CASE REPORT

Use of External Fixator in Achieving Early Osseous Fusion in Boyd's Amputation of the Ankle – A Review of Two Cases

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ABSTRACT

Boyd amputation refers to amputation at the level of the ankle with preservation of the calcaneus and heel pad with consequent fixation of the calcaneus to the tibia. This allows for complete weight bearing and provides stabilization of the heel pad. It is a technically more difficult procedure to perform than the Syme amputation which is a more popular procedure done in ankle disarticulations.

The aim of this report is to document our experience with the use of external fixators to achieve osseous union in the management of diabetic foot gangrene.

Two cases of diabetic foot gangrene were managed successfully by Boyd's amputation using external fixators to achieve compression, osseous integration and union.

This procedure will be quite useful in developing countries where prosthesis utilization is poor and expensive as obtains in higher level amputations.

Key words: Calcaneus, Disarticulation, Diabetic foot, Gangrene

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INTRODUCTION

Boyd amputation refers to amputation at the level of the ankle with preservation of the calcaneus and heel pad and consequent fixation of the calcaneus to the tibia. This allows for complete weight bearing and provides stabilization of the heel pad. It is a technically more difficult procedure to perform than the Syme amputation which is a more popular procedure done in ankle disarticulations. However, it offers some advantages over Syme's procedure. Syme's amputation was first described in 1843 in the pre-anaesthetic and pre-antiseptic era.[1] Syme was concerned with achieving simple and safe means of removing an infected or damaged foot.[1] Both procedures are indicated in clinical conditions that preserve the heel e.g.; crush injury to the toes and forefoot, severe congenital anomalies of the lower extremity where the foot is so deformed as to preclude weight-bearing, diabetic foot gangrene involving the toes, osteomyelitis of the foot etc.

The amputation being an end-bearing one is said to be of near normal length with the non-amputated leg. It offers the best possibilities of good function in terms of full weight bearing and propulsion.[2] An essential aspect of Syme's amputation is the removal of the calcaneus through subperiosteal dissection which runs the risk of compromising vascular supply to the flap. Another shortcoming of Syme's amputation is that it gives a bulbous ended stump and is unsightly and unpopular with women.

The Boyd amputation provides a more solid stump because it preserves the function of the plantar heel pad. The weight bearing surface is more solid than in the case of Syme's amputation because of the calcaneo-tibial fusion. If an amputation in which the calcaneus is completely removed is of near equal length with the normal limb, then an ankle amputation in which the calcaneus is retained would be of normal lenght.[3] This must be the factor underlying Boyd's amputation. A substantial part of the calcaneus is retained and the cut section on the superior and anterior parts of calcaneus fused with the cut surface of the distal tibia.

The procedure gives good result in children, but in adults it is less acceptable than Syme's amputation due to poor result and the necessity of calcaneo-tibia osseous union in adult as documented in some studies.[4,5]
We present 2 cases of Boyd's amputation in which osseous union was facilitated by compression with external fixator device.

Case 1
A 58 year old male trader presented to the outpatient clinic of Holy Cross Orthopaedic Hospital Nnewi with a 2 month history of ulcer on the left foot. The ulcer started on the big toe and gradually spread to involve the other 4 toes extending towards the ankle (Figure 1). The ulcer was discharging foul smelling milky fluid. There was loss of sensation in the toes with subsequent darkening of the toes. He had been diabetic for 20 years with poor compliance to medication.

Clinical examination showed a man with stable vital signs but with gangrene of all the toes extending to the mid foot. The posterior tibia pulsation was present while that of the dorsalis pedis was absent. A diagnosis of diabetic foot ulcer (Wagner 5) was made and patient was worked up for surgery.
He was offered Boyd's amputation under spinal anaesthesia, with the freshened end of calcaneus fixed to cut distal end of tibia and compressed with external fixators. Immediate postoperative condition was good. He was discharged home on the 20th post operative day after all stitches were removed. Three month follow up radiograph showed significant osseous integration and union (Figure 3).

Figure 1. Pre operative clinical photograph of case 1

Figure 2. Pre operative clinical photograph of case 2

Figure 3. Post operative radiograph of case 1 showing bony union

Figure 4. Post operative radiograph of case 2

Case 2

A 77 year old female farmer presented to the outpatient clinic of the same hospital with a 6 month history of ulcer on the left foot which started on the second toe and progressed to involve the other toes and forefoot (Figure 2). The ulcer was discharging foul smelling purulent material. There was associated pain which is occasionally severe preventing sleep and movement. She was receiving treatment from a patent medicine dealer who was visiting her at home to dress the ulcer. Due to worsening of the ulcer and her general health condition, she was taken to a nearby hospital where she was found to be diabetic and subsequently referred to Holy Cross hospital for expert management after receiving care for a short period of time. She had been hypertensive for 5 years with good control.

Clinical examination revealed an elderly woman in no obvious distress and with stable vital signs. There was absence of the 2nd toe and gangrene of the other toes. Ulcer spanned from the metatarsophalangeal joint extending towards the midfoot with a deep crater attempting to divide the foot into 2 unequal parts. The ulcer base was necrotic discharging malodorous purulent fluid. The posterior tibial pulsation was present while dorsalis pedis was not palpable. There was reduced pain and temperature sensation. A diagnosis of diabetic foot ulcer (Wagner 5) was made and patient worked up for surgery.

She had Boyd's amputation on the 3rd day of admission under spinal anaesthesia. Via a transverse incision across the ankle joint to both malleoli extending towards the heel, the distal tibia and fibula were sectioned 0.6cm above the articular surface. Talus was dissected out, anterior and superior surfaces of the calcaneus sawed off and the ends apposed to the distal tibia. Compression was effected by external fixation. The wound was closed leaving the lateral ends for drainage. Estimated blood loss was about 250ml. Patient received 3 units of blood (1 unit intraoperatively and the other 2units postoperatively). She was discharged on the 24th day post surgery with good healing of the stump. A check radiograph done 3 months post surgery showed bony union (Figure 4).

DISCUSSION

Over the ages, ankle amputations have been done to eliminate infection and provide an end bearing stump. In Canada, Syme's amputation was thought to be the best of all amputations of the lower extremity above the foot and has been used with consistent success since before the 1914 – 1918 war even to present day.[6] If an ankle amputation in which the calcaneus was removed by sub-periosteal dissection is of 'near normal length', then the Boyd's amputation in which the calcaneus is retained would be of equal length with the contra-lateral limb. This is the experience we had in these 2 cases where the heel flaps were deliberately preserved and used to cover the end of the tibia

The Boyd amputation is designed to give better results than the Syme's amputation. In the Boyd amputation, the tibio-calcaneal fusion gives added stability to the flap. There is also reduced devascularisation of the flap since the calcaneus is not dissected out.[4,5,7,8] This is an obvious advantage of Boyd's amputation over Syme's procedure in which the dissection of the calcaneus compromises blood supply to the soft tissue flap which runs the risk of failure. In the index cases, the stump wounds healed quite well and this could be as a result of preservation of the stump vascularisation.

The Boyd amputation provides a more solid stump because it preserves the function of the plantar heel pad. Also, because a portion of the calcaneus is left and fused to the tibia, the weight bearing surface is more solid than in the case of a Syme amputation.[9] Along with a stable full weight bearing stump due to tibio-calcaneal fusion, the additional length makes it easier for a patient to walk without prosthesis.[7]

Eilert *et al*. in a comparative review of children who had Boyd and Syme amputation, observed that the Boyd technique, though technically more difficult, was a surer method of obtaining good alignment of the heel pad in the plantigrade position which gave the best outcome[10].Westberry *et al*. in their series found Boyd amputation very useful in the management of children with postaxial limb bud deficiency with minimal complications. However, they encountered some complications when used for children with congenital pseudoarthrosis of the tibia.[11]

Previous authors described difficulty in achieving osseous integration at the calcaneal-tibial interface after sectioning. Tosun *et al*., in a review of 14 cases of Boyd's amputation of the ankle noted complete wound healing in 7 feet of 6 patients while 7 other cases required a more proximal amputation. They thus concluded that Boyd's amputation is still a good option in some patients to try, to preserve lenght.[12]

The use of external fixator clamps in these 2 cases ensured that osseous integration occurred in record time of 7-8 weeks. The external fixation provided rigid compressive fixation which enabled early osseous integration and union.

CONCLUSION

Boyd's amputation may be a viable alternative to Syme's amputation in developing countries where prosthesis utilization is poor and expensive for higher level amputations.

There is need for more studies on the use of Boyd's as an alternative to other methods of ankle disarticulation.

REFERENCES

1. Syme J. Amputations at the ankle joint. *London and Edinburgh Monthly Journal of Medical Sciences* 1843; 3: 93
2. Harris RI. Syme's amputation – The technical details essential for success. *J Bone Joint Surg Br* 1956; 38: 614 – 632.
3. Alldredge RH, Thomson TC. The technique of the Syme amputation. *J Bone Joint Surg Am* 1946; 28: 415-426.
4. Boyd HB: Amputation of the foot with calcaneotibial arthrodesis. *J Bone Joint Surg Am* 1939; 21: 997
5. Taniguchi A, Tanaka Y, Kadono K, Inada Y, Takakura Y. Pirogoff ankle disarticulation as an option for ankle disarticulation. *Clin Orthop Relat Res* 2003; 414:322–328.
6. Harris RI. Syme's amputation: The technical details essential for success. *J Bone Joint Surg* 1956; 38(3) 614-632
7. Altindas M, Kilic A. Is Boyd's operation a last solution that may prevent major amputations in diabetic foot patients? *J Foot Ankle Surg* 2008; 47:307–312.
8. Langeveld AR, Oostenbroek RJ, Wijffels MP, Hoedt MT. The Pirogoff amputation for necrosis of the forefoot: a case report. *J Bone Joint Surg Am* 2010;92:968–972
9. den Bakker FM, Holtslag HR, van den Brand JG. Pirogoff amputation for foot trauma: an unusual amputation level: a case report. *J Bone Joint Surg Am* 2010;92

10. Glady JF, Winters CL. The Boyd amputation as a treatment of osteomyelitis of the foot. *J Am Podiatr Med Assoc* 2000; 90(5): 234-239.
11. Eilert RE, Jayakumar SS. Boyd and Syme ankle amputations in children. *J Bone Joint Surg Am* 1976; 58(8) 1138-1141.
12. Westbery DE, Davids JR, Pugh LI. The Boyd amputation in children: Indications and outcomes. *Journal of Paediatric Orthopaedics* 2014;34(1) 86-91
13. Tosun B, Buluc L, Gok U, Unal C. Boyd amputation in Adults. *Foot and Ankle International*; 2011; 32: 1063-1068.