Osteosynthesis of malleolar fractures

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The severity of malleolar fractures derives from the destruction of the tibiofibular articulation, which holds the talus firmly in its physiological position. This destruction leads to the sliding of the talus, which pulls the fractured malleolus along with it. All of this explains the disruption provoked by a tibiofibular-tarsal diastasis. When an individual sustains a malleolar fracture both the static and dynamic functions of the ankle are disrupted since the different gravitational factors that are transmitted by the mortise joint to the calcaneus and to the foot arches through the talus are upset. The talus, firmly held in place by the mortise joint, supports the weight of the body on its postero-lateral aspect; however, if talar diastasis occurs, gravitational forces are not supported in the physiologically determined place. This means that these fractures should be reduced as anatomically as possible since—as a result of the factors mentioned—the ankle must support the body’s weight. Failure to achieve an anatomically perfect—or quasi perfect—reduction will no yield the same “good functional result” as can be obtained without an anatomical reduction in a different area of the musculoskeletal system. The reason for this is that the balance of the foot arches is so perfect that the slightest tilting of the talus will change the direction of the different forces acting in the area, with the resulting static and dynamic alterations.

When searching the literature for the views of different authors with respect to these fractures, one is confronted with a range of mostly contradictory opinions, making it difficult to adopt a neutral position. For some trauma surgeons, malleolar fractures are of some severity but can not be reduced non-surgically. On the other hand, others advocate ex ante a surgical procedure with fixation of the fractured fragments in an attempt to make sure that an anatomically perfect reduction will be obtained and that the likely uncomfortable sequelae and reduction in functional capacity that would result otherwise are avoided. Now, we wish to adopt a neutral stance to the treatment of these injuries. When confronted with them, we do not apply the described techniques dogmatically but decide on the best approach to be used on a case-by-case basis.

Among the different types of ankle injuries, the frequency of which is on the increase as a result of our hectic lifestyles, mechanization, sports practice, etc, special mention should be made of serious ankle fractures compounded with a dislocation, their treatment being problematic given the fact that in these injuries conservative approaches tend to fail not only because there are often impossible to reduce non-surgically, but also because a plaster cast is not enough as a method of external fixation. Therefore, some of these fractures tend to be treated by means of an open procedure to carry out internal fixation.

In all cases of malleolar fractures, after performing an x-ray study, we carry out a reduction as early as possible and once correction has been obtained we immobilize the area in a plaster cast. We subsequently take additional radiographs to verify the accuracy of the reduction; we do not settle for a partial reduction but do our best to achieve as anatomical a reduction as possible. We do not usually use radioscopically-guided reductions because we do not consider it necessary, although these details depend on the surgeon’s choice. We share Boppe and Vassitch’s view that the urgency of reducing a malleolar fracture is comparable with that of acute appendicitis. Generally fractured patients are sent to us rapidly, a few hours after they sustained the injury, which makes fracture reduction much easier. However, we do not consider late presentation of the fracture, i.e. after 48 hours, when it already exhibits tumefaction, phlyctenae, etc, an indication against reduction. In these cases, as well as in cases of displaced fractures, we carry out the reduction under general anesthesia, using sterile alcohol-soaked compresses and applying a contention plaster cast, which is subsequently replaced 15 days later when the tumefaction has subsided.

So far we have not deemed it necessary to resort to Achilles tendon tenotomy or to continuous traction to be able to reduce fractures of this kind; however, in a small number of cases we have had to go for a surgical fixation of the malleolar fracture given the failure of the manual orthopedic reduction maneuvers.

The causes for the failure of manual reduction that we have observed personally are the following: malleolus rotation, which leaves the surface of the fracture facing the skin, and the interposition of soft tissues between the edges of the fracture. Once the fracture site has been laid open, we carry out a malleolar osteosynthesis with a screw, which we apply to the medial malleolus through a (typically small) incision on the medial aspect of the ankle. If we find interposed soft tissues, we resect them carefully after extracting them from the fracture site. We suture the wound with surgical silk and apply a plaster cast.

Up to now it was held that metal osteosynthesis was beset with dangers both because of the above mentioned risks...
involved in laying the fracture site open and thus provoking potential infections, and because of the risk that the bone tissue might reject the osteosynthesis material. Recently, with the use of antibiotics and highly tolerable osteosynthesis materials (Vitalium) these risks could be said to have all but disappeared. However, perhaps under the influence of those fears, we prefer to extract the screw after a reasonable length of time has elapsed and once we have verified that callus formation has taken place, even if we have not seen any type of pathological reaction in the patients we have operated on so far. When performing malleolar osteosynthesis we transfer the malleolus, as well as the talus and the calcaneus, to their normal anatomical position, with the result that gravitational forces are transmitted correctly through the mortise joint, the talus and the heel. The distribution of forces that such an approach to the ankle brings about should in theory be the same as that seen in the normal foot, thus meeting the essential conditions for dynamic and static restoration. Undoubtedly, this sounds very attractive, but we invariably act conservatively in all fractures that can be treated non-surgically; evidence of this is that out of 64 fractures of this type that we have operated in our clinic in the past two years, we only resorted to osteosynthesis in five cases, in which surgery was mandatory because of the fractures’ instability and the difficulty in reducing them conservatively. Therefore, it is not the purpose of this paper to present an out-and-out interventionistic stance for malleolar fractures, but to report on the good results we have obtained in cases in which it was impossible to reduce them orthopedically.

The use of osteosynthesis, which results in solid fragment fixation, has made it possible for us to hasten the patients’ recovery and has enabled them to start walking fairly soon because the uniform pressure exerted by the screw on the fragments at the fracture site promotes earlier callus formation. The results that we have obtained are extremely satisfactory and are not in the least in line with those of Patoir, who describes a series of 12 cases subjected to surgery where the best results were achieved by a patient with ankylosis, who suffered a functional loss of 35%.

After removing the plaster cast at 5 weeks, we are not in favor of applying Unna’s paste dressing to prevent edema; instead we prescribe an elastic compression stocking from the knee to the foot, which can be taken off when needed, or to subject the treated area to masotherapy or warm saline bath treatment.

CASE REPORTS

Case 1
Aurelio M., 26, was admitted to our clinic on 10th March 1948 with a left ankle fracture he had sustained three hours before. The foot had been bandaged and protected by a Kramer splint twisted into a straight angle that went from the toes to the popliteal fossa. As soon as he was admitted x-rays were taken in two views, which showed a bimalleolar fracture with outward displacement of the talus and reversal of the medial malleolus. Ten minutes after he patient was admitted, manual reduction was unsuccessfully attempted. This led us to carry out a surgical reduction and osteosynthesis of the medial malleolus. Subsequently, the patient was put in a plaster cast. The stitches were removed two days later.

Normal post-op
Six weeks later, the plaster cast was removed and the patient started to receive massage on his calf muscles as

Figure 1. Case 1: Aurelio M. Bimalleolar fracture with reversal of the medial malleolus.

Figure 2. Case 1: Same case as in the previous figure, after osteosynthesis.
well as bath treatment. At three months and a half, the screw was extracted and one month after this the patient was discharged without any sign of disability.

Case 2
Venancio Z., 62, was admitted to the clinic on 11th August 1949. He referred that he had suffered a severe contusion on his right ankle provoked by a heavy piece of iron. The foot presented with a valgus deformity with Dupuytren’s sign and intense and localized pain in the medial malleolus.

A two-view x-ray study revealed fractures of the medial malleolus and of the lower third of the fibula with a lateral dislocation of the talus.

Non-surgical reduction under local anesthesia did not yield optimal results, none the less because the talus could not be restored to its position. Therefore, the decision was made to immediately carry out a surgical reduction and fixation. Under general anesthesia, internal fixation of the medial malleolus was performed by means of a screw as well as intramedullary fibular nailing using Rocher’s rod.

Normal post-op evolution
On 25th September the plaster cast was removed. On 24th November the osteosynthesis material was extracted and a month later the patient was discharged without a trace of disability.

Case 3
Josefa M., 63, was admitted to our clinic on 12th November 1949. She had sustained a fall at home but could not explain the position in which she had fallen. She had a valgus deformity compounded by talipes equinus. She referred pain in both malleoli and moderate swelling.

The two-view radiograph revealed a bimalleolar fracture with anterior displacement of the fibula and lateral dislocation of the talus. Orthopedic reduction was unsuccessfully attempted.

Under general anesthesia, we immediately carried out an open reduction of the medial malleolus, which was sequestered between the talus and the medial angle of the mortise, held in place by the tendon of the posterior tibial muscle, interposed and very taut. Once this hurdle was overcome, the maleollus could easily be reduced and the osteosynthesis was performed with a screw. Subsequently, the tendon of the tibial posterior muscle was restored to its retromalleolar groove, thus repairing the continuity of the osseofibrous sleeve.

A plaster bandage was applied from the knee to the tip of the toes in a physiological posture. At 6 weeks the plaster was removed and the patient was given an elastic stocking; saline bath treatment was recommended. On 12th April the osteosynthesis material was removed, without the need of a procedure at the clinic. At present, the patient has entirely recovered foot movement and function.

Case 4
Narciso G., 47, dockworker. While doing his job, he fell into the hold of a ship. Orthopedic reduction was performed and, once medial malleolus instability was verified radiographically, we decided to carry out an osteosynthesis.

Through a fenestration opened in the plaster cast we performed the surgical reduction, after having resected the soft tissues interposed in the fracture site. Screw osteosynthesis was used.
The plaster was removed after 5 weeks. After this, mobilization and bath therapy started. Three months later the screw was extracted, with the patient being finally discharged five months after sustaining his initial injury with no limitation whatsoever on going back to his former job.

Case 5
Luis H., 36, was admitted to the clinic on 3rd January 1950, after sustaining a fall when using the stairs at home. After the x-ray study, a fracture was diagnosed together with a reversal of the medial malleolus, which led us to opt for an open reduction and screw osteosynthesis from the outset. The postoperative was normal. The plaster was removed after a month and a half and the screw extracted after four months. The result was satisfactory.

Case 6
Cristina. Consolidated bimalleolar fracture driven into severe plantar varus because it was never reduced properly. When the patient came to us, we suggested a wedge-shaped resection of the fibular fracture callus and an oblique top-down linear osteotomy of the medial malleolus in order to get it to slide downward and thereby facilitate the reposition the laterally dislocated talus into the tibiofibular mortise. Once the patient agreed to the procedure, we operated on her in the manner described and fixed the medial malleolus to the tibia by means of a screw.

The anatomical result of the talar reduction as well as the correction of the deformity - resulting from the bimalleolar fracture – was perfect and the postoperative passed without a hitch. The patient recovered all of her normal tibiotalar movements.

Commentary
Manuel Salaverri and Ignacio Gorostidi published this paper on the osteosynthesis of malleolar fractures in 1950. In it, they colloquially describe their experience as pioneers of this technique. As contemporary physicians, accustomed to reading about biomaterials and third and fourth generation antibiotics for which there is no resistance, we cannot help but feel somewhat sentimental when coming across references to things like “surgical silk sutures”, “the recent advent of antibiotics” and the “use of Vitalium” as a tolerable osteosynthesis material. For most of us it is hard to conceive trauma surgery without antibiotics and with the all but craftsmanlike materials the article refers to.

At the outset, the authors make an anatomo-functional description of the ankle and discuss the causes for the severity of fractures sustained in this area, based upon the destruction of the tibiofibular articulation that disrupts the static and dynamic functions of the ankle. They also emphasize the need for an anatomical reduction of the fracture to be able to achieve a good functional result.

And right they were, since the work by Ramsey and Hamilton shows that a lateral talus displacement of 1 mm brings about a 42% reduction in the tibio-talar contact area. Yablón et al demonstrate that the position of the talus in an ankle with a bimalleolar fracture cannot be correct until the tibial malleolus is reduced.

By measuring the intraarticular pressures on the ankle, one can see that the complete rupture of the syndesmosis has no effect on the pressures until the deltoid ligament is disrupted. The syndesmosis widens when the medial side is broken, which highlights the importance of medial structures for ankle stability. Dr. Salaverri is surprised by the discrepancies regarding the treatment of ankle fractures since «while for some trauma surgeons they can always be reduced and treated non-surgically, for others they always require surgery». They distinguish ankle fractures and «severe fractures complicated by dislocation», the latter being essentially the one requiring open reduction and internal fixation.

Multiple classifications of malleolar fractures have been suggested since 1950, the widely-used ones being those by Lauge-Hansen and Danis-Weber, the latter subsequently extended by AO. The first of these classifications is based on clinical-radiographical and experimental criteria; it describes injuries in a sequential way, according to the position the foot is in at the moment of trauma (supine or prone) and the direction of the deforming force, which may be rotational (lateral or medial) or translational (abduction or adduction). Danis-Weber’s classification is based on the level of the fibular fracture and does not consider medial lesions, which had led several authors to introduce special subgroups to include these injuries. A classification is really useful when different observers using it give the same label to the same type of fracture; however for both these classifications the rate of coincidence is only 60%.
and subsequently treatment consisted of mobilization, massage and bath therapy. Once integration was achieved at 3-4 months the malleolar screw was extracted in case the metal might provoke some strange effect.

Current controversies regarding the treatment of ankle fractures, which result from the new biomechanical findings reported, revolve around such issues as the treatment of isolated lateral malleolar fractures\(^{45}\), fixation of syndesmotic ruptures\(^{13}\) and the technique to be used\(^{16}\), whether it is necessary to revise and suture the deltoid ligament\(^{59}\), osteosynthesis with reabsorbable material\(^{9,10}\), fractures in the elderly\(^{19}\) and the increasing use of arthroscopy as an aid for the treatment of these fractures\(^{45,16}\). In many isolated fractures of the lateral malleolus, with no medial lesion, surgical treatment is not necessary; excellent results can be obtained by orthopedic treatment alone\(^{59,10}\).

The suprasynodesmotic protection or fixation screw should be implanted in fibular fractures that are over 3.5 cm away from the joint when the deltoid ligament is ruptured and in fractures more than 15 cm away from the joint when the medial malleolus is fractured.\(^{32}\) Triarticular fixation is sufficient and function recovery is faster with this technique than when four cortices are engaged; in addition the ankle can be mobilized without extracting the screw\(^{18}\).

Fixation with two screws is superior than using just one plus suturing the syndesmosis\(^{9,10}\). In elderly patients, periphereal vascular alterations should be considered as well as the trophic condition of the skin; it should also be remembered that osteoporotic bone will make osteosynthesis more difficult\(^{18}\).

At present much importance is attached in the postoperative period to early mobilization and loading with an articularized orthosis\(^{21,22}\).

REFERENCES