fourth web space (the space between fourth and fifth toe), and advanced until it touched bone. An extensive posterior talar process is felt between the posterior tibia and fibula. Through the distal portal, a 4.0-mm, 30° arthroscope was then inserted. On the same vertical plane of the distal one, the proximal portal was produced. Then in distal and lateral direction, a mosquito clamp advanced until it reached the arthroscope. A blunt rod is advanced inferiorly touching the shaft of the arthroscope. Removing the rod, an arthroscopic shaver is introduced in its place, advanced anteroinferiorly until it touches the arthroscope sheath. The shaver is then slid along the arthroscope sheath until its tip is visualized through the arthroscope. (Fig. 3) At last, a cotton and crepe bandage were used to drape the ankle. The duration of the total operation time was recorded by a circulating nurse. The duration of the total operation time was recorded by a circulating nurse. (Fig. 4)

## **Statistical Analysis**

Pre- and postoperative AOFAS, VAS and KAF scores were compared. The data were analyzed by SPSS 22.0 and expressed by ( $x \pm s$ ) and independent-sample T test was used for comparison for two groups. P

value<0.05 was considered to be statistically significant.

## Results

All procedures were going as planned, regardless of their anterior or posterior location. (Fig. 5)

As shown in Table 1, the duration of double posteromedial portals for excision of a symptomatic os trigonum with ankle arthroscopy in supine position was  $36.61 \pm 3.63$  minutes (range, 31–45minutes) and the duration of standard method for excision of a symptomatic os trigonum was  $69.78 \pm 5.24$  minutes (range, 63–79minutes).

The duration of double posteromedial portals for ankle anterior arthroscopy is  $15.17 \pm 1.19$  minutes (range, 13–18minutes). The duration of standard method for ankle anterior arthroscopy is  $17.04 \pm 1.11$  minutes (range, 16–19minutes). The duration of double posteromedial portals for ankle posterior arthroscopy is  $21.43 \pm 2.98$  minutes (range, 18–25minutes). The duration of standard method for ankle posterior arthroscopy is  $32.26 \pm 4.99$  minutes (range, 30–45minutes). The standard method has extra time, including the time of turning over, spreading towel and disinfection, which costs  $20.48 \pm 1.70$  (range, 14–18minutes). However, the double posteromedial portals' extra time is 0. All data showed significant difference.

All patients get well healed of operative wound without any neurovascular complication. After twelve months of follow-up, the scores were applied in the Table 2, Table 3 and Table 4. first, These tables show significant difference between group A and group B preoperatively with the assessments of VAS, KAF and AOFAS score one month after operation. However, KAF, VAS and AOFAS score have no significant difference in three, six, twelve months after operation.

## Discussion

When anterior and posterior pathologies appearing in one ankle, through the standard anterior portals, the surgeon performs an anterior ankle arthroscopy supine first, then handle the pathologies of the posterior compartment with the patient prone, as the anterior portals is difficult to examine the pathologies of the posterior ankle.

van Dijk et al advocated a methods double-portal arthroscopic approach using the posteromedial and posterolateral portals is considered reasonable for removal of an os trigonum<sup>(13)</sup>. However, there exists a drawback that patient performed the operation is in the prone position firstly and a change to supine position is necessary for posterior ankle<sup>(22)</sup>.

Here we propose an arthroscopic procedure, with the double posteromedial portals in supine position, the procedure allows the surgeon to access the anterior compartments and the hindfoot, to handle both the anterior and posterior pathologies during the same operation, without any neurovascular or tendons complication.

The study shows that the double posteromedial portals' ankle anterior arthroscopy time, ankle posterior arthroscopy time are less than standard method. In addition, the double posteromedial portals hasn't extra time waste, which could reduce the operation time, optimize the procedure and improve the operation efficiency.

Also, postoperative AOFAS, VAS and KAF score of novel operation method are better than these of standard method one month after operation, which means patients with novel operation methods recover faster than standard group in short-term. And there is no significant difference between traditional way and double posteromedial portals in supine position way in AOFAS, VAS and KAF score in 3, 6 and 12 months, which means our new arthroscopic procedure can reach the same recovery and therapeutic effect as the standard one.

Table 1 shows that the novel method produces about 30 min less operation time. The use of the double posteromedial arthroscopic portals allows full visualization of all the structures in the posterior ankle compartments, both intra-articular and extra-articular. Because it has the advantage of eliminating changing the position during the process, the workload of preparing the operation towel are reduced, the duration of the operation is shortened, which improves the efficiency of operation a lot.

The double posteromedial portals approach which is mentioned above is located in the safe area for the reason that it is anterior to the anterior margin of the Achilles tendon. The neurovascular tibial bundle moves more anteriorly in a safe position by dorsiflexing the ankle. The method makes it possible to view the posterior talotibial, talofibular, and subtalar joints widely. And moreover, it is also permit a wide arthroscopic visualization of the tendons, of the upper calcaneal tuberosity and their sheaths. At the same time, operating with arthroscopic instruments in that region leads to no complication; which means through the double posteromedial portals, arthroscopic and endoscopic management of pathology is completely practicable.

The proximity of the tibialis posterior tendon and of the neurovascular bundle in the posteromedial aspect of the ankle has discouraged some surgeons to try to access this area with surgical instruments.

In this region, other studies have detailed the arthroscopic anatomy, focusing on the relationship between the other anatomic components of the compartment and the posterior tibial neurovascular bundle. It is helpful to avoid the risk of lesion <sup>(23)</sup>.

We admit that our study does have some limitations. First, the double posteromedial portals should be performed by experienced surgeons. However, those departments can improve the proficiency of surgeons by organizing observations of the surgery which is performed by experienced surgeons.

## Conclusion

Double posteromedial portals for excision of a symptomatic os trigonum with ankle arthroscopy in supine position improves the limitation of standard methods. It needs no position change during the

operation, reducing operation time, and improving short-term recovery effect.

## Abbreviations

Posterior ankle impingement syndrome	PAIS
flexor hallucis longus	FHL
flexor digitorum longus	FDL
tibialis posterior	PT

## Declarations

### Ethics approval and consent to participate

All procedures for this study were approved by the Ethics Committee of the Hospital of Traditional Chinese Medicine Affiliated to Southwestern Medical University.

### Consent for publication

All the authors consent for publication.

### Availability of data and materials

The all data and materials are availability.

### Competing interests

None.

### Funding

No funding was received.

### Authors' contributions

Qi Hao contribute to conception and design of study. Qi Ding contribute to data collection and literature search. Songchuan Su contribute to protocol and project development of study. All authors read and approved the final manuscript.

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## Tables

**Table I.** Comparison of operation total time between standard methods and Double posteromedial portals for excision of a symptomatic Os Trigonum

Group	Total Time	Ankle Anterior Arthroscopy Time	Ankle Posterior Arthroscopy Time	Extra Time
Group A	69.78±5.24	17.04±1.11	32.26±4.99	20.48±1.70
Group B	36.61±3.63	15.17±1.19	21.43±2.98	0.00
Statistic	T=-24.996	T=-5.510	T=-8.928	T=-57.699
	P=0.000	P=0.000	P=0.000	P=0.000

Note: The extra time includes the time of turning over, spreading towel and disinfection.

**Table II.** Comparison of AOFAS score before and after operation

Group	AOFAS score					
	n	Preoperative	One months after operation	Three months after operation	Six months after operation	twelve months after operation
Group A	23	58.61±5.53	77.30±4.23	80.78±4.38	83.04±4.40	86.96±4.86
Group B	23	58.57±6.01	80.70±4.84	82.48±4.51	84.65±4.49	86.96±5.41
Statistic		t=0.026	t=-2.532	t=-1.298	t=-1.228	t=0.000
		p=0.980	p=0.015	p=0.201	p=0.226	p=1.000

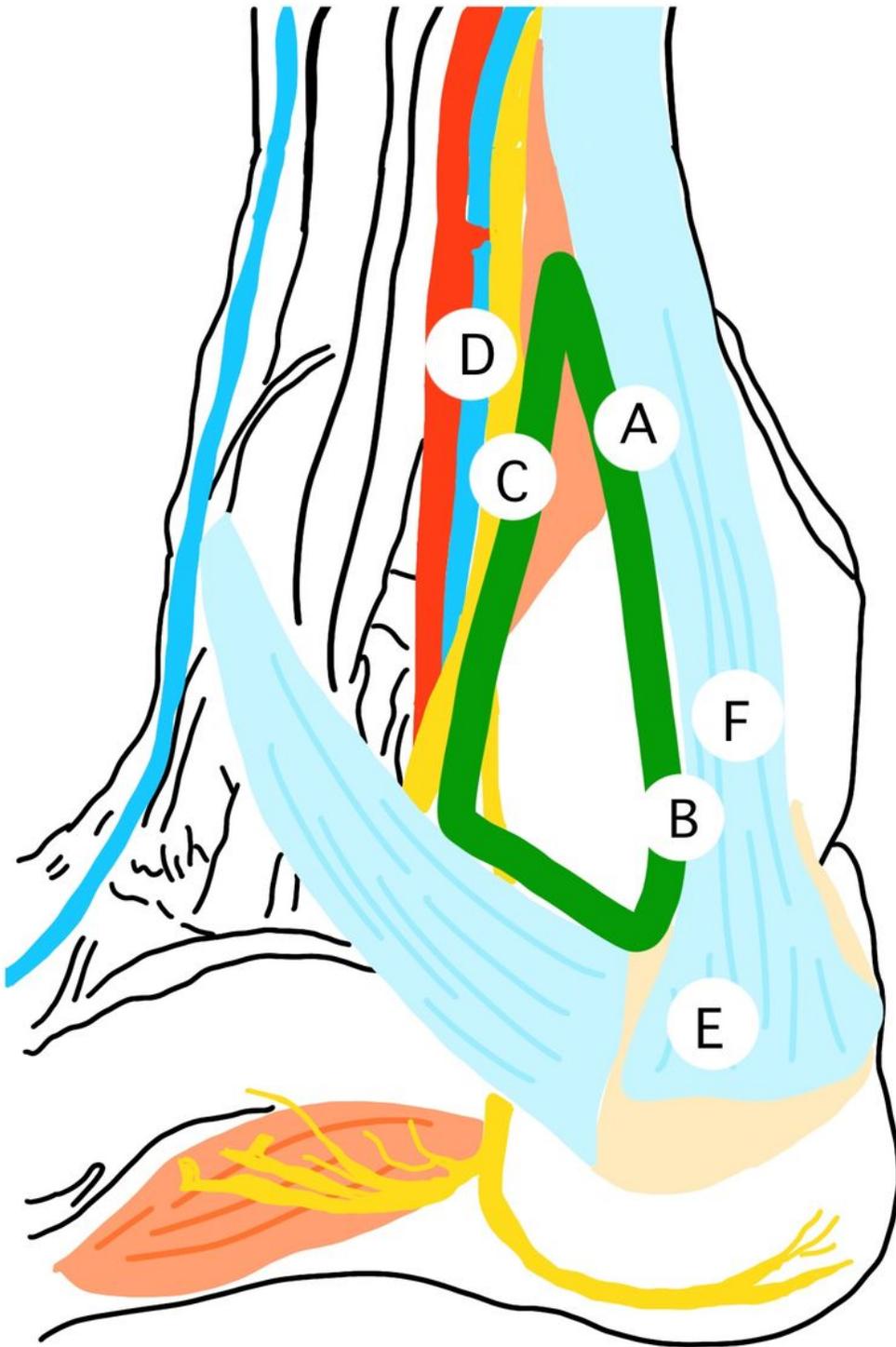
**Table III.** Comparison of VAS score before and after operation

Group	VAS score					
	n	Preoperative	One months after operation	Three months after operation	Six months after operation	twelve months after operation
Group A	23	7.22±1.00	3.91±0.95	2.83±1.11	2.22±1.13	1.39±0.66
Group B	23	7.22±1.17	3.39±0.58	3.09±1.04	2.22±1.17	1.48±0.67
Statistic		t=0.000	t=2.246	t=-0.821	t=0.000	t=-0.446
		p=1.000	p=0.030	p=0.416	p=1.000	p=0.658

**Table IV.** Comparison of KAF score before and after operation

Group	KAF score					
	n	Preoperative	One months after operation	Three months after operation	Six months after operation	twelve months after operation
Group A	23	65.48±2.61	75.48±2.61	80.43±2.69	82.91±2.78	84.91±2.78
Group B	23	64.17±2.82	77.82±2.69	79.83±2.69	82.74±2.53	83.74±2.53
Statistic		t=1.627	t=0.877	t=0.767	t=0.222	t=1.499
		p=0.111	p=0.004	p=0.447	p=0.825	p=0.141

## Figures



**Figure 1**

the triangular area where the surgical instruments access without disturbing the neurovascular bundle. The superior margin of the (E) calcaneal tuberosity, (C) the tendon of the flexor hallucis longus (FHL), and the (F) Achilles tendon circumscribe the triangular area (border green). D is posterior neurovascular bundle. A and B are two arthroscopic portals. A is the first portal. B is the second portal.

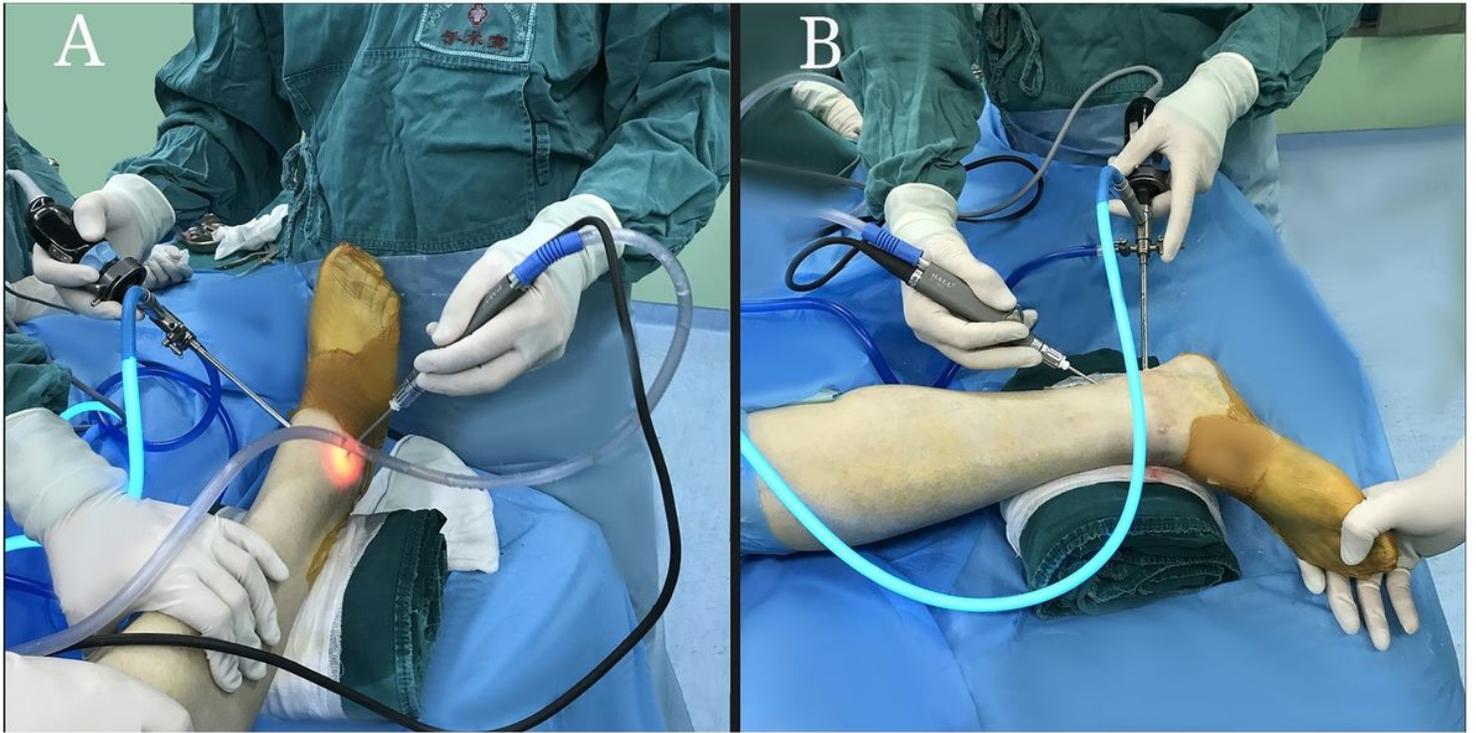


Figure 2

the anterior and posteromedial arthroscopy was underwent during the operation. (a) anterior ankle arthroscopy (b) slightly tilting the operation table toward the homolateral leg about 15 to 20 degrees externally and flexing 30 to 35 degrees to do posteromedial ankle arthroscopy.

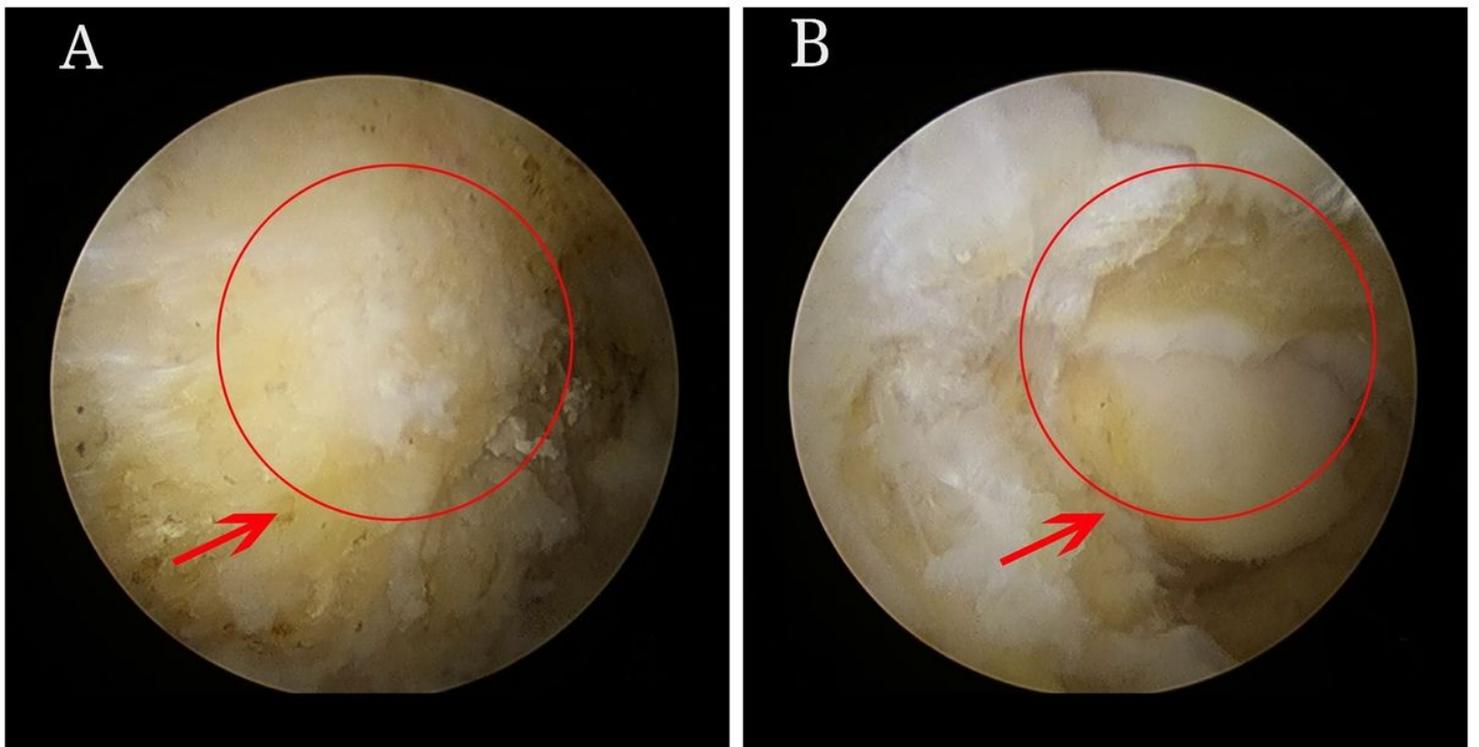


Figure 3

os trigonum under arthroscopy (red arrow) (b) Completed resection of os trigonum

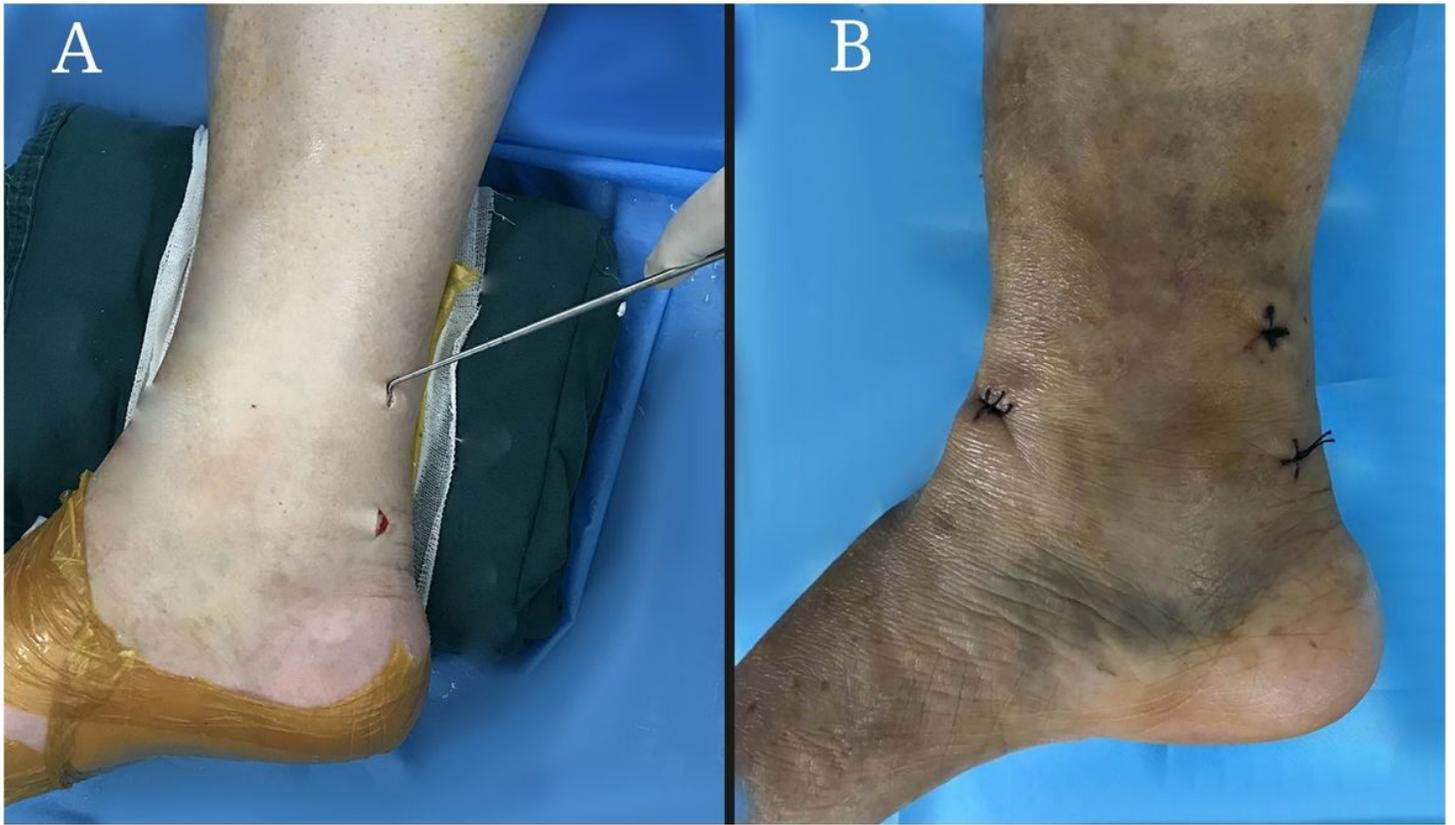


Figure 4

the two portals on the skin and sutured operative wound.

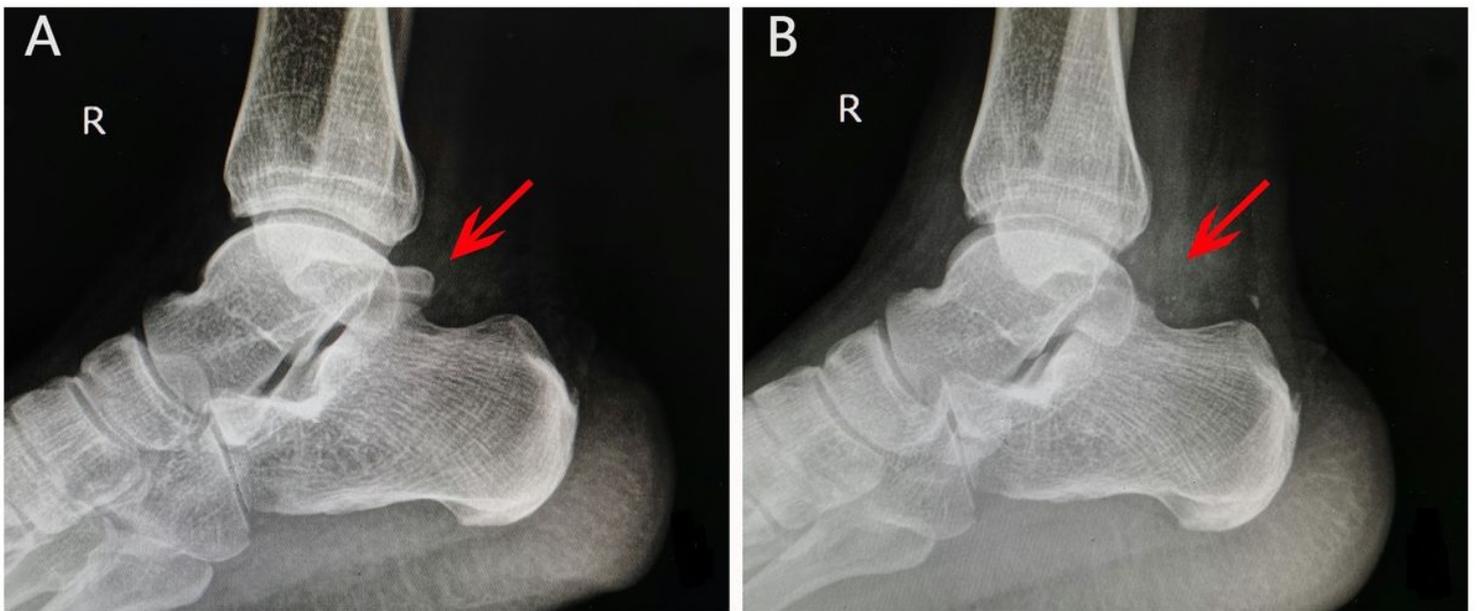


Figure 5

(a) Imaging characteristics of a symptomatic os trigonum. (a) Lateral weightbearing radiographs obtained preoperatively revealed an os trigonum posterior to the talus compared with that obtained from (b) surgical excision.