ARTHROSCOPIC MANAGEMENT OF LATE COMPLICATIONS OF CALCANEAL FRACTURES
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CALCANEAL FRACTURE
- A primary fracture line that separates the sustentaculum fragment with the tuberosity fragment.
- The sustentaculum fragment generally remains attached to the talus by the interosseous ligament.
- The tuberosity fragment displaces superiorly and laterally, resulting in shortening and flattening of the calcaneus. It typically rests in a varus heel position.
- Impaction of the talar body into the calcaneus can result in lateral cortical bulging.

STEPHENS AND SANDERS CT CLASSIFICATION OF CALCANEAL MALUNION

Zwipp and Rammelt Classification of Calcaneal Malunion

<table>
<thead>
<tr>
<th>Type</th>
<th>Characteristics</th>
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<tbody>
<tr>
<td>1</td>
<td>Subtalar incongruency, normal calcaneal morphology</td>
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<tr>
<td>2</td>
<td>Heel varus or valgus</td>
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<tr>
<td>3</td>
<td>Loss of hindfoot height</td>
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<tr>
<td>4</td>
<td>Translocation of calcaneal tuberosity without varus or valgus</td>
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<tr>
<td>5</td>
<td>Talar tilt or dorsiflexion past neutral</td>
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ADDRESS ALL THE DEFORMITIES: RECONSTRUCTIVE OSTEOTOMY WITH SUBTALAR ARTHRODESIS


OPERATIVE STRATEGIES TO DEAL WITH THE LATE COMPLICATIONS OF CALCANEAL FRACTURE
- Address all the deformities or
- Concentrate on those aspects that are the most clinically pressing
MULTIPLANE OSTEOTOMY TO ADDRESS LATERAL DISPLACEMENT AND SHORTENING OF LATERAL COLUMN

CONCENTRATE ON THOSE ASPECTS THAT ARE THE MOST CLINICALLY PRESSING

<table>
<thead>
<tr>
<th>Procedure for addressing osseous fracture instability</th>
<th>Rating</th>
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<tbody>
<tr>
<td>Lateral soft tissue release</td>
<td>1</td>
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<tr>
<td>Medial soft tissue release</td>
<td>1</td>
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<tr>
<td>Resection of symptomatic osteoarthritic degeneration</td>
<td>2</td>
</tr>
<tr>
<td>Sural nerve neurolysis or resection</td>
<td>2</td>
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<tr>
<td>Osteotomy</td>
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<td>Osteotomy</td>
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<td>Osteotomy</td>
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<tr>
<td>Lateral ligament repair or remodeling of the peroneal nerve</td>
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<tr>
<td>Subtalar bone block arthrodesis</td>
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<td>Triple arthrodesan</td>
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</tbody>
</table>

Subtalar distraction bone block arthrodesis and corrective osteotomy

- Symptoms related to loss of height (dorsiflexed talus with anterior ankle impingement) → subtalar distraction bone-block arthrodesis
- Symptoms related to loss of length (weakness of the ankle plantar flexion with easy fatigue of the calf muscle) of the bone → corrective osteotomy is indicated.

HOWEVER.....

- Myerson and Quill as well as Flemister et al cautioned against aggressive attempts to restore heel height as this may lead to hindfoot varus.
- Others have argued that complete anatomic restoration of the hindfoot, based on talar declination angle, is not necessary for a satisfactory outcome.
ARTHROSCOPIC MANAGEMENT

- Do not focus on the correction of the talocalcaneal relationship or restoration of the height or length of the calcaneus.
- Focus on the patient’s symptoms
- Management of different impingement syndromes, subtalar and/or calcaneocuboid arthrosis, arthrofibrosis, post-traumatic synovitis and various peroneal tendon pathologies associated with calcaneal fracture.
- For those patients with symptoms related to loss of height or length of the bone, corrective osteotomy or subtalar distraction bone-block arthrodesis is indicated

OPEN LATERAL OSTECTOMY FOR SANDER TYPE 1 MALUNION

Lateral calcaneal cortical bulging → calcaneofibular or peroneal impingement syndrome or shoewear problems.

Clare MP, Lee III WE, Sanders RW, J Bone Joint Surg 87A: 963-973

ENDOSCOPIC RESECTION OF LATERAL CORTICAL BULGE

- Three portals or two portals
- Preoperative evaluation with CT scan and coronal 2D reconstructions → assess the size and localization of the lateral calcaneal exostosis, its relations with the lateral malleolus as well as the extent of degenerative changes in the subtalar joint. → plan the location of the portals and precisely know the localization and amount of bone resection that will be necessary (particularly in the lateral part of the subtalar joint)

TWO PORTALS TECHNIQUE


CASE ILLUSTRATION

THREE PORTALS TECHNIQUE

Symptomatic subtalar arthrosis without hindfoot malalignment e.g. after initial open reduction and internal fixation or Sanders type II malunion.

Talar dorsiflexion due to collapse of the posterior calcaneal facet was not contraindicated for this procedure if the patients did not report anterior ankle pain and who have no pain anteriorly on forced passive ankle dorsiflexion or while squatting.

Either with the lateral portals or posterior portals technique depending on the other planned arthroscopic procedures.

In case of Sanders type II malunion, endoscopic resection of lateral cortical bulge was also performed and lateral approach with anterolateral, middle and posterolateral portals were used.

ARthroscopic IN SITU SUBTALAR ARTHRODESIS

In those cases with previous open reduction and internal fixation, the implant was not removed except those screws that blocked the placement of the arthrodesis screw.

OPEN DWYER CALCANEAL OSTEOOTMY FOR SANDER TYPE 3 MALUNION

In cases of Sanders type III malunion, calcaneal osteotomy is frequently performed in conjunction with the subtalar joint arthrodesis.

PERCUTANEOUS DWYER OSTEOOTMY

Percutaneous Dwyer Osteotomy

Correct the varus position by laterally based wedge resection of the subtalar joint during arthrodesis.

This was performed with the “closing wedge procedure” during the arthroscopic subtalar arthrodesis.

Contraindicated if there is fixed forefoot eversion with respect to hindfoot.

Arthroscopic Subtalar Arthrodesis with “Closing Wedge Procedure”

After the fusion sites are prepared, the Isham straight flute burr (Vitek Inc.) is inserted through the subtalar portals.

Lateral wedge of bone is burned while applying valgus force to the heel and the varus heel is then corrected.

However, further lateral impingement can occur. The lateral gutter needed to be examined again after the “closing wedge procedure” and the lateral gutter was decompressed further if needed.

Lateral impingement can affect the closing up of subtalar joint after “closing wedge procedure”.

Closing Wedge Procedure” vs Percutaneous Calcaneal Osteotomy

Not mutually exclusive.

“Closing wedge procedure”: more focus on correction of forefoot supination.

Percutaneous calcaneal osteotomy: more focus on correction of varus heel.

My approach: “closing wedge procedure” → correct forefoot supination → percutaneous calcaneal osteotomy if residual varus heel present.

Arthroscopic Triple Arthrodesis

Indicated in combined symptomatic calcaneocuboid and subtalar arthrosis.

It also may be indicated in the patient with preexisting deformity in conjunction with calcaneal malunion. A patient with preexisting flatfoot deformity and symptomatic calcaneal malunion may benefit from triple arthrodesis to correct the deformity and address the malunion.

Arthroscopic Triple Arthrodesis

Included arthroscopic arthrodesis of the subtalar joint, talonavicular joint, and calcaneocuboid joint.

Subtalar arthroscopy was performed through the anterolateral and middle subtalar portals.

The midtarsal arthroscopy was performed through the lateral, dorsolateral, dorsomedial, and medial portals.

Lateral and dorsolateral portals were established for calcaneocuboid arthroscopy. The talonavicular joint was approached through the medial, dorsomedial, and dorsolateral portals.

The hindfoot deformity can be corrected with the “closing wedge procedure” after preparation of the fusion surfaces.
Subtalar arthrofibrosis with limited subtalar motion is common after calcaneal fracture especially in operated patients.

- With a stiff subtalar joint, inversion eversion stresses are transferred to the ankle joint, especially the lateral ligamentous structures of the ankle. This compensatory stresses in the ankle joint, particular in the coronal plane of motion → residual pain on the lateral side of the ankle and difficulty in walking on an uneven surface.

- Arthroscopic subtalar release was indicated in patients with symptomatic subtalar stiffness.

- The tight lateral structure was released in stages to minimize the risk of over-release resulting in subtalar instability. The interosseous talocalcaneal ligament should be preserved during arthroscopic subtalar release. In addition, we perform quite extensive soft-tissue release, even extending beyond the surgical scar in the patients with previous open reduction, according to the intraoperative subtalar inversion motion gained.

- Early vigorous subtalar mobilization and peroneal strengthening exercise are two important components of post-operative rehabilitation.
Post-traumatic synovitis of the subtalar and/or calcaneocuboid joint is one of the causes of lateral heel pain after calcaneal fracture. The anterior subtalar joint synovitis is a commonly missed diagnosis. The joint(s) involved can be determined by clinical localization of the site of tenderness. Arthroscopic synovectomy, resection of scar tissue and debridement of damaged cartilage can be performed through the corresponding arthroscopy.

**Clinical Localization**

- The posterior subtalar joint synovitis → tenderness at sinus tarsi and lateral subtalar gutter.
- The calcaneocuboid joint synovitis → local tenderness over the joint.
- Anterior subtalar synovitis usually presents with sinus tarsi pain sometimes also medial heel pain around the sustentaculum tali. Tenderness can be elicited by deep palpation of the soft spot between the talonavicular and calcaneocuboid joints and pointing posteromedially.

**Anterior Subtalar Arthroscopy**

**Medial Subtalar Arthroscopy**

**Case Illustration: Calcaneocuboid Degeneration**

**Arthroscopic Posterior Ankle Decompression: Posterior Ankle Impingement**

- Malunion of the joint depressed type calcaneal fracture → the bone spike can form immediately posterior to the depressed posterior calcaneal facet + the thick scar tissue at the posterior ankle and can be pinched between the posterior tibial lip and the calcaneal bone spike during ankle plantarflexion → deep posterior ankle pain during activity with ankle plantarflexion.
- The bony impediment and the scar tissue can be resected by means of a 2-port posterior ankle endoscopy.
- Because of the malunion of the calcaneum, the portals should be modified to override the posterosuperior corner of the calcaneum in order to reach the posterior part of the subtalar joint.
- The posterior ankle scar tissue was resected. The posterior calcaneal facet was depressed and obscured by the bone spike just posterior to it. The subtalar joint cannot be visualized frequently. Intra-operative fluoroscopy is useful to identify the location of the bone spike and the posterior edge of the posterior calcaneal facet.
**ARTHROSCOPIC POSTERIOR ANKLE DECOMPRESSION**


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**ENDOSCOPIC CALCANEoplasty for Impingement to the Achilles Tendon by Malunited Tongue Type Calcaneal Process**

- Jung et al: open excision of the Haglund’s deformity for secondary Haglund’s deformity after malunion of tongue type calcaneal fracture.
- Endoscopic calcaneoplasty: The resection of the posterosuperior process should be down to the insertion of the Achilles tendon since this is the site of impingement. Approach to the deep area can be facilitated by flexion of the knee and plantarflexion of the ankle during the procedure. Moreover, it is usually obscured by scar tissue between the bone and the Achilles tendon. This should be resected in order to gain adequate visualization of the Achilles insertion.

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**ARTHROSCOPIC CALCANEOCUBOID DECOMPRESSION**

- Residual bone overhang from the displaced anterolateral calcaneal wall → a loss of motion at the calcaneal-cuboid joint → pain over the calcaneocuboid joint and increased stress to the adjacent joints.
- Clare et al suggested that both the overhang as well as the lateral fourth of the distal aspect of the calcaneus should be removed, as the articulation of this lateral portion with the cuboid is almost always arthritic.
- Calcaneocuboid arthroscopy: The portals should be modified according to the location and span of the overhang. They should be placed at the dorsal and plantar ends of the overhang. After removal of the overhang, the joint can be examined for any synovitis or cartilage damage. The joint pathology can then be treated arthroscopically. The extent of joint resection was titrated by the extent of cartilage damage.
**PERONEAL TENDOSCOPY**

- Various acute peroneal tendon abnormalities can occur with intraarticular calcaneal fractures and these include lateral displacement, bony impingement, subluxation or dislocation, hematomas and scar tissue formation, and entrapment of tendons.
- Peroneal tendinitis may occur secondarily by implant irritation when a lateral approach is used. It can present as pain over the lateral aspect of the heel. Buckling or giving way when walking also may suggest peroneal tendon dysfunction.
- Impingement or lateral displacement of peroneal tendons by underlying malunited calcaneal bone was indicated for endoscopic lateral calcaneal osteotomy.
- Peroneal tendoscopy is indicated in case of post-traumatic synovitis, longitudinal tendon tear, traumatic peroneal tendons subluxation or dislocation. Endoscopic peroneal tendon decompression, tendon repair, synovectomy and retinaculum reconstruction can be performed.

**NORTH DISTRICT HOSPITAL EXPERIENCE**

- Fifty patients (32 male, 18 female) with late complications of calcaneal fractures were managed arthroscopically between 2004 and 2009.
- All of the patients had had pain in the foot and ankle as a result of the calcaneal fracture, which had occurred at a mean of 22 months (ranged, 7 to 45 months) before the arthroscopic surgery.
- Conservative treatment with different modalities e.g. physiotherapy, insoles, shoe wear modification and non-steroidal anti-inflammatory drugs were tried for at least three months before consideration of surgery.
Diagnosis                  Procedure                              Number of patients  Median preoperative AOFAS ankle-hindfoot score (range)  Median postoperative AOFAS ankle-hindfoot score (range)
posterior and anterior subtalar joint pain, calcaneofibular impingement, secondary Haglund deformity  Arthroscopic lateral exostectomy, arthroscopic debridement of anterior and posterior subtalar joints, endoscopic calcaneoplasty  15  9  8  8
calcaneocuboid degeneration, anterosuperior impingement, calcaneocuboid impingement  Arthroscopic debridement of calcaneocuboid joint, arthroscopic calcaneocuboid decompression, endoscopic resection of anterosuperior calcaneal process  16  3  8  0
posterior ankle impingement  Arthroscopic posterior ankle decompression  1  75  100
posterior ankle impingement and Sanders type 1 malunion  Arthroscopic posterior ankle decompression and lateral calcaneal ostectomy  2  58 (58,58)  95 (90-100)
Anterosuperior impingement, Sanders type 1 malunion with far lateral degeneration  Arthroscopic lateral exostectomy, endoscopic resection of anterosuperior calcaneal process  16  9  9  0
peroneal tenosynovitis  Peroneal tendoscopy  1  67  87

PATTERNS OF PATIENTS’ PROBLEMS
- Heterogenic.
- Certain patterns between the initial treatment and late complications were observed,
- Those with initial casting or open reduction and internal fixation tended to suffer from subtalar stiffness and
- Higher chance of calcaneofibular impingement for those patients with initial non-surgical treatment or closed reduction and screw fixation.
- This is biased as the initial treatment was not randomized and was determined by the initial fracture pattern.

RESULTS
- A median of 1 arthroscopic procedure was performed for each patient (range, 1 to 4).
- The median follow-up after the latest arthroscopic surgery was 49 (range, 24-85 months) months.

RESULTS
- In all of the cases, the symptoms improved the arthroscopic surgery
- All the arthrodesis sites healed.
- The overall median preoperative AOFAS ankle-hindfoot score was 60.5 (27-75). The overall median AOFAS ankle-hindfoot score at the time of latest follow-up was 90 (73-100). The median gain of score was 30.5 (10-48).

COMPLICATIONS
- One superficial wound infection
- One sural nerve injury
REPEATED ARTHROSCOPIC SURGERIES

- were performed in two patients.
- Both of them had compensation issues.
- One of them had two operations performed and the other one had three operations. In each case, the patient’s complaint subsided after the operation and the other operation was performed for a new complaint.

SUMMARY

- In this series, many patients have suffered from a combination of problems and combined procedures were needed.
- Identification of the correct source of symptoms and proper selection of the appropriate procedures is the key to success.
- Detailed history taking and clinical examination are the most important tools for decision-making.

SUMMARY: ARTHROSCOPIC LATERAL OSTECTOMY

- Arthroscopic lateral ostectomy was the single most frequently performed procedure.
- Because the integrity of the soft tissue envelope was preserved, soft tissue complication was minimized. Moreover, the associated subtalar pathology can be examined at the same time.
- This procedure has been performed solely in 14 patients in this series with Sanders type 1 malunion with excellent results.

SUMMARY: IN-SITU SUBTALAR ARTHRODESIS

- Subtalar joint arthrosis can occur even in anatomically reduced fractures due to cartilage damage from the initial trauma or penetration of the joint by implants.
- Initial open reduction and internal fixation can restore calcaneal shape, alignment, and height and allow in situ subtalar arthrodesis.
- In situ subtalar arthrodesis is also indicated for symptomatic Sanders type II calcaneal malunion.
- Similar to the report of Mi et al, good union rate and clinical results with the arthroscopic subtalar arthrodesis was observed in this series.

SUMMARY: CALCANEOCUBOID DEBRIDEMENT AND DECOMPRESSION

- Arthritic calcaneocuboid joint is frequently asymptomatic.
- Arthroscopic debridement was performed if the arthritic joint was painful and not associated with subtalar arthrosis.
- The extent of joint resection was titrated by the extent of cartilage damage.
- The result after arthroscopic debridement of the joints was difficult to evaluate because of the heterogeneity of patterns of procedures and patient’s symptoms. In our experience, it seemed that it depended on the extent of the cartilage damage.

SUMMARY: SUBTALAR RELEASE

- Open subtalar release is not a good choice for symptomatic subtalar stiffness as the extensive surgical wound prohibits early vigorous mobilization exercise.
- Arthroscopic subtalar release has the advantage of smaller surgical wounds so that immediate vigorous mobilization is allowed.
SUMMARY: REOPERATION

- The two cases of reoperation were not considered to be failure of the arthroscopic surgery as the patient’s symptoms subsided after operation in every episode.

- The low reoperation rate in this series implies that a corrective operation to address all the deformities at the same time might be overdone.

LIMITATION OF THIS STUDY

- Retrospective study without a control group for comparison.

- The great varieties of individual pathology pattern make it difficult to draw conclusions about the effectiveness of arthroscopic management of different combination of pathology.

CLINICAL RELEVANCE

- It provides a protocol of arthroscopic management of late complications following calcaneal fracture.

CONCLUSION

- The arthroscopic approaches focused on the patient’s symptoms. It is a feasible approach to alleviate patient’s symptoms.

- Detailed history taking and clinical examination to determine the sources of the patient’s symptoms is the key to success.

BRING HOME MESSAGE

- Most of the post calcaneal fracture foot pain is treatable

- Follow up your patients, examine them carefully, offer the appropriate treatment

- No matter conservative treatment, open or arthroscopic procedures