CLINICAL ARTICLE

Three-Portal Approach of Arthroscopy for Anterior Ankle Impingement Syndrome: A Propensity Score-Matched Analysis

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Objective: To introduce a 3-portal approach of arthroscopic for anterior ankle impingement syndrome and to compare this method with 2-portal arthroscopy.

Methods: From July 2011 to April 2019, a total of 52 patients (30 females, 22 males) with anterior ankle impingement syndrome underwent surgery with 2-portal approach (anterior medial and anterior lateral approach; $N = 26$) and modified 3-portal approach (anterior medial, anterior lateral, and an accessory anterior median approach; $N = 26$) of arthroscopic were recruited retrospectively after we performed a propensity score-matched analysis (PSMA). The mean age at operation time was 44.1 years (range from 22 years to 74 years) and the mean follow-up duration was more than two years (range from 2 years to 9 years). Clinical outcomes of all patients were evaluated according to the range of motion (ROM, dorsal flex angle), the American Orthopaedic Foot and Ankle Society lesser metatarsophalangeal interphalangeal scale (AOFAS), the visual analogue scale (VAS), and the operation time before and after the surgery.

Results: During the follow-up period, both two groups indicated significant improvement in these function scores. Clinical assessment showed that for the 2-portal approach of arthroscopic the total average of AOFAS scores were significantly increased from preoperative 59.91 ± 5.281 points to postoperative 76.18 ± 1.471 points ($P = 0.02$), the VAS scores were significantly decreased from preoperative 7.64 ± 0.924 points to postoperative 4.18 ± 0.982 points ($P = 0.04$), and the dorsal flex angle was significantly increased from preoperative 12.27° ± 6.467° to postoperative 21.36° ± 3.931° at the last follow-up ($P = 0.035$). However, for the 3-portal approach of arthroscopic the total average of AOFAS scores were significantly increased from preoperative 48.64 ± 9.646 points to postoperative 79.18 ± 6.555 points ($P = 0.015$), the VAS scores were significantly decreased from preoperative 7.82 ± 0.751 points to postoperative 2.64 ± 1.629 points ($P = 0.01$), and the dorsal flex angle was significantly increased from preoperative 13.64° ± 7.775° to postoperative 20.45° ± 6.502° at the last follow-up ($P = 0.045$). There were no significant differences among the dorsal flex angle, the AOFAS scores, and the VAS scores between the two groups at the last follow-up ($P > 0.05$). Although the operation time of the 3-portal approach of arthroscopic (74.82 ± 18.395 min) was longer than that of the 2-portal approach of arthroscopic (92.55 ± 27.153 min), the difference was not significant ($P > 0.05$).

Conclusion: Both the 2-portal and the 3-portal approach of arthroscopic provides almost the same satisfactory clinical outcomes for anterior ankle impingement syndrome, but we strongly suggest the 3-portal approach of arthroscopic which can supply greater joint contact area to treat advanced impingement syndrome for a good result.

Key words: Two-portal approach; Three-portal approach; Anterior ankle impingement syndrome; Arthroscopic; Propensity score-matched analysis

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Introduction

Anterior ankle impingement syndrome (AAIS) is characterized by chronic pain in the anterior aspect of the ankle, particularly during dorsiflexion[1]. AAIS is caused by the impingement of tibiotalar osteophytes and/or soft tissue. It frequently occurs secondary to mechanical factors, repetitive microtrauma, acute injury, trauma, and chronic ankle instability[2]. AAIS usually causes severe limitation of ankle movement and frequently occurs in athletes and ballet dancers, in whom ankles are subject to repetitive forceful dorsiflexion movements[3]. Morris and McMurray first named AAIS "athlete's ankle" and "footballer's ankle," respectively[4,5]. Since then, many investigations have been carried out on the pathology of AAIS. As a result, it is easy to diagnose AAIS through physical examination and identifying soft effusions, joint swelling, focal tenderness, and limitation of ankle movement.

Although many ankle injuries can be resolved with non-surgical treatment, some can only be treated by surgery. Non-operative treatment methods include rest, orthosis, nonsteroidal anti-inflammatory drugs, physiotherapy, muscular training, and intra-articular injection. In the case of AAIS, surgical intervention is often required. There have been numerous reports of good results obtained through traditional open arthrotomy[6–8]; however, follow-up studies have revealed more and more complications, including entrapment syndrome of the cutanous nerve, iatrogenic injury of the extensor digitorum longus and the extensor hallucis longus, delayed wound healing or wound dehiscence, and hypertrophic scar tissue forming[7]. Since Hawkins[9] and Martin *et al.*[10] first reported on the arthroscopic method for the treatment of AAIS in the 1980s, its application has made great progress. Due to the limitations of surgical techniques and instruments, the complication rate of ankle arthroscopy in the past 20 years was as high as 26.4%. However, with the development of arthroscopy technology, the complication rate has dropped to as low as 3.5%[11]. In Niek van Dijk's study, patients' prognosis was stratified according to the preexisting changes in osteoarthritis of the ankle; they reported that 82% of osteophyte patients without joint space stenosis had good to excellent results and 50% of patients with joint space stenosis had good to excellent results.

Compared with traditional surgery, arthroscopy has benefits in the treatment of various joint diseases: it is minimally invasive, and involves less bleeding, less injury, quicker postoperative recovery, shorter duration of operation, less pain, quicker awakening, shorter hospitalization, and fewer complications. With the continuous development of arthroscopy technology, it has been established that the joint swelling and pain is caused by scarring after anterior fibular ligament and anterior tibiofibular inferior ligament injury, inflammation of the synovium, and external impact. Recent studies have demonstrated that the pathological changes of the AAIS are mostly on the fibula side. Therefore, arthroscopy has been suggested as the gold standard for surgical treatment of AAIS. Previous research conducted by Scranton and McDermott *et al.* shows effective arthroscopic removal of bony impediments[11,12]. The cleanup of osteophyte hyperplasia is critical in ensuring the success of the operation.

However, these previous studies describe few details regarding operation techniques. We conducted the present study to address this problem. We observed that two-portal and three-portal approaches of arthroscopic synovectomy with anterior osteophyte resection and early rehabilitation in patients improved the ankle dorsal flexion angle, the visual analogue scale (VAS), and the American Orthopedic Foot and Ankle Society (AOFAS) lesser metatarsophalangeal interphalangeal scale. In addition, the AOFAS score for the three-portal approach was higher, indicated that this additional portal was effective.

The traditional anterior arthroscopic approach is the two-portal approach (anterior medial and anterior lateral approach). However, due to the upper surface foot bulge and the tight nature of the congruent ankle joint, it is difficult to probe the lateral aspect of the talus and to remove osteophytes at the anterior edge of the distal tibia, particularly given the inability of the anterior medial arthroscope to "investigate the corners" of the shoulders of the talar dome. Furthermore, although it is unusual, some osteophytes involve the borders of the talar dome and reach the posterior areas of the lateralgutter, and these lesions are sometimes difficult to see in the two-portal approach. Therefore, we have developed a three-portal approach that accomplishes the same goals through the use of an additional anterior median approach. Using this method, the full area of the joint can be revealed and the osteophyte can be thoroughly debrided. By taking advantage of the anterior median approach, it is easier to explore the fibula side and remove the osteophytes of the lower tibia and fibula. Until now, there has been no clinical data available regarding the accessory anterior median approach for AAIS.

Therefore, we conducted a retrospective evaluation of both approaches using a propensity score-matched analysis (PSMA). The aim of our retrospective study was to: (i) describe the arthroscopic debridement using a three-portal approach; (ii) assess the clinical outcomes using the AOFAS scores, the VAS scores, the dorsal flexion angle, the radiography, and the operation time; and (iii) compare the clinical efficacy of patients with AAIS between the traditional two-portal approach and a modified three-portal approach.

Methods

Inclusion and Exclusion Criteria

The following inclusion criteria based on the PICOS principle were met: (i) patients who had sustained ankle pain and activity restrictions despite at least 6 months of conservative management; (ii) the two-portal or three-portal arthroscopic intervention included clearing the impingement soft tissue and removing osteochondral fragments; (iii) self-control and intergroup control outcome assessment preoperation and at

2-week, 6-month, and 1-year intervals postoperation until a minimum of 1 year follow-up; (iv) clinical outcomes evaluated with the range of movement (ROM, dorsal flexion angle), weight-bearing ankle dorsiflexion function, the AOFAS score, the VAS score, and plain radiography including tibia osteophyte size and Scranton and McDermott classification (SMC) grade on a regular basis; and (v) a retrospective study.

Exclusion criteria included: rheumatoid arthritis, infection, any significant distal tibial and foot fracture, peripheral neuropathy, connective tissue disease, history of ankle surgery, and absense of preoperative and/or postoperative anteroposterior radiographs of the ankle.

Ethical Approval

This research was approved by the Qingdao University Medical College Affiliated Yantai Yuhuangding Hospital Ethics Committee (Number: YHY2019071), and all patients provided informed consent.

Patient Characteristics

Our retrospective study included 52 eligible cases from 79 patients diagnosed with AAIS from July 2011 to April 2019 according to patients' clinical symptoms. Among the 52 patients, there were 32 with synovial tissue impingement, 3 with meniscoid tissue impingement, 3 with injury scar tissue impingement of the distal fascicle of the anterior tibiofibular ligament, 4 with fibrous scar tissue impingement of the anterior talofibular ligament, and 25 with articular cartilage damage. All patients had a history of ankle sprain; 25 cases were in the right ankle and 27 cases were in the left ankle. Furthermore, the ankle joint twisted more than one time: 49 cases were varus injuries, 2 cases were open injuries, and 1 case was sprained uncertainly.

Radiological Assessment

Scranton and McDermott Classification Grade

Taking lateral ankle plain radiography into consideration, the SMC grade is a common classification system which divides anterior ankle impingement into four grades before surgery: grade 1 means the tibial osteophyte is less than 3 mm, grade 2 means the osteophyte is more than 3 mm, grade 3 means there are both tibial and talar osteophytes, and grade 4 means there is associated joint space narrowing.

Evaluation of the Clearance Rate for Ankle Callus

Anterior and lateral X-rays of the ankle joint were performed before and after the operation. The clearance rate of ankle joint lesions in the two groups of patients with AAIS was compared by X-ray before and after the surgery.

Surgical Technique

The technique was carried out as follows:

1. Objective: Arthroscopic intervention included clearing the impingement tissue (e.g. synovial hyperplasia, loose bodies, and proliferation of osteophytes) and removing osteochondral fragments.

2. Anesthesia: Epidural anesthesia.

3. Position: Supine position. Placing the foot on the abdomen of the operator and entering passive dorsiflexion could reveal the injury of the joint while protecting the talus dome from iatrogenic injury.

4. Exposure: We marked the location of the anteromedial and the anterolateral approach, and the position of the main artery, nerve, and tendons before the arthroscopic operation. The use of traction increased the internal working space, so the senior authors recommend intermittent use of lumbar traction. We used anteromedial and anterolateral approaches into the ankle joint, searching in sequence, adding an auxiliary approach when necessary. The dynamic impact could be evaluated through direct visualization of passive dorsiflexion. Under arthroscopy, through passive acted ankle of black stretch, plantar flexion, varus and valgus, and the rotation of the joint, artificial simulated ankle impact performance, observed the impact of location, degree, scope, and impacted the organization's character. In this maneuver, we could check the interaction between the front of the tibia and the talus to see if there was a kissing injury or impact on soft tissue.

5. Surgery: (i) Two-portal arthroscopy. Standard anterolateral and anteromedial portals were placed immediately lateral to the peroneal tendon or to the extensor digitorum longus tendon and immediately medial to the tibialis anterior tendon at the level of the joint, respectively. A synoviumectomy was performed with the use of a shaver and radiofrequency wand through the lateral portal. Bursal tissue was cleared laterally. It was sufficient to identify the osteophytes and a working area was formed to visualize the impinging lesion. (ii) Three-portal arthroscopy. Beside the two-portal arthroscopy, an accessory anterior median portal was created just lateral to the tibialis anterior. A 2.7-mm 30° angled arthroscope (Stryker, USA) was introduced through the anterior medial or anterior median view portal. The shaver and radiofrequency were introduced through the anterior lateral working portal, and the anterior edge of the tibia was identified.

The median portal anterior was shown in a fresh cadaver ankle section (Fig. 1). Arthroscopic burrs were used to reshape the original contours of the anterior tibia and dorsal talus. The combination of the shaver and a radiofrequency device was used to remove hypertrophic or inflamed synovium and fibrous tissue. Intraoperative fluoroscopy could be used to determine the exhaustive removal of osteophytes (Figs 2 and 3).

Postoperative Management and Rehabilitation

After the operation, the patient was placed in a controlled ankle joint motion (CAM) boot with partial weight-bearing for 1 week. Activity could be started immediately after

Fig. 1 Right talus trochlear horizontal plane: (A) red line show axis section of the ankle; (B) far side view of plane fault of the ankle. 1. Extensor hallucis longus tendon. 2. Extensor digitorum longus tendon. 3. Talus. 4. Fibula. 5. Peroneus longus tendon. 6. Peroneus brevis muscle. 7. Small saphenous vein. 8. Sural nerve. 9. Anterior tibial tendon. 10. Deep fibular nerve, anterior tibial artery, and anterior tibial vein. 11. Great saphenous vein and saphenous nerve. 12. Tibia. 13. Posterior tibial tendon. 14. Flexor digitorum longus tendon. 15. Posterior tibial artery and tibial nerve. 16. Flexor hallucis longus tendon. 17. Achilles tendon.

Fig. 2 Arthroscopic images showing the anterior edge of the distal tibia as viewed through the anterior median portal (A) and the anteromedial portal (B). The osteophyte edge is observed immediately in front of the arthroscope rather than in the view through the anteromedial portal.

surgery. From 2 weeks after the operation, exercise therapy could be performed for the ROM and strength. Field training and return to sports could begin as early as 4–6 weeks post-operation. In both groups, impingement and instability were treated at the same time, which changed the timing of and plans for rehabilitation.

Range of Motion

The ROM refers to the maximum radian that can be reached during joint movement, which is divided into active and passive movement ranges. The active ROM refers to the arc of motion through which the muscles acting on the joint contract freely to move the joint, and the passive ROM refers to the arc of motion through which the joint moves by an external force. The determination of the range of joint activity is a basic step for assessing patients with muscle and bone injuries and neuropathy. It is one of the indicators for assessing the extent and degree of joint motor function damage. Its main purpose is to determine whether there is limited joint movement and to establish whether it affects joint movement. In 1992, the American Academy of Orthopedic Surgeons recommended the use of the neutral zero-degree method to record joint mobility. In principle, for human joints, the anatomical limb positions are at 0°, and the angle is recorded with the neutral position as the starting point of 0°. The angles of motion of two planes of motion, such as extension, adduction, abduction, internal rotation, and external rotation, are recorded in opposite directions. Generally, the starting point 0° is in the middle of these two angles. The normal ROM for the ankle is: dorsiflexion 0° to 20°–30°, plantar flexion 0° to 40°–50°, eversion 0° to 30°–35°, and inversion 0° to 30°. According to the Kofoed and Danborg ankle function score standard, we assessed ankle function through dorsiflexion and plantar flexion activity: dorsiflexion >30°, 5 points; dorsiflexion 15–29°, 3 points;

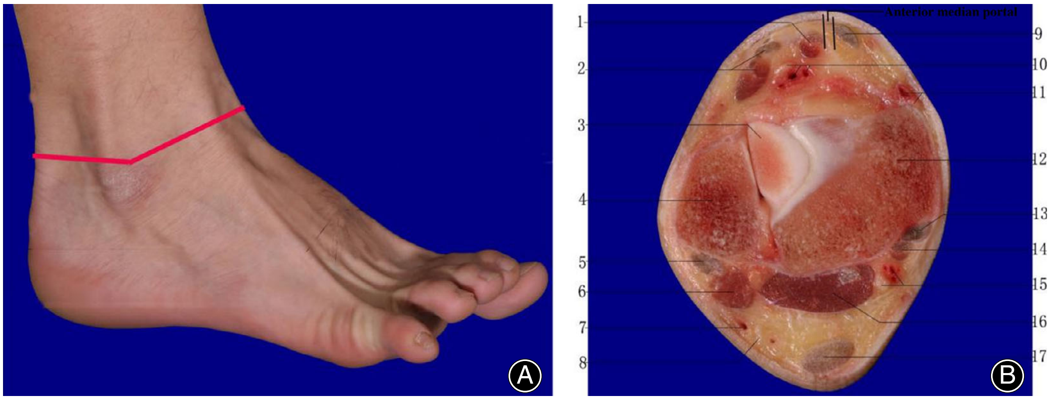

Fig. 3 (A) Preoperaion arthroscopic image demonstrates anterolateral scar impingement with associated synovitis. (B) Postoperation arthroscopic image shows the resection of the lesion.

dorsiflexion <15°, 1 point; plantar flexion >10°, 5 points; plantar flexion 5°–9°, 3 points; and plantar flexion <5°, 1 point. Scores = 10 were defined as excellent, 6 to 10 as good, 2 to 6 as passable, and <2 as poor.

American Orthopedic Foot and Ankle Society
The AOFAS ankle–hindfoot scale is mainly used to evaluate the ankle joint function of patients. The total score is 100 points, including 40 points for pain, 10 points for support, 5 points for maximum walking distance, 5 points for ground walking, 8 points for abnormal steps, 8 points for front-to-back activity, 6 points for hindfoot activity, 8 points for ankle-hindfoot stability, and 10 points for foot alignment. The higher the score, the better the joint function.

Visual Analogue Scale
The VAS is used for pain assessment. The basic method is to use a swimming ruler with a length of approximately 10 cm, which has a scale from 1 to 10 on one side. The two extremes are "0" and "10," respectively. Zero means no pain and 10 means the most unbearable pain. Patients mark the corresponding position on the ruler that represents their level of pain. The doctor scores the point according to the position marked by the patient: a score of "0–2" is "excellent," "3–5" is "good," "6–8" is "normal," and "8–" is "poor".

Statistical Analysis
The effect of the surgery was assessed using the AOFAS score, the VAS score, and the ROM. We used the SPSS 26.0 software to analyze the data of 79 patients. A PSMA was done using a multivariable logistic regression model. We used mean ± standard deviation to describe quantitative data for the comparison between groups through an independent two-sample *t*-test. The χ^2-test and the independent sample *t*-test were used for comparison of unordered categories data, while the rank sum test was used for ordered categories data. $P < 0.05$ denoted statistical significance.

Results

Summary of Demographic Data
A total of 79 patients with AAIS underwent surgery using the two-portal approach ($N = 44$) or the three-portal approach ($N = 35$) at a single institution. A PSMA was made using a multivariable logistic regression model including gender, age, diabetes, injury history, current smoker, VAS score, AOFAS score, dorsal flexion, operation time, and body mass index (BMI). Pairs of 34 patients were derived using 1:1 greedy nearest neighbor matching within PSMA score of 0.02. This strategy resulted in 26 matched pairs in each group.

The 52 patients (30 females, 22 males), who were randomly distributed equally into two groups, were prospectively evaluated, with a mean age at operation of 44.1 years (range, 22–74 years) and mean follow-up duration of more than 2 years (range, 2–9 years). The two-portal and three-portal approach groups had average ages of 51.18 ± 10.898 years and 37.09 ± 13.057 years, respectively. In addition, the mean BMI for the two-portal approach was 24.9736 ± 2.07773 and the mean BMI for the three-portal approach was 23.8382 ± 2.31497. The difference between the two groups for age and BMI was not significant. The general information and clinical function scores of the two groups are shown in Table 1 and the general information and clinical function scores between the two groups were shown in Table 2.

Radiographic Results
Ankle radiographs demonstrated that 9 cases were SMC grade I, 19 cases were SMC grade II, 19 cases were SMC grade III, and 5 cases were SMC grade IV. Based on the postoperative X-ray results, the total clearance rate of the callus was evaluated (Fig. 4 case 1; Fig. 5 case 2). Although the difference in SMC grade between the two groups was not significant, the clearance rate of the three-portal group was significantly higher; 24 cases among 26 were thoroughly debrided.

TABLE 1 General information and clinical function scores of the two groups

Group (0 = traditional two-portal group; 1 = three-portal group)		*N*	Mean	Standard deviation	Standard error mean
Age (years)	0	26	51.18	10.898	3.286
	1	26	37.09	13.057	3.937
BMI (kg/m^2)	0	26	24.9736	2.07773	0.62646
	1	26	23.8382	2.31497	0.69799
VAS (preoperation)	0	26	7.64	0.924	0.279
	1	26	7.82	0.751	0.226
VAS (postoperation)	0	26	4.18	0.982	0.296
	1	26	2.64	1.629	0.491
AOFAS (preoperation)	0	26	59.91	5.281	1.592
	1	26	48.64	9.646	2.909
AOFAS (postoperation)	0	26	76.18	1.471	0.444
	1	26	79.18	6.555	1.976
Dorsal flexion angle (preoperation)	0	26	12.27	6.467	1.950
	1	26	13.64	7.775	2.344
Dorsal flexion angle (postoperation)	0	26	21.36	3.931	1.185
	1	26	20.45	6.502	1.960
Operation time (min)	0	26	74.82	18.395	5.546
	1	26	92.55	27.153	8.187

AOFAS, American Orthopaedic Foot and Ankle Society; BMI, body mass index; VAS, visual analogue scale.

Range of Motion

At the last follow-up, clinical assessment showed that for the two-portal approach of arthroscopy, the dorsal flexion angle was significantly increased from 12.27° ± 6.467° preoperatively to 21.36° ± 3.931°(P = 0.035), while for the three-portal approach it was significantly increased, from 13.64° ± 7.775° preoperative to 20.45° ± 6.502° postoperatively (P = 0.045).

The weight-bearing position of the three-portal arthroscopic debridement operation 1 year after the operation of case 1 and foot plantar flexion (A) and dorsal extension (B) of the three-portal arthroscopic debridement operation 9 years after operation of case 2 are shown in Figs 6 and 7, respectively.

American Orthopaedic Foot and Ankle Society

The total average of AOFAS scores was increased from 59.91 ± 5.281 points preoperatively to 76.18 ± 1.471 points (P = 0.02), and from 48.64 ± 9.646 points to 79.18 ± 6.555 points (P = 0.015) for the two-portal and the three-portal approach of arthroscopy, respectively, postoperatively.

Visual Analogue Scale

At the last follow-up, the VAS scores were significantly decreased, from 7.64 ± 0.924 points to 4.18 ± 0.982 points (P = 0.04) for the two-portal approach of arthroscopy, while for the three-portal approach the VAS was decreased from 7.82 ± 0.751 points to 2.64 ± 1.629 points (P = 0.01).

Discussion

Increasing evidence in the past few years has shown that AAIS may result from bone impact and/or soft tissue impact. The pathogenesis of AAIS is believed to result from induced traumatic events, such as sprains, chronic instability, and repetitive trauma during extreme exercise. This is common among high-level athletes, as noted by 60% of elite football players. In elite runners and jumpers, the end stage of AAIS can lead to stress fractures of the medial malleolus. Symptoms related to AAIS include pain at the front and back of the ankle and reduced ROM. Palpation of the joint line is usually painful, with obvious osteophytes and swelling.[13] Preoperative CT scan evaluation revealed that the talus spurs were usually located on the medial line of the talar dome, and the tibial spurs were usually located on the lateral side.[14]

The results for standard anterolateral and anteromedial approaches with arthroscopic management for anterior ankle impingement syndrome are good to excellent in most patients.[15] The main working portals for ankle arthroscopy were the anterior medial (medial to tibialis anterior tendon) and anterior lateral (lateral to fibula or lateral to the extensor digitorum longus) portals. Due to the curved geometry of the talar, it was difficult to place the instrument in the anterior distal fibula. The grinding head was difficult to probe and the lateral side was difficult to clean thoroughly. The traditional surgical approach was insufficient for lateral cleaning up. For patients with AAIS, Chen's[16] study showed that thorough cleaning of the distal end, especially for patients with ankle instability, was key for dealing with the hypertrophic fiber bundles of the distal tibiofibular hyperplasia. However, patients with combined femoroacetabular impingement (FAI) and AAIS had a relatively poor prognosis compared with patients treated with FAI alone, probably due to

TABLE 2 General information and clinical function scores between the two groups

		f	Significance	*t*-test for equality of means	Degrees of freedom	Significance (two-tailed)	Mean error difference	Standard error difference	95% confidence interval of the difference lower	95% confidence interval of the difference upper
Age	Equal variances assumed	0.484	0.495	2.748	20	0.012	14.091	5.128	3.394	24.788
BMI (kg/m^2)	Equal variances assumed	0.107	0.747	1.211	20	0.240	1.13545	0.93789	−0.82095	3.09186
VAS (preoperation)	Equal variances assumed	1.640	0.215	−0.506	20	0.618	−0.182	0.359	−0.931	0.567
VAS (postoperation)	Equal variances assumed	1.864	0.187	2.695	20	0.014	1.545	0.574	0.349	2.742
AOFAS (preoperation)	Equal variances not assumed	4.591	0.045	3.400	15.500	0.004	11.273	3.316	4.225	18.321
AOFAS (postoperation)	Equal variances not assumed	13.396	0.002	−1.481	11.005	0.167	−3.000	2.025	−7.458	1.458
Dorsal flexion angle (preoperation)	Equal variances assumed	1.704	0.207	−0.447	20	0.660	−1.364	3.049	−7.724	4.997
Dorsal flexion angle (postoperation)	Equal variances assumed	0.347	0.562	0.397	20	0.696	0.909	2.291	−3.870	5.688
Operation time (min)	Equal variances assumed	2.403	0.137	−1.793	20	0.088	−17.727	9.889	−38.355	2.900

AOFAS, American Orthopaedic Foot and Ankle Society; BMI, body mass index; VAS, visual analogue scale.

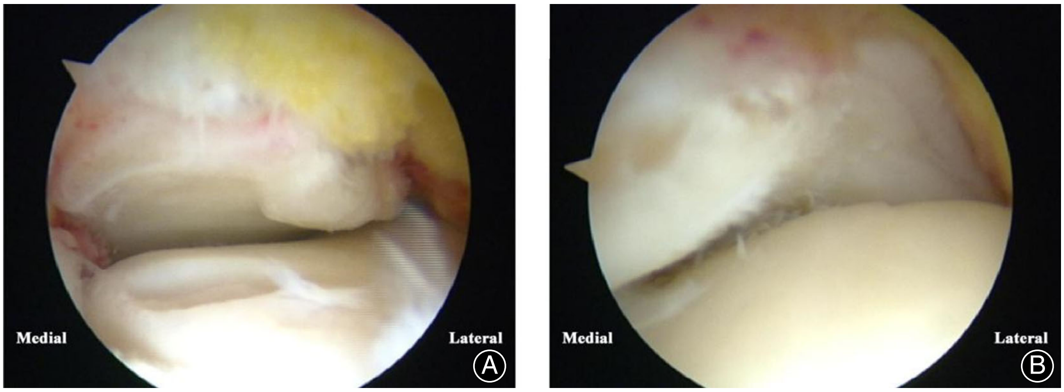

Fig. 4 Case 1. Preoperative radiography: anterior–posterior (A) and lateral (B) views demonstrate an elongated process of the talus. Postoperative radiography: anterior–posterior (C) and lateral (D) views show that the osteophytes are debrided 1 year after the operation.

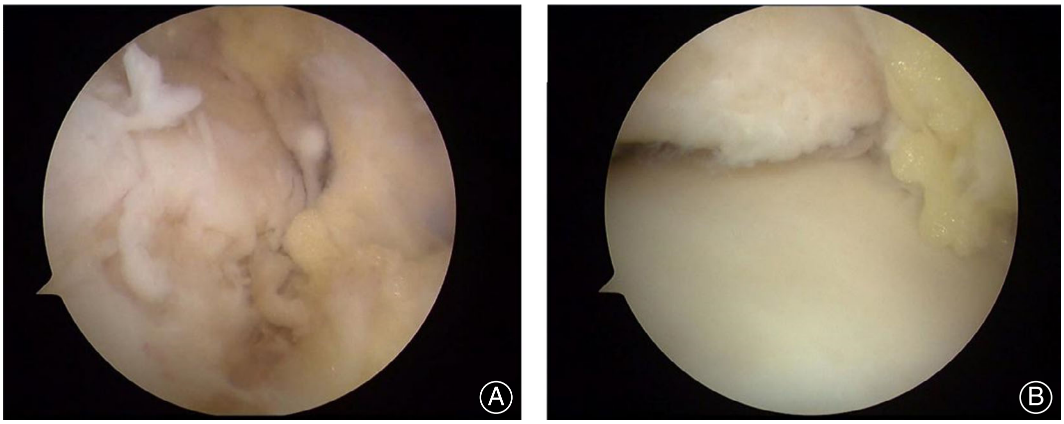

Fig. 5 Case 2. Preoperative radiography: anterior–posterior (A) and lateral (B) views demonstrate an elongated process of the talus. Postoperative radiography: anterior–posterior (C) and lateral (D) views show that the osteophytes are debrided 9 years after the operation.

hypertrophy of the distal anterior tibiofibular ligament. The medial part was located in the lateral part of the joint.

To treat this part, the anterior median approach was needed, and the medial part could not touch the lateral part.[17] The additional anterior median portal was lateral to the tibialis anterior tendon, and it was closer to the fibula and avoided the hindrance of the dorsal arch. When using the anterior lateral approach as a working portal, the anterior median approach was used as an observation channel, so that the three-portal arthroscopic debridement could fully touch the anterior part of the joint to debride osteophytes thoroughly.

In our study, there were two patients with ankle instability. The patients who underwent Brostrom's surgery described the good effect of the "all-inside" arthroscopy technique to reconstruct the lateral ankle ligament. In the case of joint instability, the removal of osteophytes should be combined with more complex surgery, such as arthroscopic debridement and lateral ankle ligament reconstruction. For patients with ankle instablity, taking advantage of the anterior median view portal and using the three-portal approach, it was easy to position the distal fibula through the lateral working portal. The factors related to the poor treatment of ankle impact arthroscopy include patients being older, longer delay from trauma to surgical treatment, ankle joint relaxation, and osteoarthritis joint space narrowing[18,19].

In addition, the majority of our cases were accompanied by arthritis: 15 cases among a total of 22 patients. For patients with arthritis, the arthroscopic debridement was satisfactory, as shown in recent studies[1, 20–22]. Our data showed that the age difference between the two groups of patients was obviously significant. The reason might be that the expected effect and surgical debridement requirements for young patients were higher. Taking this into account, we tend to choose the three-portal approach for younger patients.

Besides, compared with osteoarthritis, arthroscopic debridement must be regarded as a palliative and temporary operation, and it should be provided to young patients before the final joint fusion or joint replacement surgery.

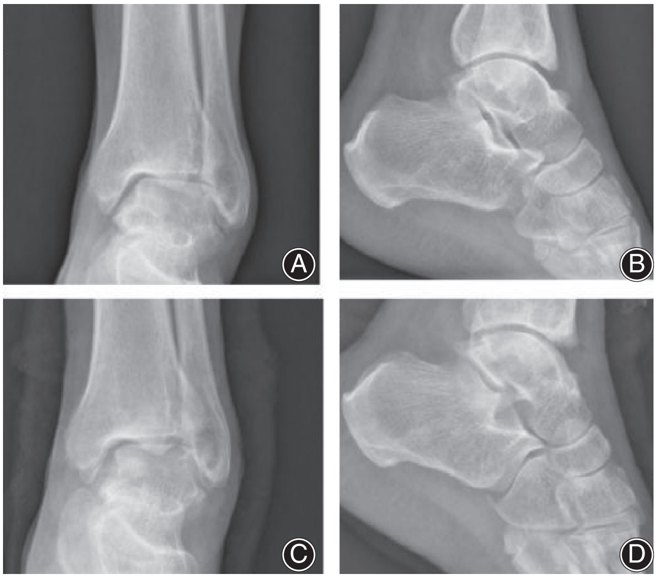

Fig. 6 Weight-bearing position of three-portal arthroscopic debridement operation 1 year after the operation.

Fig. 7 Foot plantar flexion (A) and dorsal extension (B) of three-portal arthroscopic debridement operation 9 years after the operation.

Glazebrook and his colleagues conducted a systematic review and found fair, evidence-based literature to support the use of ankle arthroscopy for the treatment of ankle impact and osteochondral injuries, and also as an adjunct to ankle fusion.

In this study, although both the two-portal and the three-portal approach of arthroscopy provided satisfactory clinical outcomes, we found that there was no obvious difference between the two groups after more than 1 year postoperation. Patients in the traditional two-portal group showed limited ankle dorsiflexion improvement (mean 12.27° preoperation *vs* 21.36° at final follow-up; $P = 0.035$) and in the modified three-portal group, dorsal flexion improved little (mean 13.64° preoperation *vs* 20.45° at final follow-up; $P = 0.045$). Moreover, there was no significant difference in joint activity and VAS scores between the two groups. The surgical incision was increased but the operation time did not increase. According to the postoperative X-ray results, although the difference in SMC grade was not significant, the clearance rate of the three-portal group was significantly higher; 24 cases in 26 were debrided thoroughly. In terms of AOFAS scores preoperation, although the scores of the three-portal group were lower than for the two-portal group, the postoperative scores were higher than for the two-portal group, indicating that for patients with more serious illness, the three-portal approach is better.

However, there are still some deficiencies in this study. These restrictions include relatively short follow-up time, with an average of approximately 24 months. Therefore, it was impossible to comment on stability or functional differences that may or may not be obvious over a longer period of time. Although larger than most studies on this subject, the sample size was still relatively small, so it might not be possible to prove a significant difference in function evaluation between the two groups. In addition, the most serious complication of the anterior median approach was dorsal plantar artery injury[23], so careful and meticulous implant of the scope through the anterior median portal had to be carried out and a learning curve existed. In future, a prospective randomized trial with a larger sample size and longer-term follow up is necessary.

Conclusion

Both three-portal and two-portal arthroscopic debridement for AAIS resulted in satisfactory clinical improvement after a mean follow-up of 1 year. Furthermore, possibly as a result of the limited number of patients and the limited follow-up time, there was no significant difference in efficacy between the two surgical methods. However, given the greater joint contact area, we strongly suggest the three-portal approach of arthroscopy to treat advanced impingement syndrome.

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