Retrograde Tibial Nailing for Arthrodesis of Ankle and Subtalar Joints


ABSTRACT

Introduction: When ankle and subtalar joints are arthritic and painful they both need fusion. Principles of treatment by fusion are removal of cartilage till bleeding of subchondral bone, keeping the joint surfaces congruous, proper positioning of the foot and ankle and stable fixation.

Materials and methods: During the last 10 years, 16 cases of retrograde nailing were done. Eight cases were post-traumatic, one was tuberculosis, three for Charcot joint and three for osteoarthritis of the ankle joint, and one case of rheumatoid arthritis. All patients had severe pain instability, varying degrees of deformities and antalgic gain. Two cases were treated with supracondylar femoral interlocking nail. Nine cases were treated with antegrade tibial nail as retrograde nail. Nine cases were treated with retrograde tibial nails with posteroanterior calcaneal screws. Two cases were treated with special nails newly designed by Smith and Nephew. Initially, older the calcaneus had two latero-medial screws. Newer designs of nail have two posteroanterior screws, passing from calcaneal tuberosity through the nail—one towards cuboid and the other towards talus. These two screws have increased the stability of the construct and improved the outcome. Mann’s technique of ankle fusion was used. Fibular strut was used as bone graft and fixed by one screws into the tibia and the other into talus. Indian tibia is smaller in diameter with a narrow intramedullary canal. Indian tibia need to have a nail with a smaller diameter.

Results: When supracondylar femoral and antegrade tibial nails were used, 4 out of 5 failed. When newer design nails with posteroanterior calcaneal screws were used, outcome improved 2 out of 11 failed.

Conclusion: Newer design of retrograde tibial nails with two posteroanterior calcaneal screws have greatly improved the outcome of pantalar arthrodesis.

Keywords: Charcot joint, Pantalar arthrodesis, Post-traumatic arthritis, Retrograde tibial nail.

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INTRODUCTION

When ankle and subtalar joints are arthritic and painful they both need fusion. This simultaneous fusion of both joints, so called pantalar arthrodesis (PA) is truly a salvage procedure, an alternative to amputation. Previously, PA arthrodesis was meant to fuse only ankle and subtalar joints. Currently, however, PA includes talonavicular and calcaneocuboid joints besides ankle and subtalar joints. Historically, pantalar arthrodesis was done in two stages: stage I—subtalar arthrodesis, stage II—ankle arthrodesis.

There are several methods of doing PA. The principles of treatment, however, remains the same. They are removal of cartilage till bleeding of subchondral bone, keeping the joint surfaces congruous, proper positioning of the foot and ankle and stable fixation. Currently, internal fixation with screws and/or plate, retrograde nailing and ring fixator are preferred methods of fixation.

When both ankle and subtalar joints are involved, the preferred technique of fixation is retrograde tibial nail, which passes through calcaneus, talus and tibia.

Tibiotalocalcaneal arthrodesis (TTCA) with intramedullary fixation is not a new idea. Lexer E reported in 1906 the use of boiled cadaveric bone as an intramedullary device for tibiotalocalcaneal arthrodesis. The first case of tibiotalocalcaneal arthrodesis with an intramedullary (IM) nail was reported by Adams JC in 1948.

Before the advent of retrograde intramedullary nailing, ankle and subtalar joints were fused using internal or external fixation. However, retrograde tibial nail has certain advantages. The purpose of this paper is to evaluate the results of retrograde tibial nail for PA and evolution of the nail.

MATERIALS AND METHODS

During the last 10 years, 16 cases of retrograde nailing were done. Twelve were males and four were females, age ranges from 25 to 65 (average 45). Eight cases were post-traumatic, one was tuberculosis, three for Charcot joint and three for osteoarthritis of the ankle joint, and one case of rheumatoid arthritis. All patients had severe pain instability, varying degrees of deformities and...
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Indications for Retrograde Nailing

Both tibiotalar and subtalar joints may be involved in inflammatory, infective, degenerative, post-traumatic and neuroarthopathic diseases. The joints are painful, and are usually have some deformity.

Treatment of these joints is fusion of both ankle and subtalar joints. Infective conditions, pyogenic or tuberculosis, also need fusion. Neuropathic deformities (Charcot joints) or fixed deformities due to other causes may require arthrodesis. Rheumatoid arthritis is another indication for PA. Patients who have failed total ankle replacement where the prosthesis has eroded into subtalar joint need fusion of both the joints. We have done tibiocalcaneal fusion when talus was removed for severely crushed talus, tumors infection of talus.

Preoperative Planning

Careful evolution is critical for better outcomes. Bone quality, metabolic disease, previous injuries, and skin condition are carefully assessed. Mobility of each joint must be tested. Standing X-rays of foot are taken. Computed tomography is useful to access all deformities. There may be frank infection with a draining sinus or may be occult infection without a sinus; so laboratory investigations like blood count, ESR and CRP are important to rule out infection. The patients may have bad, scarred skin with multiple previous incisions; therefore, incision must be carefully planned. Incision either passes through or four fingers away from the previous incision. Soft tissue contractures are carefully assessed, and stiffness of all deformities is noted.

Newer Nail Designs

The retrograde nails initially used 10 years back, did not have good control over movements of the subtalar joint and calcaneum because the initial nails did not have posteroanterior locking screws. Therefore, the failure rate was very high.

During the past 10 years, the retrograde tibial nail has evolved. Many companies have developed different designs. They all have similar principles. The nail passes through the calcaneum, and allows fixation of calcaneum talus and tibia. Initially, older the calcaneus had two latero-medial screws. This was very unstable because of the complex movements of the ankle and subtalar joints. Recently, added oblique screw passing through posterior aspect of calcaneum into talus and tibia, spanning one or both the joints is another important innovation. The bend presents in the nail places the heel in a mild valgus position, which is essential. The nails 10 years back had static locking screws going through the bone in the medial-to-lateral plane at all levels. This created a problem when there is erosion and subsidence in some patients, such as with Charcot joints where subsidence occurs. In such a situation, the static locking bolts keep the fusion area with a gap resulting in nonunion or failure of fusion. Dynamic locking hole placed proximally allows closure of the gap at the fusion site by allowing distal axial migration of the shaft tibia. There is also a distal static locking hole for mediolateral fixation. There are some designs which allow compression of the fusion site by either internal or external devices or both. Thomas Muckley et al suggested intramedullary nail with a valgus curve, two compression options, and angle-stable locking.

Posteroanterior screw was inserted through the calcaneal tuberosity into retrograde nail. This was initially perpendicular to the nail. The fixation was not optimal because of the calcaneal pitch.

In the newer design posteroanterior screw was inserted at 20° upward angle parallel to the inferior surface of the calcaneum. This allowed better fixation and matched the calcaneal pitch angle (Fig. 1).

Posteroanterior screw passing into the talus is important to improve the construct stability. The Trigen Hindfoot Fusion Nail (Smith and Nephew) allows independent positioning of the two distal locking screws.

The calcaneal screw is directed from the medial part of the calcaneal tuberosity through the nail towards cuboid at a 20° inclination. The more proximal talar screw starts...
from the lateral part of the calcaneal tuberosity through the nail and into the talar neck at a 60° inclination. This allows posterior to anterior locking distally, independently to prevent rotation around the nail and improve resistance to dorsiflexion-plantar flexion motion.  

Indian tibia is smaller in diameter with a narrow intramedullary canal. To suit the Indian tibias, we need to have a nail with a smaller diameter in the mid-shaft of tibia, 8 or 9 mm, and a larger diameter distally.

The short nail causes stress riser effect at the proximal end of the nail and may result in fracture. Therefore, currently the nails used are of longer in length (Fig. 2).

**Surgical Technique**

Along with nail development, surgical techniques also have improved. The approach depends on previous operative incisions, skin condition and surgeon's choice. However, most preferred incision is over the lateral malleolus to the tip of fibula, curving distally across the sinus tarsi. Mann’s technique is used to fuse the ankle.

The operation is carried out with the patient in supine position under tourniquet, usually under epidural anesthesia. A lateral transfibular approach is used over the lateral malleolus. Starting from a point about 6 cm from the tip of the lateral malleolus and is curved anteriorly towards the sinus tarsi. A small medial incision often required to prepare the joint surface from the medial aspect to obtain excellent bone to bone contact. Distal half of medial malleolus is cut and used as bone graft. The fibula is osteotomised fibulo-calcaneal ligament is cut and the lateral malleolar fragment is reflected posteriorly. Posterior soft tissue is preserved to maintain the vascularity of the fragment, which is used as a strut graft. The bony cuts are made by saw or osteotome (Fig. 3).

Most important is position of the foot in relation to the tibia for fusion. The foot is positioned 5° dorsiflexed, 5° valgus and slight external rotations. Unless there is 50° of dorsiflexion, Indian patients cannot squat, necessary for toilet purpose. The osteotomies are modified to correct the deformities by calculating the closing wedges.

**Preparation of Joints**

Preparation of the joints for fusion is of paramount importance. Tibial plafond and talar dome are carefully resected to correct the malalignment and other deformities, such as varus, valgus, equines and rotational malalignment by using a saw blade or osteotome. All devitalized bone and soft tissues are removed. Multiple drill holes are made in subchondral bone to enhance vascularity and healing. If there is a cavity or defect, it is filled with bone graft. The alignment of tibia, talus and calcaneum is carefully adjusted. If the body of the talus has been resected the calcaneum should be aligned with tibia.

**Finding Nail Insertion Point**

It is important to mark the starting point for placement of the guidewire. To mark the starting point (entry portal) for retrograde nail a line joining the tips of between medial and lateral malleoli is drawn on the plantar surface of the foot. It is usually at the distal end of the heel pad slightly on the lateral side of midline.

Another simple way to mark entry point is to keep a guidewire over the skin, in the dead center of AP and lateral view of the tibia as seen on image intensifier. The guidewire should pass through the body of the talus and through the center of the ankle (Figs 4A to C).
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Nailing Technique

A vertical incision is taken in the skin at the insertion point. Plantar fascia is incised. An artery forceps is inserted to stretch the soft tissues up to the calcaneal surface. A guidewire is passed through the calcaneus into the tibia. The ankle is held in neutral or slight dorsiflexion. Care is taken to prevent varus of the heel and plantar flexion of the foot. The planned fusion position is confirmed visually and fluoroscopically. It is extremely important to place the guidewire in the exact position to prevent postoperative malposition. Ten to 12 mm entry reamer is used through the calcaneus, talus and into the tibia. Sequentially, reaming should be done so that the canal is about 1 mm larger than nail diameter to prevent tibial fracture. The nail is assembled over the zig and gently hammered in, so that the nail is a few mm sides the calcaneal surface to allow for compression. This is required because when the fusion site is compressed, the nail protrudes out of the calcaneal surface. If it is proud by 2 to 4 mm, it does not matter; because the calcaneal pitch is usually of 30°, therefore, the nail does not bear body weight directly. The tip is above the weight-bearing surface. The short nail may cause stress riser fracture. A longer nail is preferred.

When the nail is in, the fusion site is compressed by manual compression. Some companies have arrangement for internal compression by internal fixation, by tightening the rod and by external device. Lateral image should show the hole in the nail for anteroposterior calcaneal locking screw, above the inferior calcaneal surface.

Calcaneal Screws

Before inserting the calcaneal screw, position of the foot is checked for varus/valgus, flexion/extension of the foot. Calcaneal screw is inserted from the medial aspect of tuberosity of calcaneum approximately parallel to the calcaneal weight-bearing surface, towards the calcaneocuboid joint. If calcaneocuboid joint needs to be stabilized, longer screw may be used (Figs 5A to F). Compression is given manually or by internal/external compression device if available. Second screw, the talar screw is passed from lateral aspect of the calcaneal tuberosity into the talar neck. If there is no hole for the talar screw, miss a nail technique can be used. Finally, mediolateral screw is inserted to further stabilize the construct.

Proximal Tibial Screws

Proximally screw is inserted in the dynamic hole, to take care of any subsidence at the fusion site. The screw is implanted while holding the required rotational position of the ankle (Figs 6A to D).

Fibular Strut Graft

The medial surface of osteotomized lateral malleolar fragment is decorticated and fixed by 2 screws-one in the distal tibia and the other in the talus as an additional stability. The fibular grafts act as a strut graft. Cancellous bone graft is packed into the crevices. Wound is closed with 3 to 0 nylon mattress sutures.

Postoperative Care

After surgery, a splint is given for about 10 days. When the edema subsides, below knee plaster cast is given and no weight bearing for 6 weeks. Then gradual weight bearing started. Full weight bearing allowed after 3 months. If there is Charcot pathology, immobilization period is doubled, i.e. no weight bearing up to 3 months.
Figs 5A to F: Mrs JJ has history of injury to ankle joint 3 years back: (A and B) AP and lateral X-rays show malunited ankle with varus deformity and subtalar involvement. Both X-rays show osteoarthritis of the ankle and subtalar joint. Both joints were painful. (C) postoperative AP X-ray shows fusion of the ankle and subtalar joint by retrograde nailing. Note the distal fibular fragment is fixed to the tibia and talus with two screws, (D) lateral X-rays show a calcaneal screw passing through the distal hole of the retrograde nail. The mediolateral screw is not seen in the lateral view. (E and F) AP and lateral X-rays after 8 months showing good fusion of ankle and subtalar joint. Patient has no pain.

then gradual weight bearing and full weight bearing after 6 months.

RESULTS

The initial cases treated by supracondylar nail, of the two cases treated with supracondylar femoral retrograde nail, 1 failed resulting in nonunion. All the three cases treated by antegrade tibial antegrade nail failed. Nine cases treated by special retrograde tibial nail. Two failed and seven fused. In all four cases which failed, was due to infection. The two cases treated by Trigen retrograde tibial nail (Smith and Nephew) united (Table 1).

Figs 6A to D: (A and B) Mr R had post-traumatic injury to the talus. Note avascular necrosis of the body of talus. He was treated outside with screws to fix both the joints. The construct failed to fuse both the ankle and subtalar joint. (C and D) he was treated with retrograde nail with a newer design with two posteroanterior screws; one cuboid screw and another talar screw (Smith and Nephew). Fusion was achieved at both joints.
DISCUSSION

Pantalar arthrodesis is a good operation for arthrodesis of both ankle and subtalar joint. Though a salvage procedure, it is a good alternative to amputation. The indications for fusion are severe deformities due to Charcot joint, post-traumatic, degenerative or congenital. Outcome of pantalar arthrodesis depends on the pathology, previous surgeries, infection, Charcot neuro-arthropathy and diabetes. However, pantalar arthrodesis is a technically challenging procedure. There are many factors, which need to be considered. Severe deformities previous multiple surgeries, poor skin conditions, diabetes and infection are important (Figs 7A to J).

The key points for arthrodesis are proper joint preparation, compression of all the fusion areas, appropriate position of the foot and stable fixation. There are multiple techniques described for pantalar arthrodesis.

<table>
<thead>
<tr>
<th>Type of the nail used</th>
<th>No. of cases</th>
<th>Failed to unite</th>
</tr>
</thead>
<tbody>
<tr>
<td>Supracondylar femoral nail</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Antegrade tibial nail</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Retrograde tibial nail</td>
<td>9</td>
<td>2</td>
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<tr>
<td>Trigen (Smith and Nephew)</td>
<td>2</td>
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Fundamental principles common to all techniques are removing articular cartilage, exposing bleeding cancellous bone, plantigrade position, and stable fixation. Motley TA was the first to describe pantalar arthrodesis (PA) for deformities of the foot secondary to poliomyelitis. This was done in two stages initially. First stage was triple arthrodesis and few weeks later ankle arthrodesis and others preferred single stage procedure but still extirpated the talus; also recommended a single stage procedure but did not extirpate the talus to decrease the risk of avascular necrosis. Recent studies failed to demonstrate a difference in arthrodesis rates between one and two stage procedure. There are many approaches depending on the skin condition and surgeon’s preference. Most commonly used approach is transfibular. This approach has advantages of allowing visualization all joints to be fused. The fibular fragment can be used as a vascular lateral strut graft with decortication of the medial wall. Special attention to soft tissue is critical. The flap of tissue should be as thick as possible. Gentle retraction of skin edges is important. Soft tissue stripping is restricted to a minimum. The use of drains is controversial in foot and ankle surgery. We use drain indicated only if there is lot of uncontrolled woozing.

Figs 7A to E: (A) Twenty-five-year-old man had pilon fracture treated with a below knee plaster cast outside, AP and lateral X-rays show pilon fracture with bimalleolar fracture. (B) After 3 months, he developed infection with draining sinuses. He was treated with debridement. (C) He presented with severe pain in the ankle and deformity of the limb. The clinical picture shows severe varus deformity. (D) Clinical picture shows swelling of the ankle joint on the lateral aspect. (E) Clinical picture shows mild procurvatum deformity.
To improve the outcome following key points must be observed:

- Exact entry portal and guidewire placement for the retrograde nail.
- Preparation of the ankle and subtalar joint, so that the congruity of the joints is maintained.
- Foot should be positioned properly in relation to tibia.
- Compression of the fusion sites is mandatory.

Fixation of fusions done by screws and plates, gives good results but with higher rates of loosening and nonunion. Plating needs extensive dissection. Ring fixator is another option, which is associated with pin tract infection, poor patient compliance and higher rates of nonunion and infection. Retrograde nailing has several advantages:

- It is a load-sharing device with high mechanical stability and a stiffer construct than the crossed screw construct.
- Dissection required is minimal with soft tissue preservation.
- Achieves better fusion
- Dynamic compression can be obtained by removing proximal static screw or both static and dynamic screws.

For these reasons during the last decade, nailing has become popular. Retrograde nailing for fusion of ankle and subtalar joint and for tibiocalcaneal joint when talus is removed, is a successful procedure. Muckley T5 presented a series of 59 cases. Bony union was obtained in 53 patients, 51 patients were satisfied. Complication rate was 25%. Their study shows a good outcome and a high rate of bony union with comparable complication rates. Patient satisfaction was good. However, the patients still had limitations. The clinical benefit of the nail used was confirmed. Jehan S et al7 reviewed 33 studies, 641 patients treated with retrograde nail. Union rate was 86.7%. Complication rate was 55% with reoperation rate 22%. Nonunion was seen in 85 joints (13.3%). The average time was 4 to 5 months. With new nail types and improvement in the surgical techniques, the indications have expanded to include neuroarthopathic conditions, clubfoot and arthritis of ankle and subtalar joints. This systematic review showed that TTCA with an IM nail has relatively good fusion rates. However, it carries a high risk of complications. This might be because of the preoperative comorbidities. Dynamic proximal locking and longer nails are a few suggestions recommended.

Fig 7F to J: (F to H) X-rays show nonunion at the metaphyseal area both tibia and fibula and osteoarthritis changes of the ankle joint, (I) CT scan confirmed the nonunion and (J) retrograde nailing was done (Courtesy: NK Agrawal)
by authors in these studies. Their logic is that the longer nails will minimize the risk of stress fractures, and dynamic screws will reduce the need for dynamization. Boer R et al\(^8\) reported 50 patients who had TTCA with retrograde intramedullary nail fixation with satisfactory results in 96% of patients with relatively low complication rate. Boer\(^9\) series has shown three interesting features. Firstly, ankle joint preparation was done percutaneously by using a 6 mm drill bit through a small arthroscopy-like portal with the help of an image intensifier. They claim percutaneous debridement is a good alternative to open procedure. There is no need to wash out the ankle because the debris acts as a bone graft. More than 50% cases were treated with percutaneous technique. Both procedures, open or percutaneous, yielded 100% union rate. Secondly, subtalar joint was not formally debrided. Because the process of reaming with as much as 12 mm reamer yields a joint that is sufficiently destroyed and grafted with debris that acts as bone graft. Thirdly, they generally dynamized by removing the proximal screws at 3 months to achieve compression at ankle but not at subtalar joint and this also reduces stress riser effect at the tip of nail. Ninimaki et al\(^9\) reported 34 patients, the subtalar joint and this also reduces stress riser effect at 3 months to achieve compression at ankle but not at subtalar joint. Eichenholtz\(^12\) developed a useful classification.

- **Stage 0:** Only symptoms of CNA but no radiological signs
- **Stage 1:** Fragmentation
- **Stage 2:** Coalescence
- **Stage 3:** Reconstruction with stable deformity.

In stages I and II, treatment is by a total contact plaster cast (TCC), followed by brace till the ‘bag of bones’ heal (stage III). Most cases are treated by TCC, braces and shoes. Advanced cases may require amputation. Fusion of the joints is done when definitely indicated. The indications for surgery are deformities, such as rocker bottom foot, exostosis or bumps causing unequal loading of foot, ulceration and infection. Results of surgery are often frustrating. In the past, fusion was done with plates and screws, with very poor results. Malunion, nonunion and recurrence of deformity were common. Risks and outcome of the surgery should be counseled with the patient. For fusion every attempts should be made to achieve as rigid an internal fixation as possible.

Currently, however, PA is preferred with retrograde tibial nail, as the results are promising (Figs 8A to G).

**Avascular Necrosis of Talus**

Avascular necrosis (AVN) of the talus from any etiology is a challenging problem. Devries et al\(^13\) reported 14 patients were treated by tibiotalocalcaneal fusion with retrograde intramedullary nail. Twelve patients went on to solid fusion, while two went on to a stable, braceable pseudoarthrosis. They concluded that salvage of talar AVN is possible by tibio-talo-calcaneal arthrodesis with a retrograde intramedullary nail (Figs 9A to F).

**Osteoarticular Tuberculous**

Gavaskar et al\(^14\) have reported seven cases of osteoarticular tuberculosis of the ankle joint, using retrograde nail. In all the seven cases, ankle fusion was achieved with satisfactory results. They have not mentioned about the status of the subtalar joint before or after retrograde nailing.

**Complications of Pantalar Arthrodesis**

Complications of PA are infection, aseptic or infected nonunion, painful callosities on the plantar surface of foot due to unequal distribution of weight; however, these can be prevented or minimized by careful planning. Complication range from hematoma, infection nonunion, malunion, arthrosis of adjacent joints and osteomyelitis.\(^3\) Complication rate is higher in patients with diabetes, severe deformity, smokers and patients having Charcot joint.\(^15\) Complication range from 28 to 50%.\(^3\) Damage to neurovascular bundle is a known complication at the
insertion site of the nail. Blunt dissection and entry point slightly on the lateral side will prevent this complication.

**Nonunion**

Nonunion may occur due to inadequate preparation of the joint, compression not achieved, Charcot joints, infection and unstable fixation. The treatment consists of dynamization of the construct. This is the reason the placement of dynamic locking screws in some of the newer nail designs. If this fails, operation should be redone. Standard procedure for nonunion are debridement of nonunion site, compression, bone grafting if needed and stable fixation.

**Stress Fracture**

The stress fracture is managed by plaster cast. If the nail is short, it may create stress riser effect and may cause fracture. Therefore, longer nail should be used. In India, the tibial medullary canal is smaller in size. Therefore, a smaller diameter nail is required. If larger nail is used fracture may occur, intraoperatively or in the postoperative period.

**Implant Failure**

Implant failure may present as backing out or breakage of screws. This is usually due to nonunion. The failed screws should be removed and a new screw is inserted in the dynamic hole. Nonunion site may need bone grafting and further stable fixation.

**Malunion**

Fusion may occur with varus, valgus or equinous deformity with excessive loading in some areas which may result in pain and ulceration. Malunion is treated by re-operation osteotomy and stable fixation.

**Difficulty in Ascending Steps**

Some patients may complain of difficulty in ascending steps, going uphill because of stiff ankle and hindfoot.

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**Figs 8A to G:** (A and B)Mr SM 53 years of age has Charcot ankle joint. Stage-three secondary to diabetes mellitus. Note the swelling on both sides of the ankle, (C) arrow shows incision over the distal fibula extending towards the sinus, (D) excised debris, (E) fibular strut is turned posteriorly, (F) note the entry portal and guidewire, (G) six months postoperative X-rays, ankle and subtalar joints have fused. Patient is asymptomatic.
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Fig. 9F: Note the fusion of the ankle and subtalar joint, proximal end of the nail high in the tibia and a dynamic hole.

This is especially predominant for patients with Charcot joints, because these patients have enjoyed unlimited mobility of ankle and subtalar joint.

Neighboring Joint Arthrosis

When both ankle subtalar joint are fused, midtarsal joints have more mobility and excessive load is placed on these joints. In due course of the time, they develop arthrosis and pain. The treatment is to fuse the painful arthritic joints usually the midtarsal joints.

Infection

Infection may be superficial or deep. The treatment is thorough debridement, local and systemic antibiotics and VAC application. Osteomyelitis may need excision of all dead neurotic bone and soft tissue and staged reconstructive procedures. Bony gap is treated with bone-grafting and stable fixation.

Diabetes and Retrograde Nailing

Wukich DK et al\(^\text{15}\) compared treatment by nailing in diabetic and nondiabetic patients. Although a postoperative complication was experienced in 59% of patients with DM compared with 44% of patients without DM. They concluded that they were not able to confirm their hypothesis that patients with DM experienced significantly lower clinical outcomes than patients without DM.

CONCLUSION

Simultaneous fusion of ankle and subtalar joints in one stage is a good salvage procedure. For better outcome, a good joint preparation, compression of fusion sites, proper positioning of the foot and stable fixation are key principles. Modern design of retrograde tibial nail appears to be an ideal implant, which is a load-sharing device and allows better positioning of the foot and compression of fusion sites. Newer design nails have greatly improved the outcome of pantalar arthrodesis.

REFERENCES


