A Different Approach to the Treatment of the Lateral Malleolar Fractures with Syndesmosis Injury: The ANK Nail

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This retrospective study was conducted on a total of 139 cases of fractured ankles involving the fibula above the syndesmosis which were treated with open reduction and internal fixation with the intramedullary ANK nail at the Department of Orthopaedic Surgery at Vakif Gureba Teaching Hospital from 1990 to 1997. We were able to review 128 of these patients after a mean follow-up of 3.1 years (range, 1–7 years) including 60 with Weber type B and 68 with Weber type C fractures. The results were evaluated using objective, subjective, and roentgenographic criteria described by Cedell. Ninety-three patients (73%) have obtained good objective results, 28 (22%) fair, and seven (5%) have obtained poor objective results. Subjective rating were 94 patients (74%), good; 26 patients (20%), fair; and eight patients (6%), poor. Good radiological results were found in 99 patients (77%), fair radiological results in 21 patients (17%), and poor radiological results were found in eight patients (6%). It is concluded that the ANK nail could be used for the fixation of the lateral malleolar fracture with tear of the syndesmosis ligament. (The Journal of Foot & Ankle Surgery 38(6):394–402, 1999)

Key words: ANK nail, injuries of the syndesmosis, intramedullary fixation, lateral malleolar fracture

Ankle fractures involving the fibula above the distal tibiofibular joint usually indicate an injury of the syndesmosis up to the level of the fracture (1, 7, 8, 10). To avoid post-traumatic osteoarthritis, restoring the normal anatomy of the lateral malleolus is crucial (2, 3, 5–11). Thordarson et al. evaluated individual and combined effects of the fibular shortening, lateral shift, and external rotation on contact pressure in the ankle joint in pronation-lateral rotation ankle fracture malunion models. They concluded that displacement of the fibula in these injuries should not be accepted (12). Philips et al. showed that 44% of patients who were treated conservatively had continuous pain at the ankle (13). Stieh and Schwartz, in 1990, stated that a less accurate reduction was achieved by conservative treatment which led to an increased incidence of arthritis in late radiological follow-up (11).

Yablon et al. showed that when the ankle fractures were treated ignoring the lateral malleolus, degenerative arthritis would develop 1–8 years later because of the residual talar tilt (8, 14, 15). Leeds et al. found significant correlation between the adequacy of the reduction of the syndesmosis and late arthritis and late stability of the syndesmosis. The late stability of the syndesmosis, and the adequacy of the reduction of the lateral malleolus and syndesmosis were also correlated with final outcome. They concluded that adequate reduction of the syndesmosis is necessary to achieve a stable ankle (6). Philips et al. stated that permanent pain and deformity were developed in 44% of the patients with ankle fractures who were treated conservatively (13, 16).

In this study, we reviewed the patients with Weber type B and C fractures of the lateral malleolus treated with ANK nail. The aim was to fix the fracture and the syndesmosis ligament injury at the same time. Until the syndesmosis heals the ANK nail works like a artificial syndesmosis.

Materials and Methods

Between July 1990 and July 1997, 139 patients with ankle fractures were treated at Vakif Gureba Teaching Hospital. All patients had open reduction and internal fixation with ANK nail for lateral malleolar fractures. Eleven patients were lost to follow-up and they were not included. The mean follow-up for the entire group was 3.1 years (range, 1–7 years). They ranged in age from 19 to 70 years.

Seventy-two patients were male and 56 were female. In 70 patients, the right ankles were affected, and in the

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other 58 patients, the left sides were affected. Seventy-four patients sustained their injuries by twisting (58%), 18 had vehicular accidents (14%), 28 had fallen from a height (22%), and eight had miscellaneous injuries (6%). The lateral malleolar fractures were classified according to Weber. Sixty cases were classified as Weber type B (47%), and 68 were classified as Weber type C (53%).

Six fractures were open fractures. They were treated within 6 hours after the injury. If there was luxation of the ankle, the luxation was reduced, and the ankle was immobilized in a posterior splint for 3 days. After edema was resolved, they were operated on.

Surgical Technique

The operation is performed on the patient under spinal or general anesthesia. The patient is positioned supine on the operating table; a sandbag or a blanket roll is placed beneath the hip of the same side as the injured ankle. This position facilitates the operation. The surgery is performed under tourniquet homeostasis. The medial or lateral malleolus can be fixed first. In our experience, it does not make any difference. Because a deltoid ligament can prevent the reduction of the talus when it is ruptured completely, some authors suggest that the deltoid ligament should be repaired first (9, 17, 18). However, Yablon et al. demonstrated in cadavers, and later in a prospective study, that only when the lateral malleolus was anatomically reduced before the medial malleolus could the talus consistently be anatomically reduced. Furthermore, if medial malleolus was reduced first, the lateral malleolus could be reduced only by stretching the lateral malleolar ligament complex. This often leads to late collapse of the reduction or ligamentous instability (15, 18, 19). If there is tibiotalar dislocation, we prefer to open both sides at the same time to control the reduction.

A linear incision is made along the lateral malleolus and is curved anteriorly for 2.5–4 cm (like a reversed J-shaped incision) to expose the anterior aspect of the tibiofibular joint and the anterior part of the tibia. The proximal length of the incision depends on the level of the fracture. The fracture site, syndesmosis, and joint capsule are exposed. The stability of the syndesmosis is assessed with the Cotton test. The test is performed by stabilizing the distal tibia and applying a lateral force to the foot. One looks out for any lateral translation of the foot, which would indicate syndesmotic instability. Because interpretation of this maneuver is difficult, modifications of this test are mostly used, such as grasping the fibula with a bone-holding clamp and, under direct vision, observing any direct motion of the fibula. If there is a tear of the joint capsule, the talus can be seen. Anatomic reduction is maintained with a bone-holding clamp (Fig. 1). A hole is made on the side of the lateral malleolus, 5 mm proximal

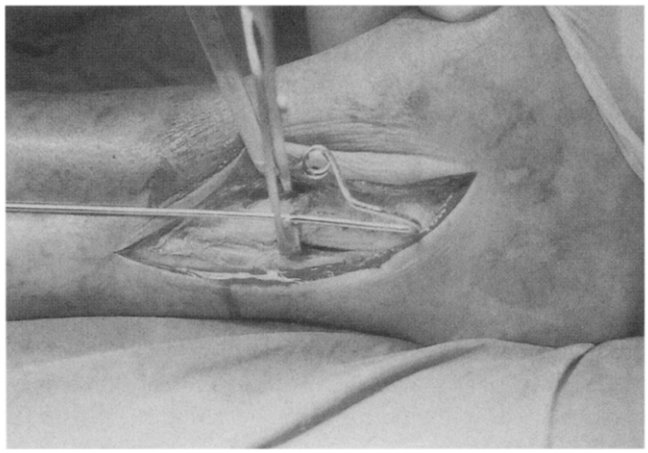

FIGURE 1 Intraoperative photo of the incision and reduction of the lateral malleolar fracture. The ANK nail is overlying the reduced fracture.

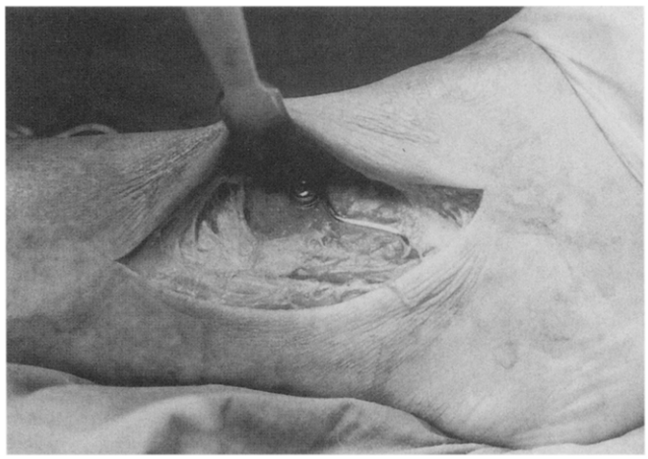

FIGURE 2 The ANK nail is placed intramedullary until its curved end abuts the tip of the fibula.

to the tip with a 2.5-mm Kirschner wire that is passed across the fracture site and into the proximal fibular fragment. Then an ANK nail is inserted until its curved end reaches the tip of the fibula (Fig. 2). An examination with the image intensifier is then performed. The hole of the ANK nail is brought towards the anterior part of the tibia, and a malleolar screw is applied to fix the ANK nail to the tibia when the ankle is in neutral position. If there is a fracture of the posterior malleolus it can also be fixed with this screw. Sometimes it is possible to penetrate the cortex of the fibula while applying the ANK nail. If the proximal end of the nail penetrates the fibular cortex proximal to the fracture side and that portion does not protrude excessively, it can be accepted. If the fracture is too oblique and reduction cannot be maintained with intramedullary fixation alone, a 2.5-mm Kirschner wire is inserted under fluoroscopic control, to the level of proximal cortex until the cortex is penetrated. Verification

of the proper nail length is determined and the Kirschner wire is placed with the ANK nail. Alternatively, a cerclage wire could be applied to resist rotation and shortening. Then the syndesmosis is carefully inspected and, whenever possible, the syndesmosic ligament is repaired.

For the fixation of the medial malleolar fracture, a separate curved incision over the medial malleolus is made. Then fixation is performed with using two Kirschner wires and cerclage (AO tension band technique).

Intraoperative radiographs are made to ensure that reduction has been achieved (Figs. 3 and 4). Following the closure of the wound, a sterile dressing is applied and the ankle is immobilized in a posterior splint with the ankle in neutral position and elevated. Postoperatively, the extremity is elevated for approximately 5 days. Gentle active assisted dorsiflexion and plantarflexion exercises are initiated the next day. Three weeks after the operation, the splint is removed, the full active range of motion (ROM) is allowed. Six weeks after the operation, the patient is allowed to bear weight on the ankle if x-rays show enough callus formation.

At the time of the follow-up examination, the patients were evaluated objectively and subjectively according to classification schemes modified from Cedell (Tables 1 and 2) (6). Factors assessed objectively included gait, inter-malleolar distance, calf atrophy, ligament tenderness, ankle range of motion, pes planus, heel valgus, and swelling. AP, lateral, mortise views, and stress views were obtained for follow-up. These roentgenograms were evaluated according to the criteria listed in Table 3, as modified from the work of Cedell (6, 20).

Results

The sex and classification of the patients are shown in the Table 4. There were 31 (43%) females and 29 (52%) males with Weber type B fractures of the fibula, and 41 (57%) females and 27 (44%) males with Weber type C fractures.

Sixty-eight patients had bimalleolar fractures, 32 had trimalleolar fractures, and six had lateral malleolar fractures with associated disruption of the deltoid ligament.

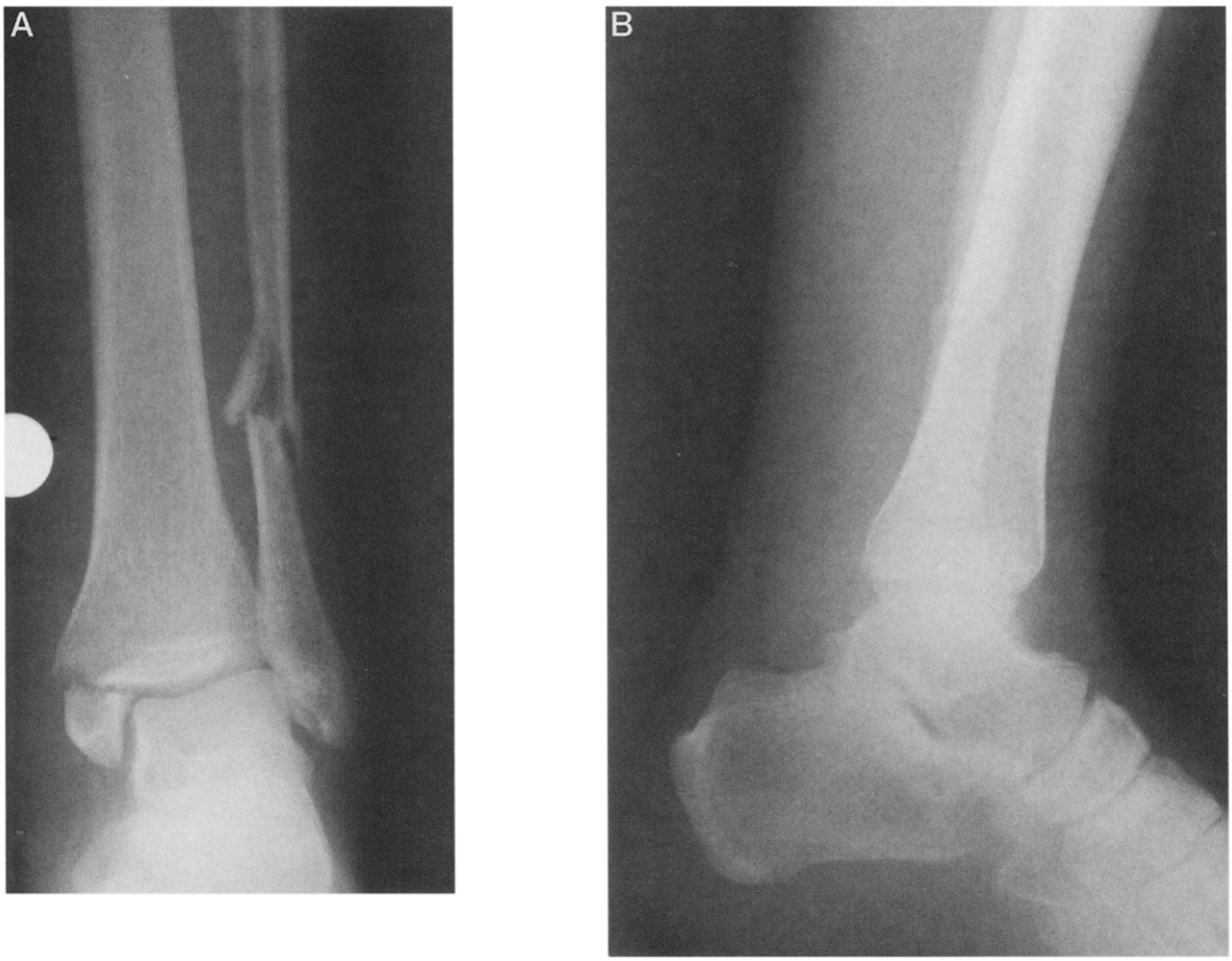

FIGURE 3 Anteroposterior and lateral views of bimalleolar fracture of the ankle (Weber type C fracture of the lateral malleolus).

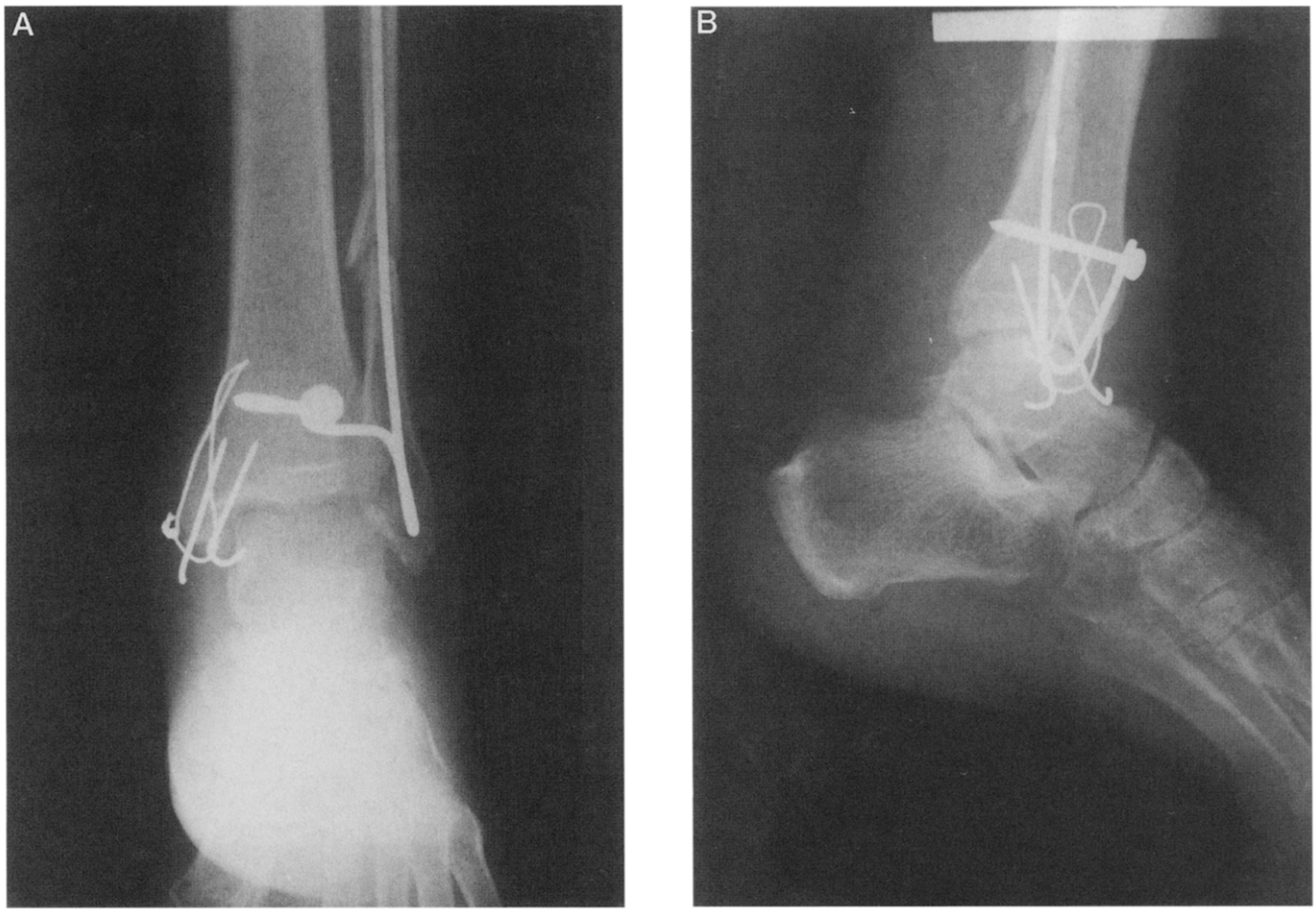

FIGURE 4 Postoperative anteroposterior and lateral radiographs.

TABLE 1 Classification of Subjective Results

Criteria	Results
Good	Complete recovery; full capacity for work and athletics; slight pain, swelling, or stiffness after excessive use; no pain medication
Fair	Full or only slightly reduced capacity for work and athletics; moderate pain, swelling, or stiffness after excessive use; occasional pain medication
Poor	Significantly reduced capacity for work and athletics; severe pain, swelling, or stiffness after exertion; pain medication used more than occasionally

TABLE 2 Classification of Objective Results

Criteria	Good	Fair	Poor
Gait	Normal	Occasionally limp	Frequent limp
Intermalleolar distance	0–1 cm	1–2 cm	>2 cm
Calf atrophy	0–1 cm	1–2 cm	>2 cm
Ligament tenderness	None	Mild	Moderate
Loss of ankle motion	0°–10°	10°–20°	>20°
Pes planus[a]	None	Mild	Moderate
Heel valgus[b]	None	Mild	Moderate
Swelling	Mild	Moderate	Marked

[a]Mild — the longitudinal arc was less well developed than on the opposite side; Moderate — significant loss of the longitudinal arch.
[b]Mild — the heel was in a more valgus position on this side than on the uninjured side; Moderate — the heel was in a marked valgus position.

Twenty-two patients also had tibiotalar luxation. The age distribution of the patients is shown in Table 5.

Distribution of the patients by mechanism of injury and type of the fracture according to Weber classification is studied in Table 6. Slip and fall caused Weber B type fractures in 36 patients and Weber C type fractures in 38 patients. Traffic accidents caused Weber B type fractures in eight patients and Weber C type fractures in 10 patients. A fall from a height caused Weber B type fractures in 11 patients and Weber C type fractures in 17 patients. Five Weber B type fractures and two Weber C type fractures occurred due to other reasons.

The time from the accident to the operative procedure is shown in Table 7. The removal of the ANK nail was carried out in 59 patients (Table 8).

TABLE 3 Classification of roentgenographic reduction

	Criteria	Rating
Lateral Malleolus	No lateral displacement; anterior, posterior or proximal displacement <2 mm	Good
	Lateral displacement <2 mm; anterior, posterior, or proximal displacement 2–4 mm	Fair
	Lateral displacement ≥2 mm; anterior, posterior, or proximal displacement >4 mm	Poor
Posterior Malleolus	Proximal displacement <2 mm	Good
	Proximal displacement 2–5 mm	Fair
	Proximal displacement >5 mm	Poor
Medial Malleolus	Proximal or distal displacement <2 mm; no medial or lateral displacement	Good
	Dorsal, ventral, proximal or distal displacement 2–5 mm; no medial or lateral displacement	Fair
	Dorsal, ventral, proximal or distal displacement >5 mm; lateral displacement, angulation, or rotation	Poor
Talus	Displacement <0.5 mm in any direction; talar tilt <0.5 mm	Good
	Talar displacement 0.5–2 mm; talar tilt 0.5–1 mm	Fair
	Talar displacement >2 mm; talar tilt >1 mm	Poor
Reduction of the Syndesmosis	In the stress view, syndesmosis ≤5 mm wide or equal to normal	Good
	In the stress view, syndesmosis 5–7 mm wide	Fair
	In the stress view, syndesmosis ≥7 mm wide	Poor
Medial Joint Space	No widening	Good
	Widening ≤1 mm	Fair
	Widening >1 mm	Poor
Stability of the Sydesmosis	Stable — no change in width compared with normal side	Good
	Mild instability — widening of mortise medially <2 mm compared with normal side	Fair
	Marked instability — widening of mortise medially ≥2 mm compared with normal side	Poor

TABLE 4 Distribution of female and male patients according to Weber classification

Classification	Females	Males	Total
Weber B	29(52%)	31(43%)	60(47%)
Weber C	27(48%)	41(57%)	68(53%)
Total	56(44%)	72(56%)	128(100%)

TABLE 5 The distribution of the patients according to age

	10–19 Years	20–29 Years	30–39 Years	40–49 Years	>50 Years
Number	4	18	28	45	35
Percentage	3	14	20	35	28

TABLE 6 The mechanism of injury

	Weber B	Weber C	Total
Twisting	36(28%)	38(30%)	74(58%)
Traffic accident	8(6%)	10(8%)	18(14%)
Fall from height	11(9%)	17(13%)	28(22%)
Others	5(4%)	3(2%)	8(6%)

TABLE 7 Time to surgery from the day of injury

	1–3 Days	4–7 Days	8–10 Days	11–20 Days	Total
Number	24	74	22	8	128
Percentage	19	58	17	6	100

TABLE 8 Time of the hardware removal

	15–20 Weeks	21–30 Weeks	31–40 Weeks	After 40th Week	Not removed
Number of patients	4	9	13	33	69
Percentage	3	7	10	26	54

The distribution of the patients by subjective results is shown in Table 9. Ninety-four (74%) patients had good, 26 (20%) fair, and eight (6%) poor results. Among the 94 patients with good results, 50 fractures were type C and 44 were type B. The 26 patients with fair results consisted of 12 Weber type B fractures and 14 type C fractures of the fibula. Four patients with poor results had type C fractures and 4 had type B fractures. The objective results of the patients are studied in Table 10.

TABLE 9 Subjective results according to Weber classification

	Good	Fair	Poor
Weber B	44(74%)	12(20%)	4(6%)
Weber C	50(73%)	14(21%)	4(4%)
Total	56(74%)	26(20%)	8(6%)

TABLE 10 Objective results according to Weber classification

	Good	Fair	Poor
Weber B	43(71%)	14(23%)	3(6%)
Weber C	50(73%)	14(21%)	4(6%)
Total	93(73%)	28(22%)	7(5%)

Ninety-three patients (73%) obtained good results, 28 (22%) fair results, and seven (5%) poor results. The good results occurred in 43 patients with Weber type B fractures (71%), and in 50 patients with Weber type C fractures (73%). The fair results occurred in 14 patients with Weber type B fractures (23%), and in 14 patients with Weber type C fractures (21%). The poor results occurred in three patients with type B fractures (6%), and four patients with type C fractures (6%).

The different factors contributing to the objective results are seen in Table 11. Occasional limp occurred in 15 patients. An increase of the malleolar size from 1 to 2 cm was registered in nine patients. Atrophy of the calf from 1 to 2 cm was seen in 20 patients. Tenderness of the anterior tibiofibular ligament or deltoid ligament on palpation was registered in 14 patients. Loss of ankle motion when it was compared to the uninjured site was seen in 18 patients. Unilateral pes planus could be demonstrated in six patients, and an equinus deformity was seen in seven patients. In 29 of the patients, moderate swelling was noticed postoperatively.

The results of the radiological examination are shown in tables 12 and 13. Ninety-nine patients (77%) had good results, 21 (17%) fair results, and eight (6%) poor results. Good results were reported in 45 cases (74%) with Weber type B fractures, and in 54 cases (79%) with Weber type C fractures. Fair results occurred in nine cases (16%) with

TABLE 11 Comprehensive objective results

Criteria	Good	Fair	Poor
Gait	108	15	5
Intermalleolar distance	115	9	4
Calf atrophy	104	20	4
Ligament tenderness	114	14	—
Loss of ankle motion	110	12	6
Pes planus	122	6	—
Heel valgus	124	4	—
Swelling	97	29	2
Equinus deformity	121	5	2

TABLE 12 Roentgenological results according to Weber classification

	Good	Fair	Poor
Weber B	45(74%)	9(16%)	6(10%)
Weber C	54(79%)	12(18%)	2(3%)
Total	99(77%)	21(17%)	8(6%)

TABLE 13 Radiological results

	Weber B			Weber C		
	Good	Fair	Poor	Good	Fair	Poor
Lateral malleolus	45	12	3	58	8	2
Medial malleolus	49	8	3	58	10	—
Posterior malleolus	49	7	4	59	9	—
Reduction of the talus	50	6	4	60	6	2
Syndesmosis	46	10	4	58	8	2
Medial joint space	48	7	5	59	7	2

Weber type B fractures and in 12 cases (18%) with Weber type C fractures. Poor results occurred in six cases (10%) with Weber type B fractures and in two cases (3%) with Weber type C fractures.

The correlation between subjective and objective results is shown in Table 14. Among 94 patients with good subjective results, 88 (93.6%) had good objective results, while 6 (6.4%) had fair objective results. 20 of 27 patients (74%) with fair subjective results had fair objective results, four of them (14.8%) had good objective results, and three (11.2%) had poor objective results. Of seven patients with poor subjective results, two had fair and five had poor objective results. Eighty-eight of 92 patients (95.7%) with good objective results had good subjective results, and four of 92 (4.3%) had fair subjective results. Of 28 patients with fair objective results, six (21.4%) had good, 20 (71.5%) had fair, and two (7.1%) had poor subjective results. Among eight patients with poor objective results, three (37.5%) had fair and five (62.5%) had poor subjective results.

The correlation between subjective and roentgenological results can be studied in Table 15. Among 94 patients with good subjective results, 90 (95.8%) had anatomic reductions, and four (4.2%) had fair roentgenological results. Of 27 patients with fair subjective results, eight

TABLE 14 Correlation between subjective and objective results

Objective Results	Subjective Results			
	Good	Fair	Poor	Total
Good	88	4	—	92
Fair	6	20	2	28
Poor	—	3	5	8
Total	94	27	7	128

TABLE 15 Correlation between subjective and radiological results

Radiological Results	Subjective Results			
	Good	Fair	Poor	Total
Good	90	8	–	98
Fair	4	16	2	22
Poor	–	3	5	8
Total	94	27	7	128

TABLE 16 Correlation between objective and radiological results

Radiological Results	Subjective Results			
	Good	Fair	Poor	Total
Good	90	8	–	98
Fair	4	16	2	22
Poor	–	2	6	8
Total	94	26	8	128

(29.6%) had anatomic reductions, and 16 (59.3%) had fair and three (11.1) had poor roentgenological results. Of seven patients with poor subjective results, two (28.6%) had fair, and five (71.4%) had poor roentgenological results. Of 98 patients with anatomical roentgenological results, 90 (91.8%) had good, and eight (8.2%) had fair subjective results. Of 22 patients with fair roentgenological results, four (18.2%) had good, 16 (72.8%) fair, and two (9%) poor subjective results. Of eight patients with poor roentgenological results, three (37.5%) had fair, and five (62.5%) had poor subjective results.

The correlation between objective and roentgenological results can be studied in Table 16. Among 94 patients with good objective results, 90 (95.8%) had anatomic reductions, and four (4.2%) had fair roentgenological results. Among 26 patients with fair objective results, eight (30.8%) had anatomic reductions, and 16 (61.5%) had fair, and two (7.7%) had poor roentgenological results. Among 8 patients with poor objective results two (25%) had fair, and six (75%) had poor roentgenological results. Of 98 patients with anatomical roentgenological results, 90 (91.2%) had good, eight (8.8%) had fair objective results. Of 22 patients with medium roentgenological results, four (18.2%) had good, 16 (72.7%) had fair, and two (9.1%) had poor objective results. Of eight patients with poor roentgenological results, two (25%) had fair and six (75%) had poor objective results.

In the follow-up, no pseudarthrosis was seen. Break of the ANK nail was not encountered.

Complications

In three patients, osteoarthritis of the ankle joint was seen during follow-up. One of these patients had open fracture and skin defect. After the operation, rehabilitation could not be started soon. The other two patients had also posterior malleolar fracture of the tibia. When we reviewed the x-rays of these patients, we saw that anatomical reduction could not be achieved during the operation. Also, 11 patients had fibular shortening.

Discussion

In addition to closed treatment, various methods of surgical fixation of the ankle fractures with tibiofibular diastasis have been described. (8, 21). Factors that are associated with a poor result in the treatment of displaced ankle fractures have been found more frequently following closed than following open treatment (2, 10, 21).

According to the system that was introduced by Danis and modified by Weber, type B fractures of the lateral malleolus are at the syndesmotic level and involve a 50% risk of the injury to the syndesmosis. The type C injury is a fracture of the fibula above the syndesmosis. The syndesmosis is disrupted, and there is almost always an associated injury on the medial side of the ankle (22). Fixation of the syndesmosis is usually recommended for Weber type B and Weber type C fractures (3, 10). Roberts reviewed 42 patients who had sustained displaced ankle fractures and been treated with open reduction and internal fixation. The pronation-eversion injury was found to have a particularly poor prognosis in this series. Fifty percent of the patients with this injury had fair or poor results objectively, and 70% subjectively. The most probable explanation for this fact was the complete rupture of the syndesmosis with this injury (10). Pettrone et al. found a statistically significant relationship between the overall results and the amount of displacement of the medial and lateral malleoli, the presence or absence of disruption of the syndesmosis, the patients' age, incomplete reduction of the lateral malleolus, and residual talar tilt (21). In our study, the stability of the syndesmosis was assessed clinically and with radiographs before syndesmotic fixation was instituted. The Cotton test or its modification was performed to assess instability during surgery (23). Even if there was a partial injury of the syndesmosis, we preferred fixation of the fracture with an ANK nail, because it allowed us to start range of motion exercises sooner after the surgery. The most commonly used technique to fix a tear of the syndesmosis ligament is syndesmotic screw. It was found that reduction and temporary pinning of the distal tibiofibular joint helps achieve fibular length (2, 3, 7). There are some problems with using a syndesmotic screw. A screw that is inserted across the syndesmosis can lead to ossification at the tibiofibular joint (2, 3). Because of this, it is advised that the syndesmotic screw should be applied a few centimeters above the joint. This could cause tightening

of the distal tibiofibular joint (2, 3, 7). A diastasis screw prevents normal movement between the tibia and fibula, and this may promote the development of a synostosis (2, 7). Weightbearing with a diastasis screw in place may cause the screw to break and loosen. Also, despite reduction of the diastasis and fixation with a tibiofibular syndesmosis screw, this ligament injury fails to heal in some patients, and after removal of the syndesmotic screw, late displacement of the syndesmosis can occur (3, 7).

Pain over a one-third tubular plate, which was used to fix the fracture of the fibula, was reported as a common problem. Also, some skin problems could be seen after plate application (24, 25). The plate method of fixation is still preferred in cases where the lateral malleolus is comminuted, as length could not be reliably maintained with intramedullary fixation. Also, Bankston et al. (26) did a biomechanical study to compare the fixation strength of a buttress plate and intramedullary screw fixation. They found that there was no statistical difference between these two groups in cadaver bone. However, when they evaluated the clinical results of 44 patients with lateral malleolar fractures who underwent intramedullary screw fixation, they concluded that intramedullary fixation of lateral malleolus fractures provides stable fixation without subcutaneous hardware. The intramedullary position of the hardware also allowed for dynamic compression at the fracture site, thus facilitating fracture healing. This position also reduced torque and bending movement on the device. Internal fixation with a plate requires the adaptation of devices, thus abnormal biomechanical stresses are created (5). With this nail, it is possible to treat the lateral malleolar fractures and syndesmotic tears at the same time. Also, as it is possible to start motion soon after the operation, early restoration of the normal ankle motion is possible. The ANK nail does not restrict the flexion and extension of the ankle. It allows lateral malleolar motion. The fracture of the lateral malleolus is fixed intramedullary with ANK nail. Rotational stability is provided by syndesmotic fixation. The curve at the distal part of the ANK nail simulates the natural lateral flare of the lateral malleolus (Fig. 5).

The most significant problem with the ANK nail is the shortness of the fibula after fixation of the fracture of the lateral malleolus. In our series there were 11 patients with fibular shortening. The length of the fibula is very important to provide the depth of the ankle mortise and stability of the ankle joint. The importance of providing fibular length is more important in weightbearing (15, 18, 19, 23). We reviewed the cases with fibular shortness, and noticed that the shortness of the fibula occurred in cases with comminuted fractures or oblique fractures of the lateral malleolus and anatomical reduction could not be obtained at the operation. Because of this problem, the

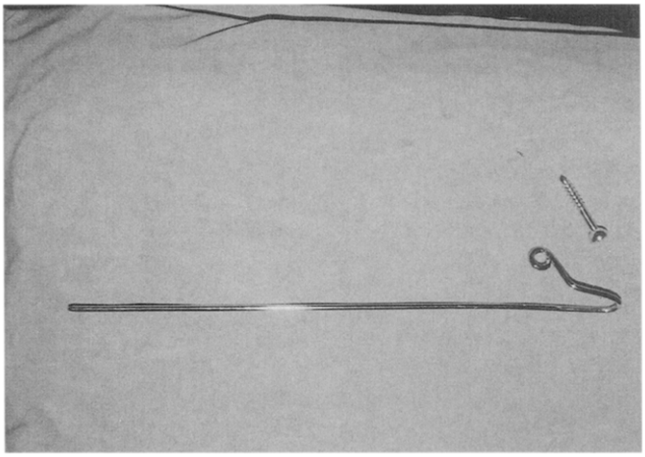

FIGURE 5 The picture of the ANK nail.

ANK nail should be applied carefully for the comminuted and oblique fractures of the lateral malleolus, but an anatomical reduction is necessary to prevent the shortness of the fibula. For oblique fractures, if anatomical reduction cannot be obtained with the ANK nail, cerclage wire is applied in addition to the ANK nail, or the proximal end of the ANK nail is placed out of the cortex proximal to the fracture line to prevent the shortness. In this situation the fixation is more stable and this protects against shortness of the fibula. In addition, weight bearing should not be allowed in these cases until a callus formation is seen radiologically. The flexibility of the ANK nail allows it to easily accommodate the distal fibular bow, resulting in three-point fixation of the fracture, which also helps for maintaining fibular length.

The ANK nail provides an elastic fixation of the tibiofibular syndesmosis. It does not cause a skin problem, because it is placed intramedullary. It is also thought that this technique is simpler than buttress plating. It is possible to walk while the ANK nail is in place. We have not seen any biomechanical insufficiency or break of the ANK nail. It is also economical. The ANK nail is preferred for the transverse fracture of the fibula but is not recommended for comminuted or otherwise unstable fracture configurations.

There are some technical considerations that will enhance the likelihood for successful implantation. The physiologic valgus of the lateral malleolus should be matched by the contour of the ANK nail. When a malleolar screw is applied, the ankle joint should be held in neutral position to determine the relative position of the tibia, fibula, and syndesmosis. Anatomical reduction should be obtained to prevent shortening of the fibula. If there is an oblique fracture, early weightbearing should not be allowed in order to avoid the fibular shortening.

In summary, this study indicates that the ANK nail could fix the fracture of the fibula and syndesmotic failure

together. Until the syndesmosis heals, the ANK nail functions like a syndesmosis, and helps to obtain a stable and functional ankle joint.

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