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Results of prophylactic simple fasciocutaneous advancement in the initial management of acute ankle fractures with high risk of operative wound complication

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ABSTRACT

Ankle fracture is the third most prevalent fracture in older adults. Wound dehiscence is the most frequent complication. Our objective is to determine the operative wound complication rate in patients with unstable ankle fracture in whom a prophylactic simple fasciocutaneous advancement was used.

Methods: Prospective registry of patients with unstable ankle fracture, in whom a prophylactic fasciocutaneous advancement was performed between August 2020 and July 2021. Demographic variables, time spent in performing the flap, cost of osteosynthesis, minor and major complications of the surgical wound, readmission or reoperation were registered.

Results: 42 older adults with ankle fracture were included. Median age 69 (60–94). 31% diabetics and 21.5% active smokers. A 40% trimalleolar fracture pattern. There were 7% of superficial complications of the surgical wound. No major complications, no reoperations.

Conclusions: Prophylactic fasciocutaneous advancement at the beginning of traumatological surgery is technically simple, reproducible, cheap and with low complications.

Level of evidence: Level IV, cross-sectional study.

1. Introduction

Ankle fracture is the third most prevalent one in older adults. Functional results are improved by close contact casting or surgical treatment of ankle fractures [1–6]. Open reduction and internal fixation (ORIF) with plates and screws anatomically restore the tibiotalar joint and control the length and rotation of the fibula fracture [7,8]. Complications of the surgical wound are associated with patient risk factors, such as advanced age, smoking, [9,10] diabetes mellitus (DM), [1,11] dislocation fractures [12,13] and lack of adherence to postoperative indications [11]. In people over 60, surgical wound complications can be found in up to 28.7% [14]. The most frequent and important one is wound dehiscence, which has a prevalence between 9% and 21.5% [10,15–17]. Minimally invasive approaches and fibula nails with arthroscopic assistance have been used to reduce complications of surgical wounds [18]. However, tension-free closure of the surgical wound is traditionally recommended, [19,20] to reduce excessive tension on the skin, produced by postoperative edema and thus, avoid ischemia, necrosis and dehiscence in suture areas. Another alternative are flaps, which can also be used [21] to resolve a complication of the surgical wound.

To the best of our knowledge, no studies have been performed which evaluate the benefit of using a simple fasciocutaneous advancement prophylactically in the first surgical intervention for ankle fractures in a population at high risk of developing surgical wound complications. We hypothesize that the use of a fasciocutaneous advancement at the beginning of the surgery in the acute management of ankle fractures avoids over-traction of the skin

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during surgery and facilitates a tension-free closure of the surgical wound and its proper healing. Our objective was to determine the rate of complications of the operative wound in patients with unstable ankle fracture associated with a high risk of wound complication, in whom a prophylactic simple fasciocutaneous advancement was used at the beginning of surgery.

2. Methods

Prospective, cross-sectional study of older adult patients with unstable ankle fracture, managed with prophylactic simple fasciocutaneous advancement at the start of traumatological surgery, in a level I trauma center between August 2020 and February 2022. Approval of the local ethics committee was obtained (HLF32–12–2020).

Patients with risk factors for surgical wound complications - such as age greater than or equal to 60, with or without association with DM and smoking - were included. They all had unstable ankle fracture according to Lampridis et al., [22] and follow-up until wound closure. Open ankle fractures, fractures with more than 21 days of evolution, ankle fractures that did not require a lateral approach, rheumatological patients, those using immunosuppressive drugs, and patients lost to follow-up were excluded.

The main objective of this work is to describe the rate of complications of the surgical wound. Demographic data, laboratory parameters, type of fracture, surgical time used to perform the fasciocutaneous advancement, its learning curve, complications of the flap according to Bhullar et al., [23] reoperations, readmissions, and cost of the osteosynthesis used in the fibula will also be described. Both surgeons were trained and supervised by the center's plastic surgery team.

2.1. Technique

The surgery was performed by two experienced foot and ankle surgeons. A) Patient positioning: the patient was placed in supine position with external leg rotation by means of using a wedge under the ipsilateral gluteus. A pressure cuff was used on the thigh ipsilateral to the injury. B) Surgical approach: A lateral incision was made over the fracture site at the level of the fibula (Fig. 1), careful dissection to identify and avoid damaging the superficial peroneal nerve, and then a simple fasciocutaneous advancement was performed. C) Preparation of fasciocutaneous advancement: We considered the angiosomes concepts and irrigation of the anterior tibial artery and peroneal artery. From superficial to deep, the fasciocutaneous advancement included: skin, cellular, and crural fascia of the leg (Fig. 2). It is important to preserve the irrigation of the perforators of the advancement by lifting the deep plane to the fascia, preserving the dermal-subdermal plexus, the same concepts used in the keystone flap (Fig. 3) [24,25]. Towards the anterior and posterior region of the leg, the advancement was dissected up to a distance of 50% of the length of the surgical wound. Towards the proximal and distal part of the leg, the advancement was dissected up to a distance of 25% of the length of the surgical wound (Fig. 4). D) Fracture management: Adequate exposure of the fracture without over traction of already released soft tissues, anatomical reduction and osteosynthesis of the ankle fracture were performed using a technique with an interfragmentary compression screw, when there was no comminution. A locking one-third tubular plate was placed in a lateral or posterolateral position according to the surgeon's preference. In case of syndesmal instability, at least one screw of 3.5 mm tri or tetra cortical was placed. E) Wound closure: was performed by planes, using separate stitches with reabsorbable material for deep planes, and Donati-type stitches with 3–0 non reabsorbable suture for the skin.

2.2. Postoperative and follow-up

Anesthesia with peripheral regional block of the intervened leg was used. The patient was discharged 6 h postoperatively with a Cam Walker boot, non-weight bearing and leg-up indication, and a home regimen for ankle joint range exercise. Clinical and photographic follow-up was carried out (Fig. 5). Stitches were removed between week 3 and 4 postoperatively. Weight-bearing was deferred until weeks 6–8 postoperatively, at the discretion of the surgeon, based on their clinical-radiological evaluation. Complications were registered.

2.3. Complications

Complications which did not require procedures in the operating room, superficial wound infections, delayed healing, and skin irritation were considered minor complications of the surgery. Those that required surgery, presented a deep infection, loss of implants, or loss of fixation were considered major complications [26].

In addition, superficial complications of surgical wounds were defined as those involving only the skin and subcutaneous tissue, while deep complications were those involving the fascia and muscle [27].

2.4. Data collection

Preoperative: variables of age, gender, active smoking, DM, other comorbidities, type of fracture, and time elapsed from fracture to surgery were recorded. Also, laboratory parameter such as glycosylated hemoglobin level was registered in case of DM. Intraoperative: time used to make the advancement, name of the surgeon, osteosynthesis used, its location, type and cost were recorded.

Clinical and photographic follow-up of the surgical wound was performed at 7, 21 and 42 days. General complications (operative wound dehiscence, superficial infection, deep infection), flap complications (hematoma, congestion, thrombosis, seroma and necrosis) according to Bhullar et al.[23] and osteosynthesis failure were recorded. A weightbearing X-ray was performed at 6 and 12 weeks postoperatively. Readmissions and reoperations, such as surgical wound debridement and/or removal of osteosynthesis material were registered. In the event of presenting a minor or superficial complication of the surgical wound, clinical follow-up and weekly change of dressings were carried out until resolved. In the event of presenting a major or profound complication, surgical wound debridement was performed.

2.5. Statistical analysis

Data processing was carried out using Excel tools and XRealStats for Excel. Data analysis was performed for a confidence level of 95% and a power of 80% using SPSS V.20. The median and the ranges of the quantitative variables were described, as well as the absolute and relative frequencies of the categorical variables, given the non-parametric distribution of the data.

3. Results

42 patients were included in this study. The median age was 69 (range, 60–94) years. There was predominance of female gender 81% (34) and right laterality 55% (23). 31% (13) of the patients presented DM, 21.5% (9) smoking and other comorbidities (Table 1). 50% (21) presented dislocation fracture and trimalleolar fractures were predominant in 40% (17) of the cases (Fig. 6). The median time elapsed between the fracture and its surgical resolution was 10 (range, 2–21) days. The median glycosylated hemoglobin (HbA1c) was 6.65 (4.0–12.3) %. The median time used to perform the flap was 66

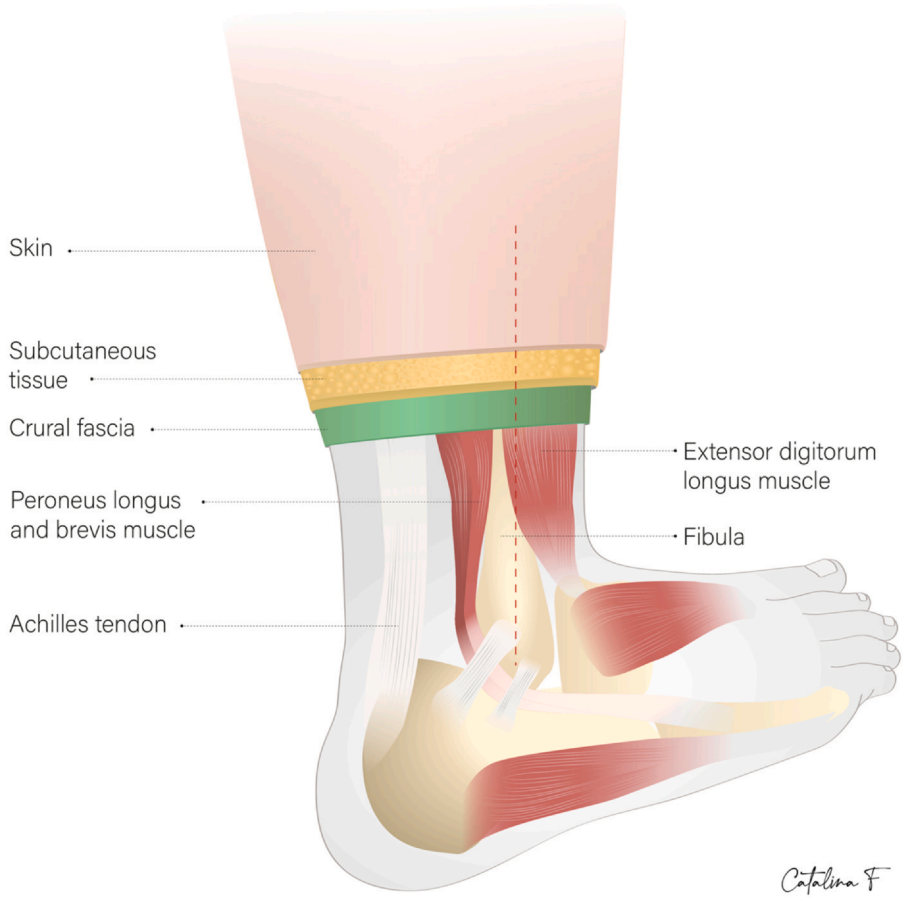

Fig. 1. Fasciocutaneous advancement dissection plane. Posterolateral view of a right ankle. Dotted line: lateral approach, from superficial to deep, skin (pink), subcutaneous tissue (yellow), crural fascia (green), peroneus longus and brevis muscle, extensor digitorum longus muscle.

(range, 38–360) seconds, the time per surgeon and the learning curve were shown in Figs. 7 and 8 respectively.

A 3.5 mm locking one-third tubular plate (DePuy Synthes®) was used in all patients. The plate was placed in a lateral position in 79% (33) and posterolateral in 21% (9). Syndesmal stabilization was performed in 81% (34). Median cost of osteosynthesis of the fibula was $313 (170–595) USD.

The prevalence of minor complications was 7% (3 patients) superficial surgical wound dehiscence (Fig. 9). There were no superficial infections. There was no skin necrosis.

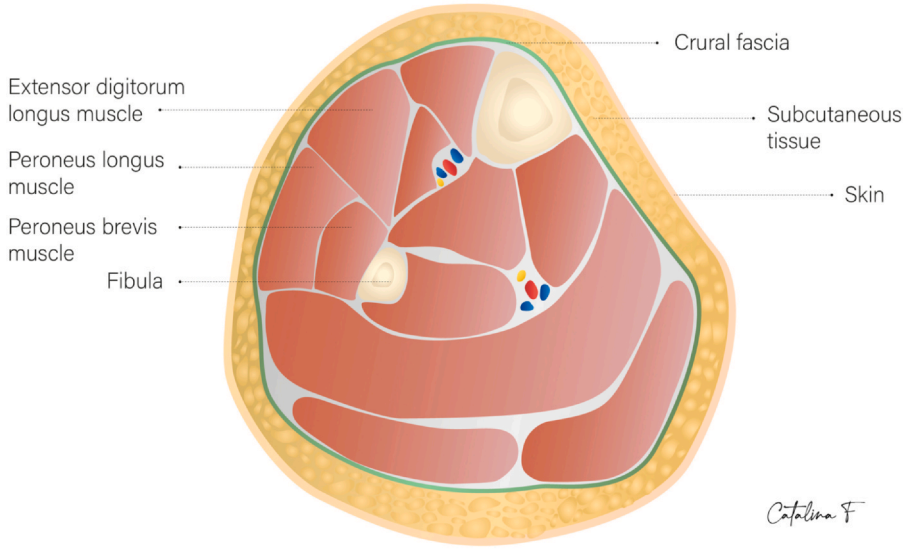

Fig. 2. Fasciocutaneous advancement dissection plane. Axial view of a right ankle. From superficial to deep, skin (pink), subcutaneous tissue (yellow), crural fascia (green), peroneus longus and brevis muscle and extensor digitorum longus muscle.

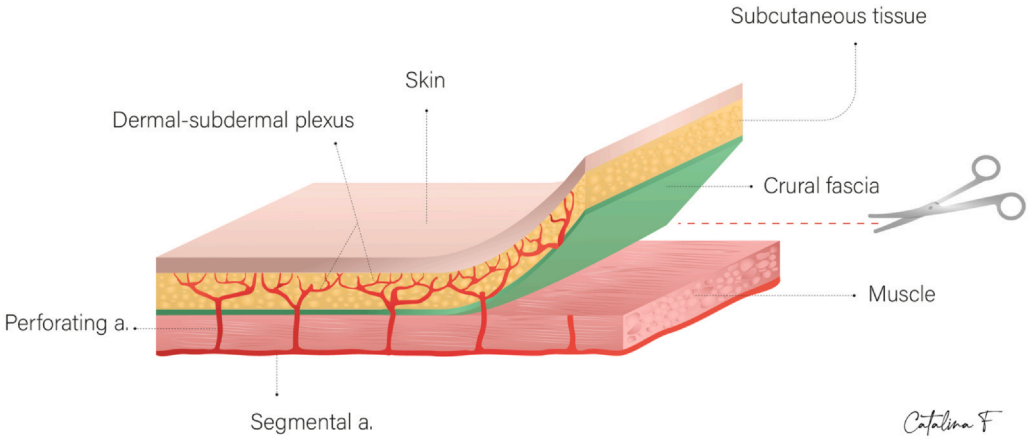

Fig. 3. Diagram of the fasciocutaneous advancement plane. Dotted line: metzenbaum scissors dissection plane. From superficial to deep, skin (pink), subcutaneous tissue (yellow), crural fascia (green) and muscle. The arterial irrigation from superficial to deep, dermal-subdermal plexus, perforating artery and segmental artery.

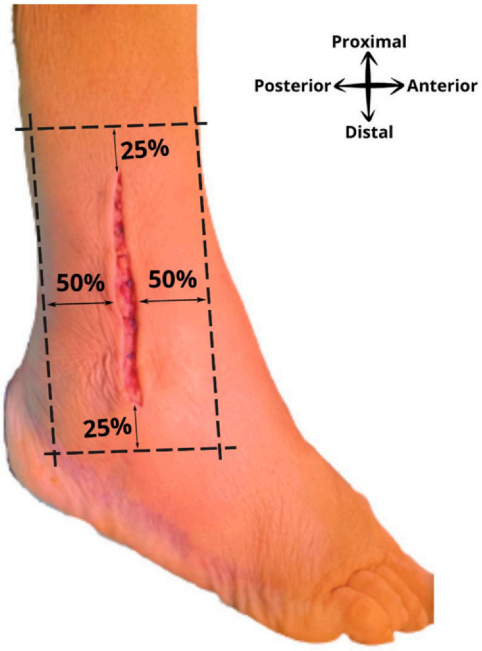

Fig. 4. Planning of the fasciocutaneous advancement dissection area. The skin, subcutaneous tissue and crural fascia of the leg should be dissected and lifted together. After performing the lateral approach, it is planned to dissected in the antero-posterior plane up to 50% of the length of the surgical wound and in the proximal-distal plane up to 25%.

Fig. 5. Intraoperative image and clinical follow-up of postoperative wound. Upper row, right ankle in a 65-year-old diabetic patient. Lower row, left ankle in a 61-year-old smoker. From left to right intra-operative images (A and E), and follow-up at 7 days (B and F), 21 days (C and G) and 42 days (D and H) postoperatively.

The prevalence of major complications was 0% deep surgical wound. There were no deep infections. Osteosynthesis failure was only observed in one case, at 7 weeks due to unauthorized early weightbearing, but there was no wound complication. This case was resolved using tibio-talar arthrodesis. There were no cases of non-union. There were no readmissions or reoperations due to the wound.

4. Discussion

Advancements of medicine have produced an increase in life expectancy and quality. Nowadays, it is increasingly common to find people over 60 who remain active and do sports [28]. Associated with this, it is common to see fractures in this age group, ankle fracture being the third most prevalent one [1].

Table 1
Demographics.

Patient Characteristics	Frequency (n)	Percentage (%)
Total patients	42	
Male	8	19.0
Female	34	81.0
Age, y		
Mean	70	
Median	69	
Smoking		
Smokers	9	21.5
Non-smokers	33	78.5
Comorbidities		
Hipertension	16	38.0
Diabetes	13	31.0
Cancer	1	2.4
Respiratory disease	1	2.4
Cardiovascular disease	1	2.4
Chronic Kidney disease	5	11.9

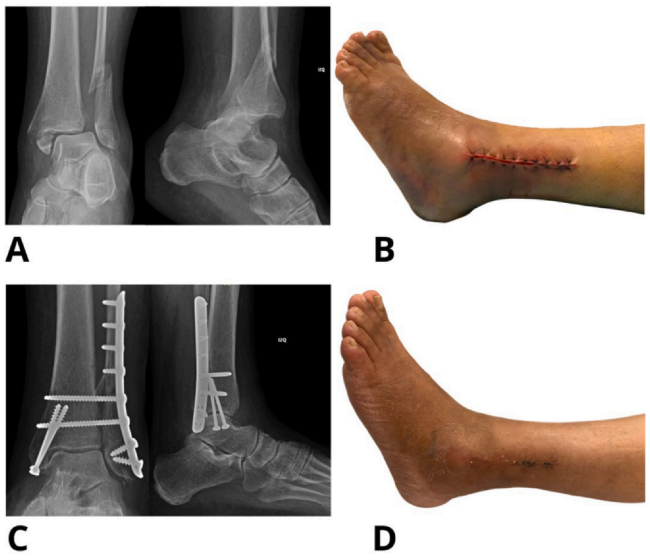

Fig. 6. Example of trimalleolar luxofracture of the left ankle in a 75-year-old smoker. A. Mortise and lateral views of the ankle on admission to the emergency department. B. Clinical follow-up of the operative wound at 7 days postoperatively. C and D. Follow-up at 42 days postoperative with weightbearing radiographs in mortise and lateral views of the ankle and clinical follow-up of the healed operative wound.

Surgery is an appropriate treatment option in patients with unstable ankle fractures because it allows early mobility of the injured limb and good functional results [29–31].

Despite all efforts displayed in the medical management of underlying pathologies, and the advances in surgical technique and implants, postoperative complications, particularly those of the surgical wound continue to be a problem in this type of population, which results in an economic cost for patients and health services [17,32].

The percentage of general complication of the surgical wound in older adults varies between 5% and 28.7% [14,16,17], depending on the type of technique used. In our series, 0% deep complications and 7% superficial complications (only wound dehiscence) were found, for which intervention was not required. In diabetic patients, complications can increase up to 43% [33–35]. However, in our series, where 31% (13/42) of the older adults were diabetic, complications of the wound were only found in 7.7% (1/13) of them. In their series of 186 ankle fractures, Zaghloul et al., [17] found 21.5% complications, from which 7% were superficial and 10.8% were major complications for which reoperation was required. Aigner et al., [14] in their series of 237 ankle fractures, found 28.7% complications, wound problems being the most frequent ones (delayed healing, superficial and deep infections). Bazarov et al., [36] obtained 25% dehiscence of the surgical wound using a minimally invasive technique (MIPO) in 44 patients over 60 years of age. Marazzi et al., [31] compared a series of 70 patients with ankle fractures with the MIPO versus the open technique, obtaining a 9% rate of complications of the surgical wound (infections and wound dehiscence).

In a meta-analysis of ankle fracture using fibula nail versus plate, Tas et al. [37] reported superficial and deep infections in 1% and 0.3% respectively for fibula nail, while Ashman et al.[38], in a series of 24 diabetic patients with ankle fractures operated with a fibula nail found wound complications in 16.7% and wound infections in 8.3%. More than half of them required surgical wound debridement.

It is important to consider that anatomic reduction of the fracture with MIPO plates or fibula nails is difficult and not always achieved. [2,14] That is why anatomical reduction of the fracture was performed and plate usage was chosen in our series with low complications comparable to minimally invasive techniques. It should be stressed that clinically accepted definitions of malunion are currently based on limited clinical evidence and perhaps there would be more conservative clinical thresholds for malunion [39].

The low soft tissue over-traction and tension-free skin closure may influence the low complications obtained, independent of the osteosynthesis position, in our series it should be noted that 79% were lateral plates, which did not mean a greater risk of complication of the surgical wound.

Although the simple fasciocutaneous flap advancement is considered a plastic surgery technique, it is defined from the point of view of the specialty as a fast, simple and safe technique, with a short learning curve [19–21]. This is confirmed in our series as the median completion of the simple fasciocutaneous flap in the two participating surgeons was of 80 s. Even though one of the surgeons was not senior, there were no significant differences when comparing the time used to perform the flap or its complications. The learning curve for the flap in our study is of 3 patients per each surgeon, regardless of the experience. This supports its easy acquisition. Nevertheless, we believe that it is necessary to be careful with the procedure and to perform the fasciocutaneous advancement deep to the fascia in order not to compromise the irrigation.

Greater economic cost is needed when managing complications of foot and ankle surgeries in older adult patients, [4] therefore efforts focused on reducing them can have a great impact. When evaluating the cost of surgery, there are differences depending on

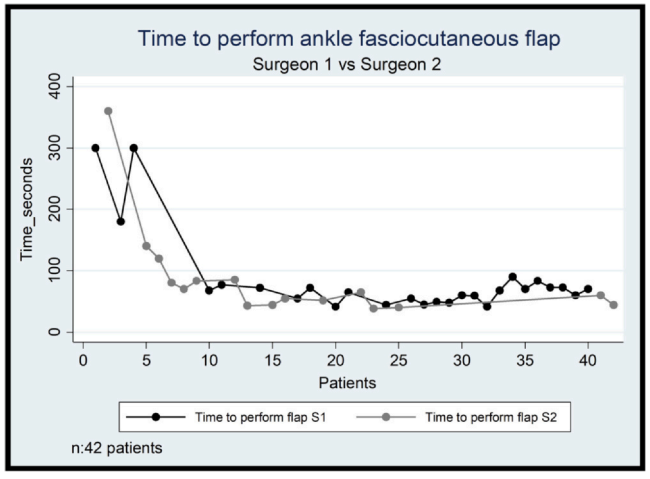

Fig. 7. Time required to perform fasciocutaneous advancement in the patients according to each surgeon. S1: surgeon 1; S2: surgeon 2.

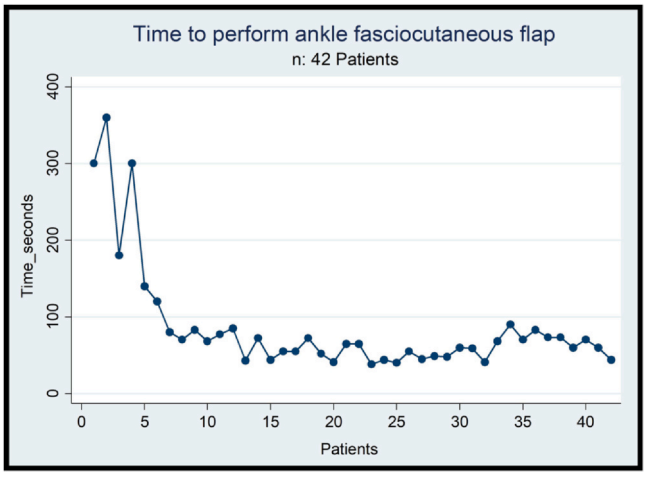

Fig. 8. Time required to perform fasciocutaneous advancement in the patients (learning curve).

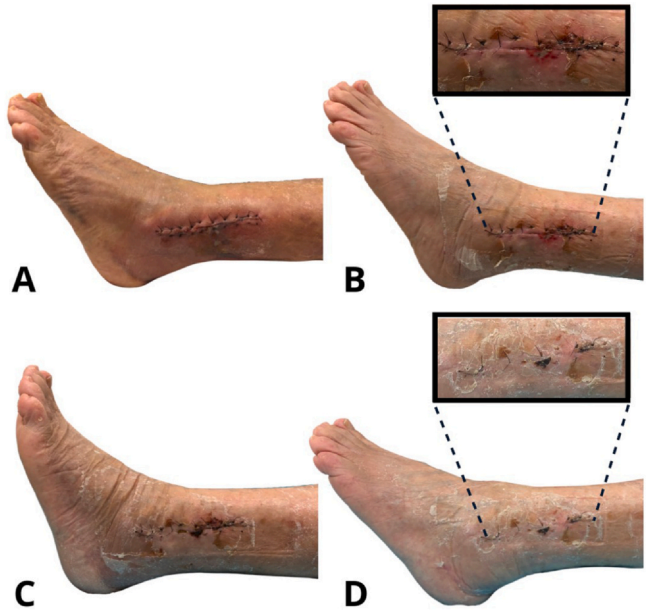

Fig. 9. Example of operative wound complication in an 83-year-old healthy institutionalized patient with bimalleolar luxofracture of the left ankle. Clinical follow-up of the operative wound in the 1st week (A), 3rd week (B) in which dehiscence of the operative wound is observed and weekly healing is started. At 4th week (C) and 6th week (D) the wound healed.

the osteosynthesis used. In our context, the fibula nail has an approximate cost of 1422 dollars, while the median cost of our construct with locked plate and screws was 397 dollars. This difference in the cost of the implant may be relevant in a case in which both techniques have low complication rates, therefore, a cost-economic study is needed to be confirmed.

Our study has limitations. First, the study design is a case series, and it does not have the power of a comparative study. Second, the study was conducted in a single center, which may affect its extrapolation. Third, Donati stitches were used, which, unlike running stitches, produce greater ischemia. This factor could have influenced our complications, especially when associated with poor adherence to postoperative instructions.

5. Conclusion

In this series of cases, the use of the simple fasciocutaneous advancement as an associated procedure in the initial surgical management of unstable ankle fractures in older adult patients with a high risk of surgical wound complications (diabetes mellitus and active smoking), had 0% profound complications of the wound, 7% superficial complications of the wound and 0% of reoperations due to complications of the surgical wound. Additionally, the fasciocutaneous advancement turned out to be technically simple, reproducible and cheap. However, comparative studies are required to support the use of the simple fasciocutaneous advancement as a management alternative in older adult patients at risk with ankle fracture.

Acknowledgements

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