Pretibial lacerations among elderly patients : A province-wide study from Kymenlaakso, Finland, 2015-2019

Seppälä, T.

2021-09

Seppälä , T , Grünthal , V & Koljonen , V 2021 , ' Pretibial lacerations among elderly patients : A province-wide study from Kymenlaakso, Finland, 2015-2019 ' , Journal of Plastic, Reconstructive & Aesthetic Surgery , vol. 74 , no. 9 , pp. 2244-2250 . https://doi.org/10.1016/j.bjps.2020.12.107

http://hdl.handle.net/10138/341406
https://doi.org/10.1016/j.bjps.2020.12.107

draft

Journal of Plastic, Reconstructive & Aesthetic Surgery xxx (xxxx) xxx

JPRAS
An International Journal of Surgical Reconstruction
www.JPRASurg.com

Pretibial lacerations among elderly patients: A province-wide study from Kymenlaakso, Finland, 2015-2019

T. Seppälä[a,*], **V. Grünthal**[a], **V. Koljonen**[b]

[a] *Department of Surgery, Kymenlaakso Central Hospital, Kymsote, Kotkantie 41, 48210 Kotka, Finland*
[b] *Department of Plastic Surgery, University of Helsinki and Helsinki University Hospital, Helsinki, Finland*

Received 20 October 2020; accepted 20 December 2020
Available online xxx

KEYWORDS
Plastic surgery;
Pretibial laceration;
Lower limb haematoma;
Traumatic wound;
Elderly

Summary In this retrospective cohort study, we analysed treatment and outcomes among ≥65-year-old patients who experienced a traumatic pretibial laceration in the province of Kymenlaakso, Finland, between 2015 and 2019. We reviewed computerised medical records for 116 patients with a pretibial laceration, 107 of whom we analysed in further detail. Patients were traced from injury to healing, including rehabilitation periods in health care centres. As expected, the majority of patients were elderly women (67%). Most lacerations were superficial and small, explaining why treatment was mostly conservative. Only 11 (9.48%) patients were treated operatively with surgical debridement or a split-thickness skin graft. The number of overall complications in wounds was high, with a complication rate of 30.2%. Most complications were local wound infections. We found that wound healing took more than 3 months in 32% of patients. Thorough patient tracing revealed numerous follow-up visits and long rehabilitative hospitalisation periods, indicating a significant decline in patient independence and the excessive use of resources. Successful wound healing was eventually observed in 89.66% patients. Furthermore, no terminology regarding pretibial lacerations was found in patient records. This study indicates that pretibial lacerations remain poorly recognised and understood in Finland.

Introduction

The term pretibial lacerations refers to acute traumatic wounds between the knee joint and ankle,[1] usually in the elderly population. Most pretibial lacerations are located in the anterior mid third, anterolateral, or mediolateral crus.[1]

Elderly women are overrepresented, possibly resulting from household work, wearing skirts that provide less protection for their legs, and a decrease in hormonal activity leading to early dermatoporosis.[1] Dermatoporosis, a chronic cutaneous fragility syndrome, is characterised by skin atrophy, caused by the decline of subcutaneous tissue, collagen formation, capillary circulation, and the dermal cell count in aging skin.[2]

Pretibial lacerations are caused by low-energy shredding and friction forces affecting the skin and subcutaneous tis-

* Corresponding author.
E-mail address: toni.p.seppala@helsinki.fi (T. Seppälä).

https://doi.org/10.1016/j.bjps.2020.12.107

Please cite this article as: T. Seppälä, V. Grünthal and V. Koljonen, Pretibial lacerations among elderly patients: A province-wide study from Kymenlaakso, Finland, 2015-2019, Journal of Plastic, Reconstructive & Aesthetic Surgery, https://doi.org/10.1016/j.bjps.2020.12.107

sue.[3] The term encompasses a wide range of injuries, from small linear, uncomplicated lacerations to severe degloving injuries.[4] Even a minor trauma, such as a collision with a walker-rollator, is sufficient to cause a pretibial laceration.[3,5] The most common trauma aetiologies for pretibial lacerations include falling, attempting to mount stairs, or hitting household and garden objects.[6,7]

Initially, in 2003, Dunkin et al. proposed a classification system for pretibial lacerations based on the treatment of such lacerations.[4] In the Dunkin classification, injuries are classified into four types, depending on the extent of tissue loss.[4] More recently, the original Dunkin classification was modified by Lo et al.,[8] who recommends categorising pretibial lacerations into five types, separating linear lacerations from flap lacerations and taking into account flap viability (vital vs. nonvital), flap loss, and lacerations with a subcutaneous haematoma.[8]

Patients with pretibial lacerations experience significant comorbidity and compromised independence.[3,9] Typically, these patients present with an extensive previous medical history, multiple comorbidities, and devices aiding mobility such as a walker-rollator. Patients are polymedicated and often live in a retirement home or at home with assistance.[10] In particular, anticoagulants and corticosteroids are associated with pretibial lacerations.[2,5,9,11] Distinctive comorbidities include dementia, diabetes, atherosclerosis, lower limb oedema, vascular disease, and dermatoporosis.[12,13]

Pretibial lacerations are common, with an incidence of up to 5.2/1000 emergency room (ER) patients[2,5,10,12] or 1 in 36 trauma admissions.[9] The incidence varies in the literature from 40 to 70/100 000 to 33/1000 population annually.[2,7,14] Previous studies found that pretibial lacerations carry an excessive mortality[9] and a significant financial impact, reaching up to £3500 per hospital admission.[5,14]

Social and Health Care Services in Kymenlaakso, Finland extends across a catchment area consisting of 170,500 residents. Kymenlaakso Central Hospital located in Kotka is a secondary 24-h on-call facility with plastic surgery services. The Kymenlaakso region also includes 14 healthcare centres and one smaller 24-h on-call centre in Kuusankoski without surgical facilities.

To the best of our knowledge, no previous studies on pretibial lacerations in Finland have been conducted. This study aims to review the pretibial lacerations occurring between 2015 and 2019, treated at Kymenlaakso Central Hospital and its surrounding healthcare centres.

Patients and methods

The Institutional Review Board of the hospital approved this retrospective chart review study and its protocol.

We performed an electronic search using the LifeCare® database of the Kymenlaakso Central Hospital for all patients treated in the central hospital or surrounding smaller healthcare centres for a traumatic lower leg wound beginning from 1 January 2015 through 31 December 2019. We searched for patients using the following ICD10 codes and surgical treatment procedural codes:

ICD10 codes:

S80.1 Contusion of other and unspecified parts of the lower leg
S81.8 Other superficial injuries of the lower leg
S81.9 Open wound of the lower leg, part unspecified
S85.8 Injury of other blood vessels along the lower leg level
S85.9 Injury of unspecified blood vessel along the lower leg level
S89.9 Unspecified injury of the lower leg
T14.0 Superficial injury of an unspecified body region
abrasion, blister (nonthermal), bruise, contusion, haematoma, injury from superficial foreign body (splinter) without major open wound, insect bite (nonvenomous), superficial injury
T14.5 Injury of the blood vessel(s) of an unspecified body region
T14.9 Injury, unspecified

Surgical procedure codes used in our patient search:

QDB00 Lower limb wound suturing
QDB05 Lower limb wound revision
QDB10 Lower limb wound dressing change
QDB99 Other lower limb wound suturing/dressing change
QDG20 Lower limb chronic wound revision
QDA10 Lower limb skin incision
ZZA00 Split skin graft, autograft
TQW11 Negative pressure wound therapy application

We included patients who were ≥65 years old, had a traumatic wound, laceration, contusion, or a haematoma with a skin defect along the lower leg. The anatomical location was defined as falling between the knee and ankle anteriorly, medially, or laterally.

The computerised medical records of patients included were reviewed in detail by one author (TS) and the data reviewed for each patient included their age, gender, independence, physical ability, the use of walking aid equipment, previous medical history, medications (specifically anticoagulation, per oral cortisone, and immunosuppressants), the injury mechanism, wound length, length of stay (LOS) in the hospital's plastic surgery ward, LOS in a healthcare centre ward, mortality, treatment (conservative or operative), complications, and outcome. If wound healing extended beyond three months (90 days), the wound was classified as chronic.[15,16] We also recorded the number of ER visits, follow-up visits with a physician, and any nurse consultations or appointments. Finally, we recorded additional traumatic lacerations before the pretibial laceration

Based on the medical record data and photographs obtained for the wounds, a modified Dunkin classification was established for each patient. We used the following description for the modified Dunkin classification: type I represented a simple linear laceration without skin loss; type II a laceration with a viable flap; type III a laceration with a nonviable flap; type IV a total skin loss; and type V a laceration with a subcutaneous haematoma.

The LOS was extracted from the electronic patient files, whilst the cause of death was determined from patient death certificates. We calculated the 3-month mortality rate from hospital admissions records. The Charlson comorbidity index (CCI) was calculated for each patient based on the diagnoses listed in the computerised medical records

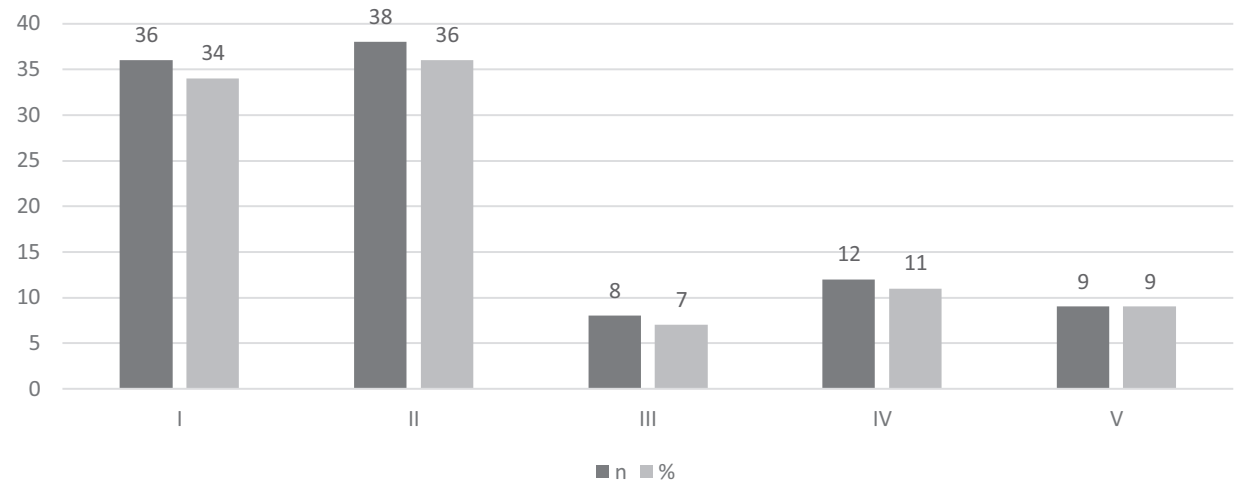

Figure 1 Patients stratified by their modified Dunkin classification in 103 patients.

using the following internet calculator: https://www.mdcalc.com/charlson-comorbidity-index-cci. For postoperative complications, we used the Clavien–Dindo classification.[17]

Results

The specific inclusion criteria yielded 116 patients. Table 1 summarises their detailed demographic data and wound-related data. Nine (7.76%) patients were from abroad or from other provinces and, thus, were lost to follow-up. This resulted in 107 patients available for a more thorough analysis. Briefly, we observed a slight female overrepresentation, with 67% women. The mean age for all patients was 79 years, ranging from 65 to 97 years. A total of 77 (66.4%) were self-sufficient or independent, and 51 (44%) patients used walking aid equipment. In addition, 61 (52.99%) patients had at least one additional traumatic laceration in their medical history before or after the pretibial laceration analysed.

Charlson comorbidity index

The CCI was calculated based on the medical records for 107 (92%) patients. The mean CCI was 5.64, ranging from 2 to 11 with a median of 5. Underlying conditions and medications known to affect the skin and subcutaneous tissue included anticoagulant medications in 67 (57.8%) patients, dermatoporosis in 64 (55.2%), and cortisone medications in 34 (29%) patients.

Wounds

The distribution of the wounds included 58 (50%) affecting the left, 56 (48.3%) the right, and 2 (1.7%) affecting both legs. In the patient files, sufficient information was found in 103 (88.79%) patients to determine the modified Dunkin classification (Figure 1). Wound length was recorded in 97 (83.62%) patients, finding in a mean length of 8.09 cm (range, 1–30 cm). Photographs were taken for the electronic files in 24 (20.69%) patients.

Modified Dunkin classification

The distribution of the modified Dunkin classifications was as follows: 36 (34.95%) patients had a type I linear laceration, 38 (36.89%) a type II, 8 (7.77%) a type III, 12 (11.65%) a type IV, and 9 (8.74%) a type V laceration. The median modified Dunkin classification was 2.

The injury mechanism was recorded in 100 (86.21%) patients, for whom falling on a flat surface was the most common, which was noted for 25 (21.55%) patients.

The term ‘pretibial laceration’ or ‘dermatoporosis’ did not appear at all in patient medical records during data extraction. Findings were described in a more commonplace manner, through phrases such as ‘wound of the shin/crus’ or ‘pergament-like skin’ in cases of obvious dermatoporosis.

Treatment

The majority of patients ($n = 95$; 81.90%) were discharged home from the Kymenlaakso Central Hospital ER or from a healthcare centre appointment. The mean number of ER visits due to the same laceration was 1.3 (range, 1–6) across 109 patients. Altogether, 21 (19%) patients had at least one readmission to the ER within 30 days of the initial injury, 5 (4.6%) had two ER readmissions, and 1 (0.9%) had three or more readmissions.

Figure 2 illustrates treatment in relation to wound classification. Most ($n = 109$; 93.97%) of the wounds were treated conservatively, of which 36 (33%) were type I, 38 (34.9%) type II, 8 (7.3%) type III, 10 (9.2%) type IV, and 5 (4.6%) type V lacerations. Among 15 (12.93%) patients, conservative treatment involved the use of negative-pressure wound therapy.

A total of 66 (56.90%) were treated using primary suturing of the wound without a scheduled follow-up, except for suture removal. Amongst these patients, 26 (39.4%) were

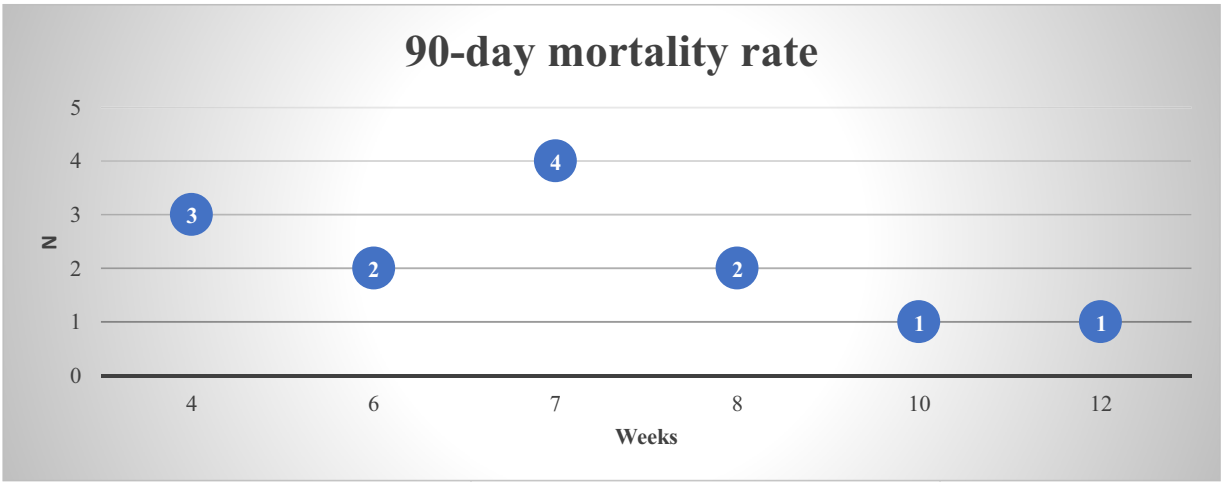

Figure 2 Ninety-day mortality, starting from the day of the admission.

type I, 31 (47.0%) type II, 4 (6.0%) type III, 3 (4.5%) type IV, and 2 (3.0%) type V lacerations.

A total of 11 (9.48%) patients received operative treatment. In 9 (81.8%) operatively treated patients, the use of negative-pressure wound therapy was involved. Furthermore, among operatively treated patients, 1 (9.1%) wound was primarily type I, but needed a revision due to infection, 1 (9.1%) type II, 0 (0.0%) type III, 4 (36.4%) type IV, and 5 (45.5%) type V lacerations. In addition, 6 (54.5%) patients were treated with a split-thickness skin graft, among whom 2 (33.33%) had a type IV and 4 (66.67%) had a type V laceration. Two patients did not consent to operative treatment despite a recommendation and their wound classification was undetermined. The average time from injury to surgery was 21.8 days (range, 2–70 days).

Only 25 (21.55%) patients received treatment via the plastic surgery ward. The mean LOS was 9.6 days in the plastic surgery ward (range, 1–51 days). Following primary hospitalisation, 13 (11.21%) patients needed treatment and rehabilitation in a healthcare centre ward. The mean duration of in-hospital stays in healthcare centres was 21.1 days (range, 0–86 days).

Complications

Overall, 35 (30.17%) complications were recorded, the most common of which included local wound infections (71.4%). More severe cellulitis-type infections or generalised infections were recorded for 9 (7.76%) patients. Only two patients undergoing operative treatment had a minor infection complication (i.e., Clavien–Dindo class 1).

Follow-up healing

Wound healing whether conservatively or operatively treated was tracked or monitored in 88 (75.86%) patients. The mean duration for follow-up was 75.16 days, ranging from 0 to 356 days. Wound healing took more than 3 months in 37 (31.90%) patients, requiring on average 3.4 (range, 0–13) physician visits or consultations and 18.9 (range, 0–200) nurse consultations or appointments including home visits. Successful wound healing was eventually observed in 89.66% of patients during a time period ranging from 0 to 356 days.

Mortality

Amongst all 107 patients, 13 died during the first three months following hospital admission. The mean age among deceased patients was 84.77 years (range, 70–90; Figure 3). The 90-day mortality rate was, thus, 12%. Altogether, 6 (46%) patients died at home or in a retirement home and 7 (54%) on a hospital ward. The cause of death was determined for 11 (85%) patients: 4 (30.7%) patients died of pneumonia, 4 (30.7%) from coronary artery disease, 2 (15.4%) from Alzheimer's disease, and 1 (7.7%) from kidney failure. All of these patients suffered a pretibial laceration 22–81 days earlier, with 12 (92.3%) patients experiencing unsuccessful wound healing before death.

Discussion

We reviewed 116 computerised medical records for patients who experienced a traumatic pretibial laceration, from which 107 patients were analysed in further detail. We found that the majority of patients were elderly women, consistent with previous studies.[2,9,10] Most lacerations were superficial and small, such that modified Dunkin types I and II lacerations accounted for 71.84% of all wounds, explaining why treatment was largely conservative. Only 11 (9.48%) patients were treated operatively with a split-thickness skin graft or surgical debridement, among whom 9 (81.8%) were classified as experiencing modified Dunkin type IV or V lacerations. The modified Dunkin classifications appeared to correlate with the specific treatment options selected (conservative or operative) for the lacerations. The number of complications in our cohort was high, with an overall complication rate of 30.2%. Most complications consisted of local wound infections, whilst severe infections consisting of cellulitis or systemic infections remained rare.

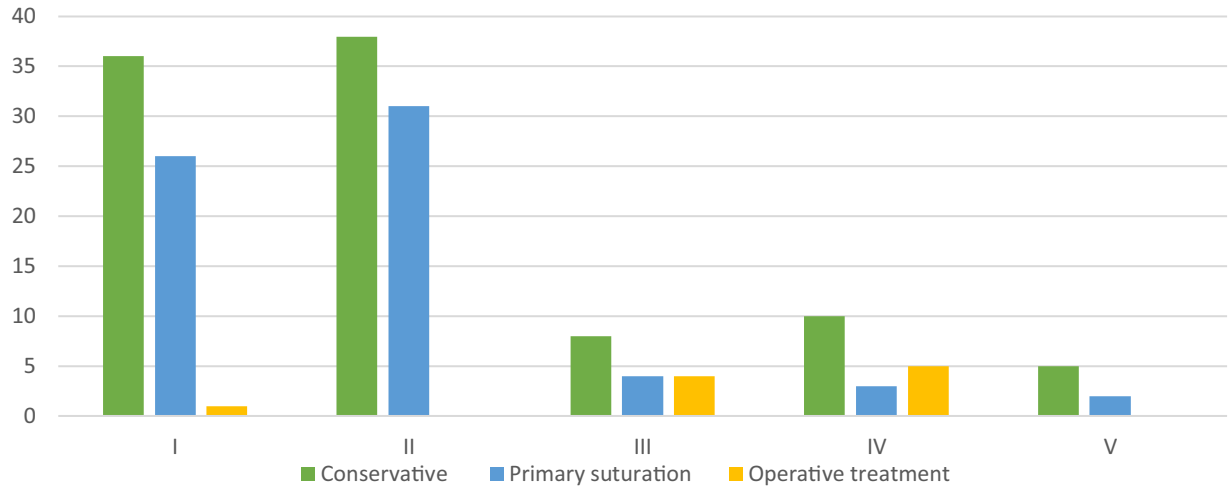

Figure 3 Treatment in relation to Modified Dunkin classification.

Comorbidities and medications were frequent in our cohort, although over half of the patients were self-sufficient or independent and less than 50% of patients used walking aid equipment. Nevertheless, the general incidence of patient independence may explain why LOS on the plastic surgery ward was relatively long, reaching a mean of 9.6 days and ranging from 0 to 51 days. Cahill et al. reported a LOS of 7.8 days for patients undergoing surgery.[10] In our cohort, patients who received further treatment and rehabilitation in a healthcare centre ward had a mean LOS of 21 days. Taken together, patients with pretibial lacerations appear at risk for long hospitalisations, possibly leading to a further decline in their independence.

The majority ($n = 66$, 56.90%) of lacerations were treated primarily with suturing. This included both linear and flap lacerations, despite recommendations in the literature against the use of primary suturing of flap lacerations given the increased risk for skin-edge necrosis.[18,19] What is particularly striking is that healthcare professionals appeared unfamiliar with the entire concept of pretibial lacerations and did not seem to regard pretibial lacerations as a distinct medical entity. No terminology related to pretibial lacerations or even dermatoporosis was found in the patient records we examined. This indicates that pretibial lacerations are poorly recognised and understood in Finland.

Mirroring the existing literature, we found that wound care takes place primarily in community-level healthcare centres by wound care nurses.[18] This leaves emergency department physicians not knowing the outcome of primary treatment,[18] possibly explaining why flap lacerations are sutured despite poor healing. It is known that without adequate wound care pretibial lacerations frequently become chronic.[2] In our study, wound healing extended beyond 3 months in 32% of patients. Follow-up care required multiple nurse appointments and the excessive use of wound healing products. Successful wound healing was eventually observed in 89.66% of patients. This, then, points to the need for studies regarding treatment methods that facilitate healing and lessen the number of follow-up visits required.

Our study constitutes a large cohort of patients compared to previous studies, cohorts ranging from 24 to 73 patients.[5,6,12,13,18] Larger trials on the treatment of pretibial injuries and prospective studies also remain limited.[6] We found only one randomised trial of 25 patients examining treatment methods for pretibial lacerations, which advocated skin grafting over primary flap defatting and closure.[20] Other results across treatment options vary and no consensus on treatment guidelines currently exist.[5,10] Some evidence supports operative treatment via skin grafting since conservative treatment for larger defects may take time.[19,20] Other studies recommend conservative treatment for comorbid elderly patients.[8]

The limitations of this study include its retrospective study design. We relied on data recorded for purposes other than research and, thus, reviewing and analysing clinical diagnostic impressions from medical records can limit the findings of our work. Furthermore, data related to the modified Dunkin classification were unavailable and we were forced to classify lacerations using the descriptions or photographs of wounds from the computerised patient medical records. The strength of this study lies in our ability to track a patient's rehabilitation accurately, thereby gaining a realistic understanding of pretibial laceration healing process. Thorough patient tracing revealed the numerous follow-up visits and long rehabilitative hospitalisation periods, indicative of significant declines in patient independence and the need for resources.

Treatment, LOS, and follow-up of pretibial lacerations require excessive healthcare resources as noted in previous studies[7]. Understanding that pretibial lacerations are prone to wound infections and prolonged healing, as well as associated with compromised independence could result in directing aid and preventive resources to these patients. This study can help raise awareness amongst healthcare professionals regarding pretibial lacerations. Preventing pretibial lacerations from happening in the first place may be highly advisable. This could be achieved, for example, by encouraging at-risk patients to wear clothing made with protective fabric.[7] In this study, a significant proportion of patients (52.9%) suffered or had suffered at least one addi-

Table 1 Demographic data of 116 patients with a pretibial laceration.

Gender	***N* (%)**
Female (%)	78 (67.24%)
Male (%)	38 (32.76%)
Mean age	**Years (range)**
All	79.30 (65-97)
Female	81.3 (65-97)
Male	75.2 (65-94)
Charlson comorbidity index	***N* (%)**
3	19 (17.8%)
7	18 (16.8%)
5	16 15.0%)
4	15 (14.0%)
6	13 (12.2%)
8	10 (9.3%)
9	6 (5.6%)
10	5 (4.7%)
2	4 (3.7%)
11	1 (0.9%)
Previous medical conditions	***N* (%)**
Hypertension	88 (75.86%)
Dermatoporosis	64 (55.17%)
Lower limb oedema	37 (31.90%)
Cognitive impairment	35 (30.17%)
Autoimmune disease	30 (25.86%)
Asthma	27 (23.28%)
Atherosclerosis	26 (22.41%)
Congestive heart failure	25 (21.55%)
Diabetes	20 (17.24%)
Kidney insufficiency	16 (13.79%)
Cancer	16 (13.79%)
Hypothyreosis	15 (12.93%)
Rheumatoid arthritis	12 (10.34%)
Peripheral vascular disease	7 (6.03%)
Chronic venous impairment	6 (5.17%)
COPD	6 (5.17%)
Polymyalgia rheumatica	5 (4.31%)
Pacemaker	4 (3.45%)
Epilepsy	4 (3.45%)
Pulmonary fibrosis	3 (2.59%)
Sarcoidosis	3 (2.59%)
Liver cirrhosis	2 (1.72%)
Cardiomyopathy	1 (0.86%)
Polycythaemia vera	1 (0.86%)
Parkinson's disease	1 (0.86%)
Laterality of injury	***N* (%)**
Left	58 (50.00%)
Right	56 (48.28%)
Bilateral	2 (1.72%)
Mean wound size	**cm/cm^2 (range)**
Length	8.9 (1-30)
Area	38 (1-200)

(*continued on next page*)

Table 1 (*continued*)

Aetiology of injury	***N* (%)**
Falling on flat ground	25 (21.55%)
Stumbling during outdoor work	17 (14.66%)
Stumbling in the bathroom or sauna	14 (12.07%)
Hitting an object	14 (12.07%)
Stumble upon a walker-roller or wheelchair	12 (10.34%)
Stumble upon furniture	12 (10.34%)
Stumble upon or falling from the stairs	12 (10.34%)
Hitting a car door	9 (7.76%)
Falling from a bed	4 (3.45%)
Falling from a wheelchair	4 (3.45%)
During a boat ride	4 (3.45%)
Bumping into or falling with a bicycle	3 (2.59%)
During construction work	3 (2.59%)
Injured by a pet or animal	1 (0.86%)
Treatment	***N* (%)**
Conservative	109 (93.97%)
Operative	11 (9.48%)
Split thickness skin graft	6 (5.17%)
Mean length of hospital stay	**Days (range)**
Local health care centre ward	21.1 (1-86)
Plastic surgery ward	9.62 (1-86)
Mean number of follow-up visits	***N* (range)**
Nurse wound care appointments	18.90 (0-200)
Physician appointments/ consultations	3.3 (0-13)

tional traumatic laceration during the time period examined, emphasising the need for preventive measures. Future studies should focus on treatment for and calculating the accurate costs of pretibial lacerations.

Declaration of Competing Interest

Each author declares no financial conflict of interest regarding the data presented in this manuscript.

Funding

Funding for the research presented in this article was received from departmental sources only.

Ethical approval

The local ethics review board has approved the study protocol.

References

1. Beldon P. Haematoma: assessment, treatment and management. *Wound Essentials*, 6; 2011. p. 36-9.

2. Hili S, Wong MKY, Stephens MP. Pretibial lacerations. *Br J Hosp Med* 2017;**78**(11):5.
3. Strazzieri-Pulido KC, Peres GRP, Campanili TCGF, de Gouveia Santos VLC. Incidence of skin tears and risk factors: a systematic literature review. *J Wound Ostomy Continence Nurs* 2017;**44**(1):29–33. doi:10.1097/WON.0000000000000288.
4. Dunkin CSJ, Elfleet D, Ling C, Brown TPLH. A step-by-step guide to classifying and managing pretibial injuries. *J Wound Care* 2003;**12**(3):109–11. doi:10.12968/jowc.2003.12.3.26473.
5. Singh P, Khatib M, Elfaki A, Hachach-Haram N, Singh E, Wallace D. The management of pretibial lacerations. *Ann R Coll Surg Engl* 2017;**99**(8):637–40. doi:10.1308/rcsann.2017.0137.
6. Glass GE, Jain A. Pretibial lacerations: experience from a lower limb trauma centre and systematic review. *J Plast Reconstr Aesthet Surg* 2014;**67**(12):1694–702. doi:10.1016/j.bjps.2014.08.001.
7. Swee T.T. Journal of the New Zealand Medical Association, 13-March-2009, Vol 122 No 1291. Pre-tibial_letter.pdf.
8. Lo S, Hallam MJ, Smith S, Cubison T. The tertiary management of pretibial lacerations. *J Plast Reconstr Aesthet Surg* 2012;**65**(9):1143–50. doi:10.1016/j.bjps.2011.12.036.
9. Rees LS, Chapman T, Yarrow J, Wharton S. Long term outcomes following pretibial injury: mortality and effects on social care. *Injury* 2008;**39**(7):781–5. doi:10.1016/j.injury.2007.08.025.
10. Cahill KC, Gilleard O, Weir A, Cubison TCS. The epidemiology and mortality of pretibial lacerations. *J Plast Reconstr Aesthet Surg* 2015;**68**(5):724–8. doi:10.1016/j.bjps.2015.01.011.
11. Karthikeyan GS. Simple and safe treatment of pretibial haematoma in elderly patients. *Emerg Med J* 2004;**21**(1):69–70. doi:10.1136/emj.2003.005801.
12. Vasdeki D, Naji S, Kelsey C, Khan IU. Management of pretibial lacerations: how patients' well-being is affected by their management. *Trauma* 2016;**18**(4):255–60. doi:10.1177/1460408616638688.
13. Galán-Olleros M, Valle-Cruz JA, García-Coiradas J, et al. Tension subcutaneous haematomas associated with anticoagulants in the elderly: do they have earlier morbidity and mortality than hip fractures? *Rev Esp Cir Ortopédica Traumatol Engl Ed* 2019;**63**(5):361–9. doi:10.1016/j.recote.2019.06.001.
14. Thomson WL, Pujol-Nicolas A, Tahir A, Siddiqui H. A kick in the shins: the financial impact of uncontrolled warfarin use in pre-tibial haematomas. *Injury* 2014;**45**(1):250–2. doi:10.1016/j.injury.2012.07.007.
15. Agale SV. Chronic leg ulcers: epidemiology, aetiopathogenesis, and management. *Ulcers* 2013;**2013**:1–9. doi:10.1155/2013/413604.
16. Kahle B, Hermanns H-J, Gallenkemper G. Evidence-based treatment of chronic leg ulcers. *Dtsch Aerzteblatt Online* 2011 Published online. doi:10.3238/arztebl.2011.0231.
17. Clavien PA, Barkun J, de Oliveira ML, et al. The Clavien-Dindo classification of surgical complications: five-year experience. *Ann Surg* 2009;**250**(2):187–96. doi:10.1097/SLA.0b013e3181b13ca2.
18. McClelland HM, Stephenson J, Ousey KJ, Gillibrand WP, Underwood P. Wound healing in pre-tibial injuries – an observation study. *Int Wound J* 2012;**9**(3):303–10. doi:10.1111/j.1742-481X.2011.00884.x.
19. Wound Essentials Vol 3 2008. wound-essentials-3-pretibial-injuries-assessment-and-management.pdf.
20. Haiart DC, Paul AB, Chalmers R, Griffiths JMT. Pretibial lacerations: a comparison of primary excision and grafting with "defatting" the flap. *Br J Plast Surg* 1990;**43**(3):312–14. doi:10.1016/0007-1226(90)90078-E.