

Partial Calcaneotomy as an Alternative to Below the Knee Amputation for Limb Salvage in Infected Heel Ulcer with Osteomyelitis

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Abstract

Background: Amputations above the ankle level are usually the gold standard procedure for severe calcaneal osteomyelitis. Partial calcaneotomy have been advocated as viable alternatives to below knee amputation. It aimed to limb salvage with subsequent decrease morbidity, mortality and improve quality of life

Patients and Methods: A prospective single arm cohort study conducted on 20 patients between 2020 to 2022 at single center, Ain Shams University Hospitals, Patients had infected heel ulcers with osteomyelitis and Partial Calcaneotomy was performed to them, then follow-up of the wounds was done.

Results: No postoperative complication or signs of ischemia 15 males (75%) and 5 females (25%). The age ranged between 51 years and 73 years with mean age of 63 ± 7 . Most of patients are diabetic (90%), hypertensive (85%), 2/3 of them were smoker. Limb salvage was achieved on 65 % of cases with no recorded 30 day mortality All cases had score 4 WIFI classification and there were no sever limb ischemia. Subgroups difference in wound depth, degree of foot infection and ankle brachial index may have impact on limb salvage. (ABI), achieved in 3 cases after 1 month, 7 cases after 3 month and 3 cases after 7 months.

Conclusion: Partial calcaneotomy is safe and effective alternative to below knee amputation in treatment of heel ulcer and calcaneal osteomyelitis.

Key Words: *Partial calcaneotomy – Calcaneal osteomyelitis.*

Introduction

LARGE heel wounds, mostly accompanied by osteitis of the calcaneus, are a major treatment challenge and mostly end up with a major amputation. These can represent decubitus ulcers often seen in patients with diabetes mellitus, arterial insufficiency, impaired sensation or a sinus of an

infected calcaneal fractures [1]. Amputations above the ankle level are usually the gold standard procedure for severe calcaneal osteomyelitis, but it cause inefficient gait [2], physical activity [3], and a high mortality rate approaching 70% at 5 years [4]. Partial or total calcaneotomy have been advocated as viable alternatives to below knee amputation [5]. Calcaneotomies aimed to limb salvage with subsequent decrease morbidity, mortality and improve quality of life [6]. These procedures have been reported to yield a minimal risk of flap necrosis and scarring, a stable soft tissue envelope closure and a functional end-bearing limb [7]. In case of failure to control osteomyelitis or soft tissue infection, the level of the next amputation remains unchanged [7].

We studied the results of partial/subtotal calcaneotomy as an alternative treatment modality in these patients. With this procedure all infected and non-viable tissue (both soft tissue and bone) are resected. This also decompresses the soft tissues of the heel in order to allow wound closure without tension.

Patients and Methods

Type of study: It's a prospective single arm cohort study conducted on 20 patients between 2020 to 2022 at single center, Ain Shams University Hospitals.

Inclusion and exclusion criteria:

- 1- **Inclusion criteria:** Ambulatory patients presented with heel ulcer with osteomyelitis confirmed by radiograph, age >18 years and mild or no ischemia with Ankle Brachial Index (ABI) >0.6.

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2- *Exclusion criteria:* Severe infection that hinder limb salvage, ABI <0.6, Non Ambulatory or bed ridden patients, Adjuvant flap transfer, use of negative vacuum dressing and Refusing follow-up or signing consent.

3- *Primary endpoint:* Limb salvage.

4- *Secondary endpoint:* Wound healing, 30 days mortality.

Under spinal or general anesthesia, the ulcer was excised totally. All devitalized tissue, including the ulceration, was excised with incisions extending to bone. Once visualized, the degree of bony resection was largely determined by the extent of infection and necrosis noted in the calcaneus. The calcaneus is cut through on a line beginning just below the inferior tip of the calcaneocuboid joint, backward and slightly upward, ending just below the insertion of the Achilles tendon. The aim of all procedures was to debride the calcaneus to bleeding cancellous bone and to fashion remaining bone in an attempt to provide a smooth weight-bearing surface.

Results

This is a prospective single arm cohort study involving 20 patients presented with heel ulcers and calcaneal osteomyelitis in a high-volume tertiary referral center, El Demerdash Hospital. It was conducted between 2020 to 2022 with 6 months follow-up with primary endpoint is limb salvage and secondary endpoint is wound healing and 30 days mortality. All wounds were categorized as Grade 3 on the Wagner classification of foot wounds [12]. Partial Calcanectomy was performed without adjuvant tissue flap or transfer, followed by traditional wound dressing without use of negative vacuum dressing.

The study included 15 males (75%) and 5 females (25%). The age ranged between 51 years and 73 years with mean age of 63 ± 7 . Most of patients are diabetic (90%), hypertensive (85%), 2/3 of them were smoker, Risk factors and its relation to limb salvage was reported in Table (1).

There was no statistically significant difference between Limb Salvage risk factors of diabetes, hypertension and ischemic heart diseases. However, it's statistically significant with smoking, active smoking has negative impact on limb salvage.

We tried to collect laboratory investigations of patients, and to detect any relation with limb salvage, Table (2). Unfortunately, we couldn't detect any statistical significance. It could be related to low number of cases.

All cases had score 4 according to WIFI classification and there were no severe limb ischemia. There's a bit difference in wound depth, degree of foot infection and ankle brachial index (ABI), Which make an impact and statistical significance on limb salvage, Table (3).

Follow-up of wound healing and limb salvage was done for 6 months. Complete wound healing was achieved in 3 cases after 1 month, 7 cases after 3 month and 3 cases after 7 months, limb salvage was achieved on 65% of cases with no recorded 30-day mortality.

Table (1): Risk factors and its relation to limb salvage.

	No.	%
<i>Smoking:</i>		
Non-smoker	8	40.0
Smoker	12	60.0
<i>DM:</i>		
No	2	10.0
Yes	18	90.0
<i>HTN:</i>		
No	3	15.0
Yes	17	85.0
<i>IHD:</i>		
No	13	65.0
Yes	7	35.0

	Limb salvage				Test value*	P-value	Sig.
	No		Yes				
	No.	%	No.	%			
<i>Smoking:</i>							
Non-smoker	0	0.0	8	61.5	7.179	0.007	HS
Smoker	7	100.0	5	38.5			
<i>DM:</i>							
No	1	14.3	1	7.7	0.220	0.639	NS
Yes	6	85.7	12	92.3			
<i>HTN:</i>							
No	2	28.6	1	7.7	1.556	0.212	NS
Yes	5	71.4	12	92.3			
<i>IHD:</i>							
No	3	42.9	10	76.9	2.321	0.128	NS
Yes	4	57.1	3	23.1			

p-value >0.05: Non significant (NS).

p-value <0.05: Significant (S).

p-value <0.01: Highly significant (HS).

Table (2): Laboratory investigation and their relation to limb salvage.

	No.=20
<i>Total leukocyte count:</i>	
Mean ± SD	14.18±4.30
Range	6-23
<i>Hemoglobin:</i>	
Mean ± SD	10.56± 1.64
Range	8.2-14.4
<i>PLT:</i>	
Mean ± SD	366.45±100.07
Range	190-515
<i>Serum Creatinine:</i>	
Mean ± SD	1.14±0.50
Range	0.5-2.5
<i>INR:</i>	
Mean ± SD	1.08±0.15
Range	0.9-1.5

Table (3): WIFI classification components and their relation to limb salvage.

	No.	%
<i>Wound:</i>		
Deep ulcer	12	60.0
Deep, extensive ulcer	8	40.0
<i>Ischemia:</i>		
ABI ≥0.80	10	50.0
ABI (0.7-0.79)	10	50.0
<i>Foot infection:</i>		
Moderate local infection, with erythema >2cm	12	60.0
Severe local infection, with signs of SIRS	8	40.0
<i>WIFI score:</i>		
4	20	100.0

	Limb salvage		Test value*	p-value	Sig.	Limb salvage				Test value*	p-value	Sig.	
	No	Yes				No	Yes	No	%				No
	No.=7	No.=13				No.	%	No.	%				
<i>Total leukocyte count:</i>						<i>Wound:</i>							
Mean ± SD	15.07±5.91	13.70±3.33	0.671	0.511	NS	- Deep ulcer	2	28.6	10	76.9	4.432	0.035	S
Range	6-23	8.7-19.5				- Deep, extensive ulcer	5	71.4	3	23.1			
<i>Hemoglobin:</i>						<i>Ischemia:</i>							
Mean ± SD	9.81±1.49	10.95±1.63	-1.533	0.143	NS	- ABI ≥0.80	1	14.3	9	46.2	5.495	0.019	S
Range	8.2-12.8	9-14.4				- ABI (0.7-0.79)	6	85.7	4	30.8			
<i>PLT:</i>						<i>Foot infection:</i>							
Mean ± SD	401.00±49.63	347.85±116.42	1.142	0.268	NS	- Moderate local infection, with erythema >2cm	2	28.6	10	76.9	4.432	0.035	S
Range	345-458	190-515				- Severe local infection with signs of SIRS	5	71.4	3	23.1			
<i>Serum Creatinine:</i>						<i>WIFI score:</i>							
Mean ± SD	1.27±0.82	1.06±0.19	0.899	0.381	NS	- 4	7	100.0	13	100.0	NA	NA	NA
Range	0.5-2.5	0.8-1.5											
<i>INR:</i>													
Mean ± SD	1.10±0.22	1.06±0.10	0.543	0.594	NS								
Range	0.9-1.5	0.9-1.2											

p-value >0.05: Non significant (NS).
 p-value <0.05: Significant (S).
 p-value <0.01: Highly significant (HS).
 • : Independent t-test.

p-value >0.05: Non significant (NS).
 p-value <0.05: Significant (S).
 p-value <0.01: Highly significant (HS).
 *: Chi-square test.

Table (4)

	Wound healing	
	No.	%
<i>Follow-up:</i>		
1 Month	3	15.0
3 Months	7	35.0
6 Months	3	15.0
<i>Limb Salvage:</i>		
No	7	35.0
Yes	13	65.5
<i>30 day mortality:</i>		
No	20	100.0



Fig. (1): Process of healing after partial calcaneotomy.

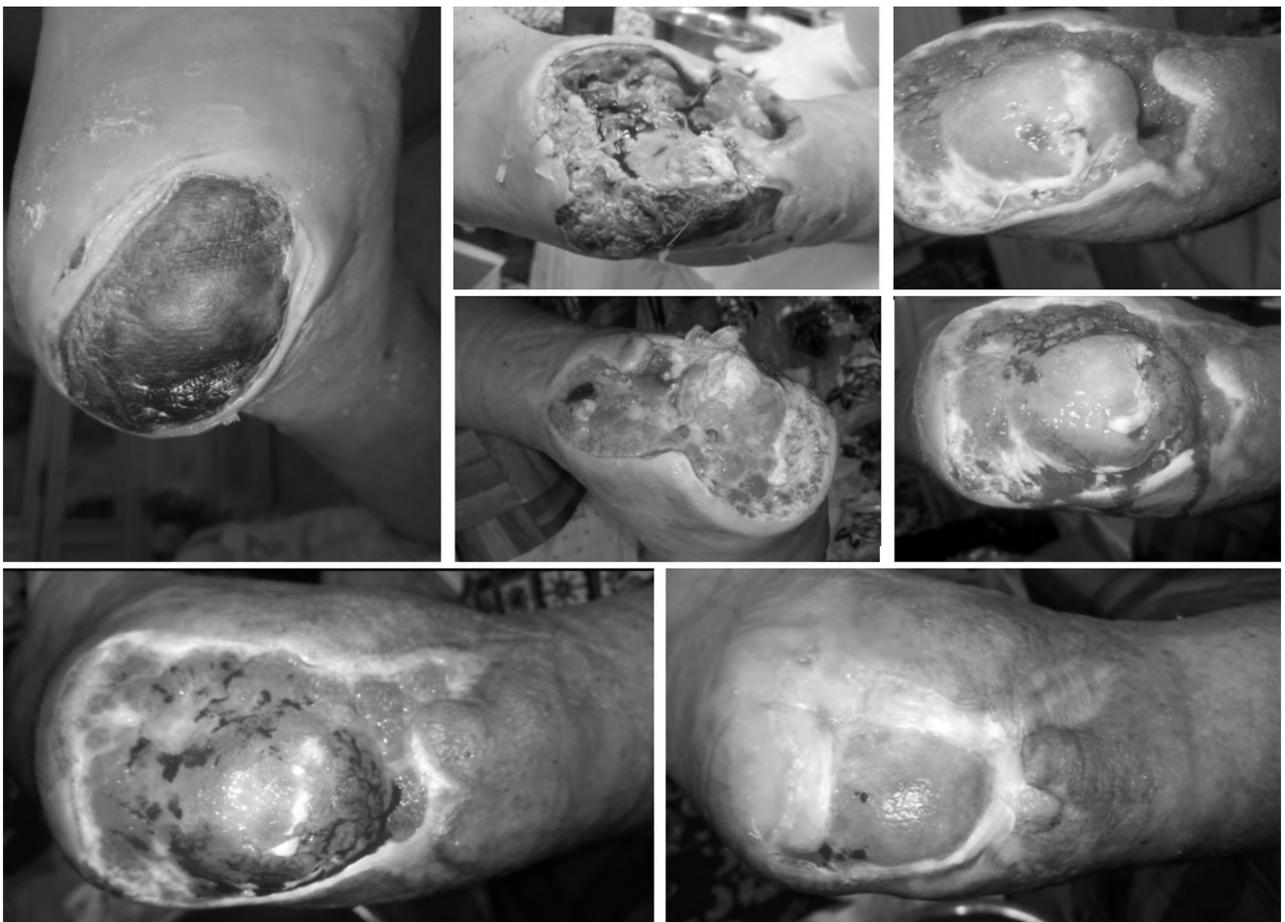


Fig. (2): Process of healing after partial calcaneotomy.

Discussion

Perez et al., [8] stated that calcaneotomy instead of below-knee amputation decreased both morbidity and mortality. He stated that this technique is applicable in both ambulatory and non-ambulatory patients, patients with or without diabetes and with or without osteitis. With this procedure the foot can be saved, but the gait is impaired in most patients and shoe adaptations are often needed.

Bollinger and Thordason [9] investigated 22 patients after calcaneotomy. All their patients healed but in 12 there was a delayed wound healing, including all 9 patients with diabetes. They considered wound healing delayed.

Schade [10] reported in a systematic review, that include Sixteen studies involving 100 patients (76 partial and 28 total calcaneotomies), 10% of patients required a major lower-extremity amputation. Major complications and major lower-extremity amputations occurred more frequently after total calcaneotomy and in patients with a diagnosis of diabetes. The results of this systematic review reveal that total or partial calcaneotomy is a viable alternative for limb salvage, with greater than 60% of patients having no complications and 85% maintaining their ambulatory status postoperatively. This study included ambulatory patients older than 18 years who underwent partial or total calcaneotomy without adjunctive free tissue transfer for the treatment of calcaneal osteomyelitis and had a mean follow-up of 12 months or longer.

Pereira et al., [11] reported case series study among 6 patients, retrospective single center study between 2008 to 2019, result of study shown In 4 of the 6 patients, infection control and wound closure was achieved with total calcaneotomy with follow-up ranging from 1 to 12 years. The 4 patients maintain walking ability. Two major complications: An early death caused by a respiratory infection and a below the knee amputation due to recurrence of the foot infection.

This study is prospective observational cohort study to detect role of partial calcenectomy as an alternative in below knee amputation in patients presented with heel ulcer and calcenealosteomytilits. Limb salvage and wound healing were achieved in (65%) within 6 months follow-up. There was a relation between severity of infection, mild Ischemia and active smoking with poor result and liability of limb loss.

Conclusion:

Partial calcaneotomy is safe and effective alternative to below knee amputation in treatment of heel ulcer and calcaneal osteomyelitis.

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استئصال عظم الكعب الجزئي كبديل للبتر تحت الركبة لإنقاذ الأطراف في حالات قرح الكعب الملتهبة والتهاب العظام

يعتبر استئصال عظمة الكعب الجزئي علاجاً راسخاً لقرحة الكعب المصاحبة لالتهاب العظم والنكروز العظمي. عادة ما تنتج تقرحات الكعب عن مزيج من الضغط المزمن والاعتلال العصبي وأمراض الشرايين الطرفية في المرضى الذين يعانون من أمراض مصاحبة متعددة عالية الخطورة بما في ذلك مرض السكري. في حالات التقرح طويل الأمد أو الغرغرينا، ينتج التهاب العظم والنكروز العظمي من الانتشار المستمر للعدوى. الكعب هو ثاني أكثر الأماكن شيوعاً لقرحة الضغط والمكان الأكثر احتمالية لتسبب القرحة في بتر الأطراف السفلية.

تسبق تقرحات القدم أكثر من ٨٠٪ من حالات بتر الأطراف السفلية، وتعد التهابات القدم السكرية السبب الرئيسي لبتر الأطراف غير الرضية.

الهدف من هذه الدراسة: هو تحديد دور استئصال عظم الكعب الجزئي كبديل للبتر تحت الركبة لإنقاذ الأطراف في حالات قرح الكعب الملتهبة والتهاب العظام.

النتائج: هذه دراسة أترابية مرتقبة بذراع واحدة تشمل ٢٠ مريضاً يعانون من قرح في الكعب والتهاب العظم والنقى العظمي في مركز الإحالة العالي الحجم، مستشفى الدمرداش. تم إجراؤه بين عامي ٢٠٢٠ و ٢٠٢٢ مع ٦ أشهر من المتابعة مع نقطة النهاية الأولية وهي إنقاذ الأطراف ونقطة النهاية الثانوية هي التئام الجروح وموت ٣٠ يوماً. تم تصنيف جميع الجروح على أنها من الدرجة الثالثة في تصنيف فاغنر لجروح القدم تم إجراء استئصال العظم الجزئي دون نقل أو نقل الأنسجة المساعدة، متبوعاً بضمادة الجرح التقليدية دون استخدام الضمادة الفراغية السلبية.

الاستنتاج: الاستئصال الجزئي للعظم هو بديل آمن وفعال للبتر تحت الركبة في علاج قرحة الكعب والتهاب العظم والنقى العظمي.