Who Ya Gonna Call?
To Get Started on Research

Nicole Cates, DPM, AACFAS

Tommy Saing, DPM, Moderator
Presenter Disclosures

Nicole Cates, DPM, AACFAS
Nothing to disclose

Tommy Saing, DPM
Nothing to disclose
Overview

- Why get involved in research?
- Where are we as a field?
- Staying up to date
- How to get started
- How to actually do research
Why get involved in research?

For the profession
- Increase knowledge base
- Make us all better physicians
- Parody with other specialties

Personally
- Fellowship / Jobs
- Speaking opportunities
- Consulting
Join Me at The National

Nicole K. Cates, DPM, AACFAS

Techniques for Posterior Malleolar Fractures in Trimalleolar Equivalent

ACFAS Vegas SCIENTIFIC CONFERENCE

ST MARY'S MEDICAL CENTER PRESENTS

PODIATRIC MEDICINE & SURGERY SYMPOSIUM

HOSTED BY: LAURENCE ELOFF, DPM & MATTHEW DOYLE, DPM, MS

DLS 2022 celebrates International Women's Day 2022!

International Women's Day is a global day celebrating the social, economic, cultural, and political achievements of women. We are proud and grateful to these internationally recognized faculty members for being a part of what makes the Diabetic Limb Salvage conference so successful!

Karen Kim Evans, MD
Medstar Georgetown University Hospital
Washington, D.C.

Nicole Cates, DPM
Hand and Microsurgical Medical Group
San Francisco, CA

Janet D. Corney, MD, FFAOBS
Sine Hospital of Baltimore
Baltimore, MD

Frances Green, NDH
Royal Derby Hospital
University Hospitals of Derby and Burton NHS Foundation Trust
Derby, United Kingdom

Cafill B. Zirik, DPM
Medstar Georgetown University Hospital Georgetown University Medical Center Washington, D.C.
Where are we as a field?

• Podiatry Database Registry
• Mentorship program
• Annual ACFAS Clinical & Scientific Research Grant
Podiatry Database Registry

Clinical Data Registries Play Crucial Roles

Registry Purposes
- Quality improvement
- Benchmarking
- Clinical research
- Clinical effectiveness
- Cost effectiveness
- Device surveillance
- Treatment surveillance
- Population surveillance

Registry Uses
- Decision support
- Guideline development
- Measure development
- Regulatory and public reporting (MACRA/MIPS, QCDR)
- Value-based reimbursement and payment
- Patient engagement
- Post-market surveillance
- Registry-based clinical trials
- Education development
- Certification and accreditation
Mentorship Program

• Develop a network of seasoned researchers who will function as mentors to young members within the ACFAS committee.
Annual ACFAS Clinical & Scientific Research Grant

$25,000 Grant
New researchers

Applications for the ACFAS Clinical & Scientific Research Grant are now open!

Thanks to support from PICA and the ACFAS Regions, the College will again be offering funding of up to $75,000 for an established investigator and $25,000 for a new researcher.

Important Dates
Letters of intent were due September 15 at 5:00 pm CT.
Final applications must be received by October 15 at 5:00 pm CT.
Awards will be announced in December and funding will be provided in January 2023.

How to Apply
All applications must follow a modified NIH P20 format. The principal investigator (PI) must be a member of ACFAS in good standing. Fellows and residents may not serve as PI. Applicants must identify if they are seeking an established investigator award or new researcher award. Generally speaking, established investigators will have a history of prior funding and publications.

https://www.acfas.org/research-publications/research-resources/acfas-clinical-scientific-research-grant
Staying up to date

• Journals
• Virtual Journal Clubs
• Podcasts
• Residencies Academics
As part of ACFAS' live educational events designed to help teach the A to Zs of research, please join us monthly for the ACFAS Virtual Journal Club series, brought to you by the ACFAS Research Committee.

Each 60-minute session is hosted and presented by research experts from fellowship programs with ACFAS status. The ACFAS Virtual Journal Club is open to all students and residents and will review noteworthy articles on pertinent topics of research.

**Upcoming Virtual Journal Club Sessions**

**TARs**

**Thursday, January 19 | 7:00 pm CT**

Host: Pennsylvania Intensive Lower Extremity Fellowship

Fellowship Director: Jason R. Miller, DPM, FACFAS and Krista Kotzeva, DPM

The following articles will be presented:

- Age-Related Outcomes in Total Ankle Arthroplasty: An Analysis of 112 Patients, Cottom 2020
- Effect of age on outcome and revision in total ankle arthroplasty, Gaugler 2020
- Total Ankle Arthroplasty Survivorship, Complication, and Revision Rates in Patients Younger Than 55 Years, Censul 2022

Register
Podcasts

- Podcasts
- ACFAS On Demand
- Foot & Ankle International
Student Research Lecture Series

2022

Key
Neurocognitive Impairments and Pain Processing
Western University College of Podiatric Medicine, Student Club President: Antwan Al-Awadi, DPM, ’24
AFCAS Regions/Case Speaker: Thomas Matt, DPM, AACFAS
AFCAS Research Committee Volunteer: Todd Butler, DPM, AACFAS

April
Arthritis Analysis
New York University College of Podiatric Medicine, Student President: Maria Pina, DPM, ’23
AFCAS Regions/Case Speaker: Michael Holman, DPM, AACFAS
AFCAS Research Committee Volunteer: Elizabeth Arman, DPM, AACFAS

March
Survey Studies
Box Bowman University School of Podiatric Medicine, Student President: Erika Brown, DPM, ’21, Research Associate, ’21
AFCAS Regions/Case Speaker: Troy Reed, DPM, AACFAS
AFCAS Research Committee Volunteer: Colin Brown, DPM, AACFAS

February
Methods and Systematic Reviews
Type CFT
View Recording

New York College of Podiatric Medicine, Student President: Nancy Leo, DPM, ’21
AFCAS Regions/Case Speaker: Josephine Silver, DPM, AACFAS
AFCAS Research Committee Volunteer: Beth Gersh, DPM, AACFAS

January 31
Literature Review
Type CFT
View Recording

Arizona College of Podiatric Medicine, Student Club President: Shailly Mhatre, DPM, ’21
AFCAS Regions/Case Speaker: John J. Anderson, DPM, AACFAS
AFCAS Research Committee Volunteer: James Connors, DPM, AACFAS

2021

November 27
Contacting a Retrospective Study
Type CFT
View Recording

Henry University School of Podiatric Medicine, Student Club President: Adama Moustacte, DPM, ’23
AFCAS Regions/Case Speaker: Bradley Lane, DPM, AACFAS
AFCAS Research Committee Volunteer: Nicole Coyle, DPM, AACFAS

October 19
IRB Protocols and Ethics
Type CFT
View Recording

New York College of Podiatric Medicine, Student Club President: Gregory Base, DPM, ’23, and Paul Almeida, ’23
AFCAS Regions/Case Speaker: Robert Proctor, DPM, AACFAS
AFCAS Research Committee Volunteer: Elizabeth Arman, DPM, AACFAS

September 16
Presenting a Research Topic
Type CFT
View Recording

Temple University School of Podiatric Medicine, Student Club President: Emily Kaye-Carlson, DPM, ’23
AFCAS Regions/Case Speakers: Andrew Negr, DPM, FNAPAS and B. Scott Hanley, DPM, FNAPAS
AFCAS Research Committee Volunteer: Elizabeth Arman, DPM, AACFAS

https://www.acfas.org/student-resources/student-research-lecture-series
Type of Publications

- Technique papers
- Case Report / Case Series
- Reviews - *Student Research Lecture Series*
  - Systematic Reviews
  - Metanalyses
- Original Research - *Student Research Lecture Series*
  - Retrospective
- Perspectives - *Student Research Lecture Series*
Technique Papers

• Abstract
  • Discussion the topic (standard approach), why the new technique is relevant (easier technique, less complications), review the new technique

• Introduction
  • Traditional approach review, pitfalls, last paragraph briefly introduce new technique

• Technique
  • Step by step outline of how it is performed
    • Optional: Case Example

• Discussion
  • Benefits of new technique, review of any pertinent literature, limitations, conclusion

• Figures
Case Reports and Series
The Vertical Contour Calcanectomy, an Alternative Approach to Surgical Heel Ulcers: A Case Series

Nicole K. Cates, DPM1, Kaibhua Wang, DPM1, Jered M. Stowers, DPM1, Christopher E. Attinger, MD2, Paul J. Kim, DPM, MS, FACFAS2, John S. Steinberg, DPM, FACFAS2

1 Resident Physician, Department of Plastic Surgery, MedStar Georgetown University Hospital, Washington, DC, USA
2 Attending Physician, Department of Plastic Surgery, MedStar Georgetown University Hospital, Washington, DC, USA

Abstract

Heel ulcers have a significant impact on lower-extremity morbidity and confer high risk of major amputations. Treating these ulcers is difficult because of poor tissue coverage and the bony ex calcis, often leading to proximal amputation. This case series shows the vertical contour calcanectomy (VCC) as a surgical alternative in functional limb salvage. Sixteen feet (14 patients) with recalcitrant heel wounds who underwent VCC were identified. The minimum follow-up time for inclusion was 1 year. Body mass index, diabetes, renal disease, peripheral vascular disease, lymphedema/venous insufficiency, smoking status, Charcot, amputation, vascular intervention, wound recurrence, reoperation rate, and ambulatory status were evaluated. The average follow-up time was 27.3 months (range 13.5 to 51.1). At 1 year of follow-up, 56% of heel wounds (9 of 16) treated with the VCC remained closed. An average of 1.44 subsequent surgeries were required per patient. Baseline or improved ambulatory status was achieved in 68% of patients (9 of 14) at 1-year follow up and 100% of patients (8 of 8) at 2-year follow up. The overall rate of major amputation was 10%. The long-term ambulatory status of patients treated with the VCC shows promise. The VCC should be considered as an alternative, reliable, surgical limb salvage tool for heel ulcerations.
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Case Series: Introduction

• Background Literature Review
  • Literature overview of the problem and traditional techniques

• Introduce Case series
  • Literature pitfalls with traditional methods
  • Introduce case study technique

• Introduce the Cohort
  • Primary aim +/- secondary aim
  • Outcomes overviews
  • Hypothesis of results

Plantar heel ulcers are notoriously difficult to treat because of plantar pressures, prevalence of infection/osteomyelitis, tenuous vascular supply, and neuropathy in patients with high-risk medical comorbidities (1). Increased posterior pressures in bed-bound patients and increased plantar pressure during ambulation decrease wound healing ability, especially in patients with complex comorbidities (2). In the lower extremity, the heel is the most common location for pressure ulceration, and the second most common in the body (3). The effects of heel ulcerations on patient function are devastating. Diabetic foot ulcerations are the number 1 cause of below-the-knee amputation (BKA) from nontraumatic causes (4). Decubitus heel ulcerations increase mortality by 2.81 times for in-hospital patients (5). With an expanding population of obese patients, the difficulty in treating heel ulcers and the rate of heel ulcerations is increasing (6).

Heel ulcerations are further complicated by the presence of infection and osteomyelitis. Calcaneal osteomyelitis accounts for 7% to 8% of all osteomyelitis in adults (7). In cases of necrotizing soft tissue infection and sepsis, a proximal amputation is often required (1, 8). Osteomyelitis in the calcaneus can increase the odds of a major amputation by 15 times, although extension of the ulcer to the calcaneus does not definitively indicate osteomyelitis (1, 9). Eradication of the infection is indicated; however, a dead space can result from aggressive curettage of the calcaneus and can increase the recurrence of the infection (10).

With the prevalence of peripheral artery disease in this patient population, regardless of other compounding ulcer etiology, vascular intervention is often necessary. Shah et al (11) showed limb salvage rates of 86% at 5 years for diabetic patients with heel ulcerations treated with revascularization. Although vascular intervention can address large vessel disease, microvascular disease often present in patients with advanced diabetes is exceedingly difficult to treat. The effects of microvascular disease are pronounced in wound healing and peripheral sensation (12). This cascade of microvascular disease, and in turn, the sensory deficits, can lead to higher plantar pressures and shear forces, which result in ulceration (13).

To address a lack of evidence-based options between partial calcaneectomy and major lower-extremity amputation, the vertical contour calcaneotomy (VCC) was introduced (2). With the ultimate goal of functional limb salvage, the VCC provides a functional alternative to the traditional partial calcaneotomy while avoiding or delaying major lower-extremity amputation in cases of heel ulcerations. The VCC is a modification of the partial calcaneotomy that provides a consistent approach and reproducibility. The long-term outcomes of the VCC as a treatment for recalcitrant heel ulcerations with and without osteomyelitis are unknown at present.

The primary aim of the present study is to analyze the outcomes of patients who underwent a VCC procedure because of plantar heel ulceration with a minimum of 1-year follow up. The outcomes included number of postoperative surgeries, major lower-extremity amputation, 30-day readmission rates (related to the lower extremity only), mortality, and ambulatory status. The VCC, in theory, has the ability to maintain ambulation in patients that would have otherwise lost a limb to amputation.
Case Series: Patients & Methods

- **Methods**
  - IRB approval & dates of patient collection
  - How patients were identified: CPTs / ICD-10s
  - Specific criteria for inclusion/exclusion
  - Total patients in study

- **Demographics**
  - List & define all information collected
    - Preoperative factors
    - Postoperative outcomes

- **Statistical analysis**
  - Specifics on how statistical analysis was performed

**Patients and Methods**

The study was approved by Georgetown University Hospital Institutional Review Board. We performed a comprehensive chart and radiographic review of all patients who underwent a VCC from March 2014 to July 2016 using Current Procedural Terminology code 28120 (partial saucization of bone, calcaneus), querying the records of 3 of the authors (C.E.A., P.J.K., and J.S.S.). All radiographs were evaluated by physicians to confirm the VCC technique was used. The patients in the cohort were treated over a 2.4-year period (year to year) by the Georgetown Limb Salvage team for acute or chronic heel wounds. Patients were treated on an outpatient basis or admitted to the Georgetown Limb Salvage team for treatment of lower-extremity infection and/or ischemic changes. Patients had surgical debridement before VCC based on need to eradicate infection determined by clinical signs of infection and postoperative cultures. VCC and closure were performed after eradication of infection, and vascular optimization was ensured. Patients were excluded from the cohort if they were <18 years of age, had <1 year postoperative follow-up, were treated with nonsurgical management, or did not have a VCC performed. With the above exclusion criteria, 14 patients (16 limbs) were included in the cohort.

Demographic data collection included age, body mass index, diabetes mellitus, Charcot neuroarthropathy, renal disease (including chronic kidney disease and end-stage renal disease), peripheral vascular disease, transplant history, coronary artery disease, cancer history, human immunodeficiency virus history, autoimmune disease history, and smoking history (current or former). Additionally, data were collected on whether the patient preoperatively had an angiography and angiography intervention, whether the patient had preoperative osteomyelitis (based on bone biopsy), the length of time in days with heel ulceration before VCC, and contralateral amputation. Operative data included number of surgical debridements before VCC, whether primary closure was performed, and number of surgeries to closure after VCC. Postoperative data on number of surgeries post-VCC, whether major lower-extremity amputation (defined as BKA, knee disarticulation, or above-the-knee amputation [AKA]) was performed, 30-day readmission rate (related to lower extremity only), and mortality. Data on ambulation status was collected and categorized into full weightbearing, partial weightbearing, and non-weightbearing before surgery and after surgery at 1, 2, and 3 years.

For statistical analysis, descriptive statistics were used to describe study subjects. Continuous variables were described by means, mode, and range (minimum–maximum).
Case Series: Results / Tables

• Demographics of cohort

  • **Results**: 1st paragraph~ Type out all demographics from table 1

  • **Table 1**: list demographics
    - Categorical variables: % (n/N)
    - Ex: Diabetes: 85.7% (12/14)
    - Continuous variables: mean(range)
    - Ex: Age 63.8 (51 to 86)

• Preoperative factors / operative techniques / postoperative outcomes

  • **Results**: List all data in paragraph form

  • **Tables**: List all data, using same categorical & continuous variables structure

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### Results

Overall demographics data is presented in Table 1. There were 14 patients and 16 limbs in the cohort. The mean age at the time of VCC was 63 ± 4 years (range 51 to 86). Male 5/14. The mean body mass index was 30 ± 5 kg/m² (range 22 to 32). Male 5/14. The prevalence of diabetes was 86.7% (12/14), Chronic obstructive pulmonary disease (COPD) 21.4% (3), and osteoporosis 21.4% (3). DIABETES MELLITUS type 2 (n=12/14).

#### Table 1: Demographics of patients who underwent vertical contour correction (N=14 patients)

<table>
<thead>
<tr>
<th>Age (yrs)</th>
<th>63.8 (51 to 86)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Body mass index (kg/m²)</td>
<td>14.2 (3)</td>
</tr>
<tr>
<td>Diabetes</td>
<td>n=9 (64.3)</td>
</tr>
<tr>
<td>Chronic obstructive pulmonary disease</td>
<td>n=3 (21.4)</td>
</tr>
<tr>
<td>Renal disease</td>
<td>n=5 (35.7)</td>
</tr>
<tr>
<td>Previous Vascular Injury</td>
<td>n=8 (57.1)</td>
</tr>
<tr>
<td>Transplant</td>
<td>n=1 (7.1)</td>
</tr>
<tr>
<td>CAD</td>
<td>n=3 (21.4)</td>
</tr>
<tr>
<td>Gastrointestinal</td>
<td>n=3 (21.4)</td>
</tr>
<tr>
<td>HIV</td>
<td>n=1 (7.1)</td>
</tr>
</tbody>
</table>

Abbreviations: CAD, coronary artery disease; CKD, chronic kidney disease; ESRD, end-stage renal disease; HIV, human immunodeficiency virus; PD, peripheral vascular disease.

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### Table 2: Operative considerations and outcomes of 16 lower extremities undergoing VCC (N=14 patients)

<table>
<thead>
<tr>
<th>Procedure</th>
<th>Number (% total)</th>
<th>Mean (range)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Renal transplant</td>
<td>3 (21.4)</td>
<td>14.2 (3)</td>
</tr>
<tr>
<td>Carotid endarterectomy</td>
<td>3 (21.4)</td>
<td>73 (1/14)</td>
</tr>
<tr>
<td>Limb salvage</td>
<td>8 (57.1)</td>
<td>80 (5/114)</td>
</tr>
<tr>
<td>Endovascular intervention</td>
<td>3 (21.4)</td>
<td>31.3 (5/18)</td>
</tr>
<tr>
<td>Open operative</td>
<td>5 (35.7)</td>
<td>50 (5/14)</td>
</tr>
</tbody>
</table>

### Table 3: Demographics of patients who underwent vertical contour correction (N=16 patients)

<table>
<thead>
<tr>
<th>Ambulatory Status</th>
<th>Preoperative (n=14)</th>
<th>Postoperative (n=14)</th>
</tr>
</thead>
<tbody>
<tr>
<td>With weight-bearing</td>
<td>10 (71)</td>
<td>10 (71)</td>
</tr>
<tr>
<td>Partial weight-bearing</td>
<td>4 (29)</td>
<td>4 (29)</td>
</tr>
<tr>
<td>Non-weight-bearing</td>
<td>0 (0)</td>
<td>0 (0)</td>
</tr>
</tbody>
</table>

| Child % of | 91.4 |

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### Open tables in new tab

- Ambulation status categorized into full weight-bearing, partial weight-bearing, and non-weight-bearing is shown in Table 3. Preoperatively, 10/14 (71%) were full weight-bearing, 4/14 (29%) were partial weight-bearing, and 0/14 (0%) were non-weight-bearing. At 1 year postoperatively, 10/14 (71%) were full weight-bearing, 4/14 (29%) were partial weight-bearing, and 0/14 (0%) were non-weight-bearing. At 2 years postoperatively, 10/14 (71%) were full weight-bearing, 4/14 (29%) were partial weight-bearing, and 0/14 (0%) were non-weight-bearing.
Case Series: Discussion

• Why the topic is relevant
• Brief paragraph re-introducing the topic
• Summarize the results
• Review literature that explains the findings
• Limitations paragraph
  • Limitations in manuscript: how patients were identified, data collection, institutional biases, etc.
• Conclusion paragraph
  • Summarize overall message of manuscript

Discussion

Patients with plantar heel ulcerations pose a particular challenge to clinicians and are at a high risk for major lower-extremity amputations. With the ultimate treatment goals of eradication of infection, soft tissue coverage, biomechanical stability, and tendon limb salvage, there are nonsurgical and surgical interventions available. Nonsurgical options include offloading, local wound care, antibiotics, and medical comorbidity management (1, 14). Hyperbaric oxygen can be used as an adjunctive treatment in wound care to accelerate the rate of healing because of possible physiological angiogenesis at the site of the ulcer (15). Nonsurgical intervention does not typically address the true etiology of heel ulceration, including poor vascular supply, infection, biomechanical instability, and soft tissue coverage.

Surgical interventions include soft tissue work consisting of debridements, sling grafts, and flap reconstruction; osseous intervention including partial and total calcaneotomies; vascular intervention; and major limb amputations (BlAKA) (16). In cases of large soft tissue defects, as a result of infection or skin breakdown from pressure or biomechanical instability, methods of soft tissue reconstruction, local rotational flaps, or free flaps (17). Flap reconstruction is a useful tool for heel ulceration; however, it has some relative contraindications. In a study by Oh et al (18), the rate of flap loss rate was increased by an odds ratio of 17 in the patients with a history of angioplasty and increased by an odds ratio of 10 in patients with peripheral arterial disease. Other significant risk factors for flap loss include diabetes mellitus, venous insufficiency, underlying osteomyelitis, noncompliance, and age > 65 years, all of which are common in the nontrauma heel ulcer cohort (19). Ducic and Allinger (20) found that diabetes did not have a direct impact on flap success; however, diabetes significantly increased the number of surgical debridements, increased the healing times, and decreased the long-term survival rate.

Total and partial calcaneotomies are frequently used to treat nonhealing heel ulceration both with and without osteomyelitis, with the aim of ambulation and wound closure (21, 22). The benefits of the calcaneotomies include removal of infected bone, decrease in plantar pressure, and reduction in bony prominences to allow for soft tissue coverage (7). Since Gausien described the initial calcaneotomy, the conventional partial calcaneotomy has been portrayed as a viable alternative to a transarticular amputation (23). However, literature on the partial calcaneotomy shows a wide variance of healing, reoperation, major amputation rates, and postoperative morbidity (24). The current literature on the partial calcaneotomy reveals a lack of consensus on the amount of bone to remove or the alignment of the osteotomies (21, 25, 26). Because of the lack of evidence-driven guidelines, the amount of resected bone is typically guided by the presence of osteomyelitis (22). In patients who go on to nonhealing partial calcaneotomy secondary to a heel ulceration, 29% went on to BlAKA (2). The bone-to-soft tissue ratio must be biased toward a soft tissue closure without tension, especially with postoperative edema (26). Although negative pressure wound therapy and bioengineered allografts with offloading show some success, evidence shows that early soft tissue coverage, especially with the unique fortality heel pad, is key in preventing recurrent ulceration (27). Certain technical drawbacks of the partial calcaneotomies include fracturing resulting from weakening of the plantar cortex after osteotomy and delayed wound healing (2, 28).

Major lower-extremity amputations are often used as definitive treatment options if limb salvage is unobtainable because of the lack of acceptable surgical options. With diabetic foot ulcerations being the number 1 cause of BKA from nontraumatic causes (4), heel ulcerations are at an extremely high risk of amputation (1, 22, 26). The presence of osteomyelitis increases the rates of major lower-extremity amputation to as high as 82% (9). However, through a multidisciplinary approach, a limb salvage rate as high as 90% can be achieved (29). Although preservation of limb length is certainly a consideration, the main goal of limb salvage should not be focused on sparing the foot but on functional outcomes (30). Ambulation rates after BKA are often a debated topic. The study by Evans et al (3) showed a 30% rate of return to ambulation at 2 years compared with the historical range of 22% to 65% (30). A factor leading to such a low percentage is that many patients never fully learn to ambulate in their prosthesis after a BKA (31). Mortality ratios in patients post-BKA are between 20% and 50% at 3 years (32, 33) and 40% and 70% at 5 years (27, 33).

To address a lack of evidence-based options between partial calcaneotomy and major lower-extremity amputation, the VCC was introduced (2). With the ultimate goal of functional limb salvage, the VCC provides a functional alternative to the traditional partial calcaneotomy while avoiding or delaying major lower-extremity amputation in cases of heel ulcerations. The VCC is a modification of the partial calcaneotomy that provides a consistent approach and reproducibility. The VCC addresses the mechanical issues of the partial calcaneotomy with resolution of the tendosynovials, thus decreasing the area on the plantar cortex and decreasing probability of fracturing (2). The VCC removes enough bone to allow for soft tissue coverage and allow for resection of infected bone while maintaining a functional ambulatory limb (2).
Reviews

Systematic review

• Gathers all available empirical research by using clearly defined, systematic methods to obtain answers to a specific question.
  • Complete overview of a subject

Meta-analysis

• The statistical process of analyzing and combining results from several similar studies
  • Statistical analysis of a complete subject
Systematic Review

1. Formulate an idea
2. Define
   - Key terms
   - Inclusion criteria
   - Exclusion criteria
3. Collect & review all articles
4. Analysis included articles
5. Write the manuscript
Systematic Review

• Defined databases
  • Ex medline, EMBASE, Google Scholar, Cochrane Library, Clinicaltrials.gov and reference lists of included studies, from January 1, 1980 to April 1, 2020

• Defined key terms
  • Charcot neuroarthropathy, diabetic neuroarthropathy, diabetic complication, radiographic, X-ray, angle, angular ulcer, ulceration, deformity progression, alignment, and imaging
• Creating list of included articles
  • Define inclusion / exclusion criteria
  • All abstracts are reviewed independently by two physicians
  • In the case of a disagreement, a third physician read the full article and decided if it should be included.

A Systematic Review of Angular Deformities in Charcot Neuroarthropathy

Nicole K. Cates, DPM, AACFAS1, Jonathan Tenley, DPM2, Helene R. Cook, DPM2, Paul J. Kim, DPM, MS, FACFAS3

1 Fellowship-trained foot and ankle surgeon, Hand and Microsurgery Medical Group, San Francisco, CA
2 Resident physician, Department of Plastic Surgery, MedStar Georgetown University Hospital, Washington, DC
3 Professor and attending physician, Department of Plastic Surgery, University of Texas Southwestern Medical Center, Dallas, TX
An inclusive database search was performed on medline, EMBASE, Google Scholar, Cochrane Library, Clinicaltrials.gov and reference lists of included studies, from January 1, 1980 to April 1, 2020.

- Titles Reviewed: 95
- Removed irrelevant articles
- Abstract reviewed: 10
- Failed to meet inclusion or exclusion criteria
- Eligible Articles: 7
Double Versus Triple Arthrodesis Fusion Rates: A Systematic Review
Nicole K. Cates, DPM, AACFAS, Alissa Mayer, DPM, Jonathan Tenley, DPM, Jacob Wykes, DPM, MS, FACFAS, Eshbeeta Tefra, MS, John S. Steinberg, DPM, FACFAS, Paul L. Kim, DPM, MS, Glenn M. Weinraub, DPM, FACFAS.
Charcot Reconstruction: Outcomes in Patients With and Without Diabetes

Nicole K. Cates, DPM, AAFAS
Emily C. Wagler, DPM
Taylor J. Bunka, DPM
Tammer Elmarsafi, DPM, MBBS, AACFAS
Eshetu Tekera, MS
Paul J. Kim, DPM, MS, FACFAS
George T. Liu, DPM, FACFAS
Karen K. Evans, MD
John S. Steinberg, DPM, FACFAS
Christopher E. Attinger, MD

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2 Attending Physician, Department of Plastic Surgery, MedStar Georgetown University Hospital, Washington DC
3 Department of Biomaterials and Biomechanical Engineering, MedStar Health Research Institute, Washington DC
4 Attending Physician, Department of Plastic Surgery, University of Texas Southwestern Medical Center, Dallas, TX
5 Attending Physician, Department of Orthopaedic Surgery, University of Texas Southwestern Medical Center, Dallas, TX

A R T I C L E  I N F O

Level of Clinical Evidence: 3 Retrospective Study
Keywords:
Charcot neuropathapy delayed osseous union return to ambulation well controlled diabetic patients

A B S T R A C T

The objective of this study is to compare risk adjusted matched cohorts of Charcot neuropathapy patients who underwent osseous reconstruction with and without diabetes. The 2 groups were matched based on age, body mass index, hypertension, history of end-stage renal disease, and peripheral arterial disease. Bivariate analysis was performed for preoperative infection, location of Charcot breakdown, and post-reconstruction outcomes, in patients with a minimum of 1 year follow-up period. Through bivariate analysis, presence of preoperative ulceration (p = .0499) was found to be statistically more likely in the patients with diabetes; whereas, delayed osseous union (p = .050) and return to ambulation (p = .001) was statistically more likely in patients without diabetes. The nondiabetic Charcot patients were 17.6 folds more likely to return to ambulation (odds ratio [OR] 17.6 [95% confidence interval [CI] [1.5-187.6]]), and 16.4 folds more likely to have delayed union (OR 16.4 [95% CI [1.9-139.6]]). Subanalysis compared well-controlled diabetic and nondiabetic Charcot neuropathapy patients for same factors. Multivariate analysis, in the subanalysis, found return to ambulation was 15.1 times likely to occur in the nondiabetic CN cohort (OR 15.1 [95% CI 1.3-175.8]) compared to the well-controlled diabetic CN cohort.

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Retrospective: Form an Idea

- Cohort: What group are you evaluating?
- Comparison: What are you comparing?
- Factors: What factors are you comparing for?
- Review existing literature to see if study exists: Database like pubmed
• Cohort: Charcot patients that underwent reconstructive surgery

• Comparison: Comparing Charcot patients with and without diabetes

• Factors:
  • Preoperative risk factors: age, BMI, HTN, PAD, renal disease, smoking history, location of preoperative ulcer, etc.
  • Postoperative outcomes: delayed union, dehiscence, amputation, Charcot recurrence, postoperative ambulation, etc.
Retrospective: IRB

Institutional Review Board (IRB)
ACFAS Research Committee Meeting: IRB Processes and Ethics

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**ACFAS 2023 Scientific Conference**

**Step it Up!**

**Los Angeles * February 9-12**
Retrospective: Datamining

- **Cohort:** Define cohort and determine how to find the patients
  - **ICD-10’s:** If cohort based on diagnosis can pull patients by diagnostic codes
    - Ex) Dr Foot, patients with PTTD
      “Dr Foot patients for ICD-10: M76.821 & M76.822 (need left & right codes)
  - **CPTs:** If surgical patients can pull patients by surgical codes
    - Determine if you want single surgeon or multiple surgeons
    - Ex) Dr Foot’s patients who had multiplanar external fixator devices. “Dr Foot’s patients for CPT 20692”
Retrospective: Datamining

• Inclusion Criteria:
  • Cohort: defined as X
  • Underwent X surgery, surgery defined as

• Exclusion Criteria:
  • <18 years old
  • < 1 year follow up postoperatively
Inclusion Criteria

• Cohort: Charcot joint involvement defined as joint subluxation, dislocation, presence of small osseous fragments, or osseous fracturing consistent with Charcot neuroarthropathy
• Underwent: Charcot reconstructive surgery which included arthrodesis, osteotomies, or deformity correction of the ankle / hindfoot.

Exclusion Criteria

• <18 years old
• < 1 year follow up postoperatively
Define Each Factors:

- Age: defined as age at time of surgery
- PAD: defined as non-triphasic doppler signal
- Renal disease: defined as either CKD or ESRD in medical records
- Amputation
  - Minor amputation: toe, ray, TMA, symes, choparts amputation
  - Major amputation: below the knee or above the knee amputation
- Postoperative ambulation: defined as non-ambulatory (wheelchair bound), partially ambulatory (transfers only or assistive devices and fully ambulatory (unassisted ambulation)
Factors:

Continuous variable: value is obtained by measuring
- Example: age, BMI, A1C

Categorical variable: variable that can take on one of a limited, and usually fixed, number of possible values
- Example diabetes yes = 1, no = 0
- Example postoperative ambulatory status, non=0, partial=1, full=3

Retrospective: Datamining
### Retrospective: Datamining

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# Retrospective: Datamining

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<tr>
<th>MRN</th>
<th>Age at repair</th>
<th>BMI value at time of repair</th>
<th>Diabetes</th>
<th>CKD</th>
<th>ESRD</th>
<th>HTN</th>
<th>Smoker hx or current</th>
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<table>
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<tr>
<th>Preop ulcer</th>
<th>Forefoot</th>
<th>Midfoot</th>
<th>Hindfoot</th>
<th>Ankle</th>
<th>Preoperative Soft tissue infection</th>
<th>Preoperative Osteomyelitis</th>
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<table>
<thead>
<tr>
<th>CN forefoot</th>
<th>CN midfoot (TMTJ+CNJ)</th>
<th>CN hindfoot (TNJ+CCJ+S TJ)</th>
<th>CN rearfoot (AJ+calcane us)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1=yes</td>
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<tr>
<td>0=no</td>
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### Descriptive Statistics for Non-diabetic versus Diabetic Charcot Neuroarthropathy (Bivariate Analysis)

<table>
<thead>
<tr>
<th>Post Reconstructive Outcomes</th>
<th>Non Diabetic CN (N=25)</th>
<th>Diabetic CN (N=50)</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Delayed healing</td>
<td>52.0% (13/25)</td>
<td>34.0% (17/50)</td>
<td>0.1336</td>
</tr>
<tr>
<td>Dehiscence</td>
<td>36.0% (9/25)</td>
<td>16.0% (8/50)</td>
<td>0.0512</td>
</tr>
<tr>
<td>Major lower extremity amputation</td>
<td>16.0% (4/25)</td>
<td>26.0% (13/50)</td>
<td>0.3933</td>
</tr>
<tr>
<td>Delayed osseous union</td>
<td>28.0% (7/25)</td>
<td>4.0% (2/50)</td>
<td><strong>0.0051</strong></td>
</tr>
<tr>
<td>Recurrence of Charcot</td>
<td>16.0% (4/25)</td>
<td>12.0% (6/50)</td>
<td>0.7186</td>
</tr>
<tr>
<td>New Charcot location collapse</td>
<td>0% (0/25)</td>
<td>6.0% (3/50)</td>
<td>0.5481</td>
</tr>
<tr>
<td>Return to ambulation</td>
<td>85.7% (18/25)</td>
<td>29.8% (14/50)</td>
<td><strong>&lt;0.0001</strong></td>
</tr>
</tbody>
</table>
Retrospective: Statical Analysis

• What to ask the statistician to get p-values
  • “X had statistically higher rates of Y and Z” (p=0.002)

• What to ask the statistician to get odds ratios
  • “X was 8 times more likely to develop Y than Z
    [OR 8.01 (95% CI (3.5-87.6))]
Retrospective: Statical Analysis

• P-values
  • Bivariate analysis: comparing two different groups for a factors
  • Two groups: Charcot patients **WITH** and **WITHOUT** diabetes
  • Factor 1: comparing for Age at time of reconstruction
  • Factor 2: comparing for BMI at time of reconstruction
  • Factor 3: comparing for preoperative diagnosis of renal disease
  • Etc, etc
• Odds ratios: Multivariate logistic regression
  • A model that is used to predict the probabilities of the different possible outcomes of a variable, given a set of independent variables
  • Need to run separate regressions for preoperative factors and postoperative outcomes
    • Comparing all statistically significant preoperative factors to see which have the biggest impact
Retrospective: Statical Analysis

Charcot Etiology: Diabetic vs non Diabetic

Comparing Charcot Neuroarthropathy with Diabetic vs Non-Diabetic Etiology for pre-operative infection, anatomic location of Charcot breakdown, and outcomes

a. Pre-operative Infection
   i. Bivariate analysis comparing “CN DM” and “CN non DM” for:
      1. Pre-op ulcer (column AH)
      2. Forefoot (column AI)
      3. Midfoot (column AJ)
      4. Hindfoot (column AK)
      5. Ankle (column AL)
      6. Medial (column AM)
      7. Lateral (column AN)
      8. Soft tissue infection (column AO)
      9. Osteomyelitis (column AP)
   ii. Multivariate logistic regression for the statistically significant factors from above

b. CN by anatomic location
   i. Bivariate analysis comparing “CN DM” and “CN non DM” for
      1. Forefoot collapse (column AQ)
      2. Midfoot collapse (column AR)
      3. Hindfoot collapse (column AS)
      4. Rearfoot collapse (column AT)
   ii. Multivariate logistic regression for the statistically significant factors from above

c. Outcomes
   i. Bivariate analysis comparing “CN DM” and “CN non DM” for
      1. Delayed/non healing (column BL)
      2. Dehiscence (column BJ)
      3. Major lower extremity amputation (column BK)
      4. Non union (column BL)
      5. Recurrence of Charcot (column BM)
      6. New Charcot location collapse (column BN)
      7. Return to ambulation (column N)
   ii. Multivariate logistic regression for the statistically significant factors from above
Retrospective: Evaluating the Results

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Non Diabetic N=25</th>
<th>Diabetic N=50</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Delayed healing</td>
<td>13 (52.0)</td>
<td>17 (34.0)</td>
<td>0.1336</td>
</tr>
<tr>
<td>Dehiscence</td>
<td>9 (36.0)</td>
<td>8 (16.0)</td>
<td>0.0512</td>
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<tr>
<td>Major lower extremity amputation</td>
<td>4 (16.0)</td>
<td>13 (26.0)</td>
<td>0.3933</td>
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<tr>
<td>Non union</td>
<td>7 (28.0)</td>
<td>2 (4.0)</td>
<td>0.0051</td>
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<tr>
<td>Recurrence of Charcot</td>
<td>4 (16.0)</td>
<td>6 (12.0)</td>
<td>0.7186</td>
</tr>
<tr>
<td>New Charcot location collapse</td>
<td>0 (0.0)</td>
<td>3 (6.0)</td>
<td>0.5481</td>
</tr>
<tr>
<td>Return to ambulation</td>
<td>18 (85.7)</td>
<td>14 (29.8)</td>
<td>&lt;.0001</td>
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</table>

Multivariate logistic regression for the statistically significant factors from above

<table>
<thead>
<tr>
<th>Effect</th>
<th>DF</th>
<th>Chi-Square</th>
<th>Pr &gt; ChiSq</th>
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<tbody>
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<td>osseous_delayed_non</td>
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Odds Ratio 95% Confidence Limits

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<td>139.6</td>
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<tr>
<td>Ambulator</td>
<td>17.6</td>
<td>3.5</td>
<td>87.6</td>
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</table>
Retrospective: Evaluating the Results

- What values are statically significant
- What do these values being statically significant mean?
- Understand the results and what they mean clinically
Retrospective: Writing the Manuscript

Order in which I write

1. Title page
2. Methods
3. Tables
4. Results
5. Abstract
6. Introduction
7. Discussion
8. References
9. Figures
Charcot Reconstruction: Outcomes in Patients With and Without Diabetes

Nicole K. Cates, DPM1....Christopher E. Attinger, MD2

First author: author who wrote majority of the manuscript
Last author: most senior author

Attending Physician, Department of Plastic Surgery, MedStar Georgetown University Hospital, 3800 Reservoir Rd NW, Washington DC, 20007

Name, title, affiliation, email, Phone, Fax

Financial disclosures of all authors
• **Methods**: this helps me define my cohort, and factors
  • IRB approval board
  • How you identified patients for the study (cohort, icd-102 or CPTs, for X surgeons, time frame Y-Z)
  • Inclusion / exclusion criteria
  • Datamining: all factors evaluated: preoperative factors and postoperative outcomes (how each was defined)
  • Any study specific equation / concept (fully define)
  • Statistical analysis (Statistician typically writes this paragraph)
Tables: puts all the results in one area in a clean format
- Fill in the tables with the data from the statistician
- Need tables citations (Table 1) in the paper to appear in the order they appear at the end of the manuscript
- Table 1: always demographics
- Following tables: bivariate analysis, multivariate regression, etc
# Writing the Manuscript: Tables

## Tables

**Table 1: Demographics of Patients Included in the CN Osseous Reconstruction Cohort**

<table>
<thead>
<tr>
<th></th>
<th>Number % (N=75), Median</th>
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<tbody>
<tr>
<td>Age at repair</td>
<td>56 (31-86)</td>
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<tr>
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<td>Median: 58</td>
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<tr>
<td>Body Mass Index (BMI)</td>
<td>32.4 (20.7-45.6)</td>
</tr>
<tr>
<td></td>
<td>Median: 31.6</td>
</tr>
<tr>
<td>Glycosylated hemoglobin A1c (HbA1c)</td>
<td>8.5 (5.0-14.6)</td>
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<tr>
<td></td>
<td>Median: 7.4</td>
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</table>
## Writing the Manuscript: Tables

### Table 2: Descriptive Statistics for Non-diabetic versus Diabetic Charcot Neuroarthropathy (Bivariate Analysis)

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Non Diabetic</th>
<th>Diabetic</th>
<th>P value</th>
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<tbody>
<tr>
<td></td>
<td>(cases) N=25</td>
<td>(Matched controls) N=50</td>
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</tr>
<tr>
<td>Age at repair</td>
<td>56 (31-82) Median: 57</td>
<td>56 (31-86) Median: 58</td>
<td>0.9886</td>
</tr>
<tr>
<td>Body Mass Index (BMI)</td>
<td>30.4 (20.7-41.3) Median: 29.8</td>
<td>33.4 (21.3-45.6) Median: 33.8</td>
<td>0.1098</td>
</tr>
<tr>
<td>Hypertension</td>
<td>64.0% (16/25)</td>
<td>64.0% (32/50)</td>
<td>1.0000</td>
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</tbody>
</table>
**Table 4:** Multivariate Logistic Regression, for risk outcome Osseous Delayed Union and Return to Ambulation

<table>
<thead>
<tr>
<th>Effect</th>
<th>Odds Ratio</th>
<th>95% Wald Confidence Limits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Return to Ambulation</td>
<td>17.6</td>
<td>3.5</td>
</tr>
<tr>
<td>Osseous Delayed Union</td>
<td>16.4</td>
<td>1.9</td>
</tr>
</tbody>
</table>
Results: Use the tables section to write the results section
- List out all the demographic data
- Bivariate analysis: solely include statistically significant results (p-values)
- Multivariate regression solely include statistically significant results (odds ratios)
Writing the Manuscript: Abstract

- **Abstract**: Helps think through the overall message of the paper
  - Primary & secondary aims of the study
  - Methods: what statistical analysis did you perform (bivariate analysis, multivariate regression)
  - Results: only statistically significant variables
  - Conclusion: summarizing clinical significance and meaning of the results
Abstract

• Primary & secondary aims of the study sentence
  • The objective of this study is to compare risk adjusted matched cohorts of Charcot neuroarthropathy patients who underwent osseous reconstruction with and without diabetes.

• Methods sentence
  • Bivariate analysis was performed for preoperative infection, location of Charcot breakdown, and post reconstruction outcomes, in patients with a minimum of 1 year follow-up period.
Abstract

• Results sentence
  • Through bivariate analysis, presence of preoperative ulceration ($p=0.0499$) was found to be statistically more likely in the patients with diabetes; whereas, delayed osseous union ($p=0.0050$) and return to ambulation ($p\leq0.0001$) was statistically more likely in patients without diabetes.
  • The non-diabetic Charcot patients were 17.6 folds more likely to return to ambulation [OR 17.6 (95% CI (3.5-87.6)], and 16.4 folds more likely to have delayed union [OR 16.4 (95% CI (1.9-139.6)].
Abstract

• Conclusion sentence
  • Our results demonstrate that DM CN patients are more likely to present with preoperative ulcerations compared to non DM CN patients. Though the non DM CN patients show higher rates of delayed union after CN reconstruction, they are more likely to return to ambulation compared to patients with DM.
Introduction

- 1st paragraph: Generally introduce the topic
- 2nd paragraph: Overview of current literature on the topic
- 3rd paragraph: Why this research is relevant. Primary / secondary aims of the study
Discussion

- **Overview paragraph**: General overview of the topic. Want to explain why this concept is important.
- **Results Paragraph**: Paragraphs explaining each statistically significant results with literature to back up hypothesis of why it is statistically significant.
- **Limitations paragraph**: review all the limitations to the study, and how future studies can improve on this study.
- **Conclusion paragraph**: overview of the results with a clear take home message for the reading.
Writing the Manuscript: Results

References

• Fill in as you go, even if you don’t completely format the references put a skeleton list for yourself to work off later
• Within the manuscript don’t number until after attending edits, keep citations as (author) or (author-year) if there are duplicates of the same author
  • After final attending edits number in order they appear in the manuscript (1).... Blah blah (2).
  • Have reference citations match order they appear in the manuscripts
Writing the Manuscript: Figures

Figures

- Clinical or radiographic figures that highlight and demonstrate key concepts from the paper
- Can also include algorithms, decision trees, radiographic measurements, etc.
- *Need figure citations (Figure 1) in the paper to appear in the order they appear at the end of the manuscript
Thank you!

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