CHAPTER **14**

SYME'S AMPUTATION: A Retrospective Review of 10 cases

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INTRODUCTION

Combined structural and functional preservation of the lower extremities is the goal of healthcare professionals dedicated to limb salvage in high risk patients, especially the diabetic patient population which continues to grow at an impressively alarming rate. Unfortunately these goals are all too often not realistic or attainable due to a variety of pathological conditions most notably severe deformity/infectious processes in the soft tissue and bone, recalcitrant to conservative treatment modalities. Critical limb ischemia further complicates some cases. When limb salvage is not realistic, amputation, unfortunately, may become the only realistic solution. Far too often, a BKA or more recently a distal trans-tibial amputation is the outcome. The purpose of this paper is to increase the awareness of the value of the Syme's ankle disarticulation procedure as a potentially highly functional amputation with clear advantages and benefits over more proximal amputations.

In his original paper describing amputation at the level of the ankle joint in 1843, James Syme expressed lament at the number of limbs that he had previously cut off which might have been saved with an alternative procedure.[1] Undoubtedly, this is a feeling shared by many foot and ankle surgeons whose own patients have progressed to either a BKA or AKA for conditions that were not amenable to either forefoot or midfoot amputations. At the time of its introduction, the Syme's procedure was viewed as a major technical advance. The procedure was developed in the era prior to the advent of antiseptics and anesthesia and one of Syme's major goals was to develop a safer and more reliable procedure than the traditional below-the-knee amputation, which at that time had a mortality rate between 25-50%.[2]

Syme felt that compared to the BKA, the ankle amputation afforded a smaller risk of loss of life, a more comfortable stump and a more useful limb for support and progressive motion.[1] Wagner proceeded to popularize the procedure as both a limb salvage and function-sparing procedure.[3] He proposed a two-stage technique that he believed would significantly decrease the risk of infection and would also ensure the preservation of the heel pad and distal tibia as entities for direct load transfer, therefore, more closely simulating normal weight bearing. He widely utilized the Syme's procedure in patients with nonsalvageable infection or gangrene and, in an unpublished study, reported excellent results in more than 500 patients.

Today, more than 150 years after the introduction of the Syme's amputation, the risk of death from sepsis or hemorrhage following a below-the-knee amputation is virtually nil, making the Syme's amputation a safe procedure in the absence of co-morbid conditions in the patient who is undergoing lower extremity amputation. It can be argued that ankle amputation provides a more useful, durable stump that allows the amputee to function with little to no disability.

Periodic case reports in the literature have affirmed the long-term durability of this level of amputation with the subjects enjoying over forty years of success with the stump.[4,5] Recent studies have demonstrated a significant decrease in the energy and metabolic expenditures with ambulation experienced by patients having undergone an ankle disarticulation procedure versus a higher trans-tibial amputation or even a more distal midfoot amputation, making the Syme's procedure of even greater interest.[6-9] Current literature concerning morbidity and mortality demonstrates that patients having undergone a Syme's procedure experience less short-term morbidity and tend to survive longer overall when compared to patients having undergone a more proximal procedure.[10] Pinzur et al observed that approximately 33% of patients having undergone a Syme's ankle disarticulation had died at 5 years post procedure while 33% of trans-tibial amputees did not survive beyond 2 years.[10] The main advantages of the Syme's procedure are a potentially fully weightbearing stump of near-normal length, a swift and positive return to functional activity and decreased mortality when compared to trans-tibial amputation.

Despite these well-recognized advantages of the Syme's amputation, there has been a tendency towards its underutilization with the procedure enjoying widespread popularity only in Canada and Scotland.[2,11] The reasons for underutilization of the procedure are multifactorial. Perhaps it is the perception that wound healing is routinely difficult and prolonged or that that the residual stump is prone to ulceration or difficult to fit with a prosthesis. Perhaps it is the result of "tradition" that is passed on year in and year out with the established mindset being that a below-the-knee amputation is next in line after a failed midfoot amputation. Unfortunately, the truth is that this procedure is often avoided simply because many foot and ankle surgeons have been indoctrinated with the notion that the procedure simply "does not work." As a consequence, more recently trained foot and ankle surgeons, whether orthopedic or podiatric, receive little if any training in the Syme's amputation procedure. The authors believe that many of the concerns regarding this procedure are ill conceived misperceptions. The authors have previously published a comprehensive review of the procedure including a detailed description of the surgical technique. The senior author has continued to employ this procedure for a variety of foot and ankle conditions that would have traditionally required a higher-level amputation; a retrospective review of cases is presented.

SURGICAL CONSIDERATIONS

The Syme's ankle disarticulation is indicated primarily in diabetic patients suffering from gangrene, a severe Charcot process, non-healing dysvascular ulcers and severe nonsalvageable diabetic foot infections; compromised arterial circulation is not uncommon. The Syme's amputation may be employed in any patient suffering from a wide range of foot and ankle conditions including congenital deformities, trauma/crush injury, soft tissue and osseous sarcomas of the foot, ischemia, frostbite and osteomyelitis (Figure 1).

Contraindications to performing a Syme's procedure include inadequate blood flow to the ankle and rearfoot, infection or large open lesions of the heel pad, ascending cellulitis or lymphangitis, severely immunocompromised patients and/or malnutrition. A lack of potential for the amputee to become a community ambulator following the procedure should be considered a contraindication as well (Figure 2).[12-14]

Healing of the amputation has traditionally not been problematic in patients undergoing the procedure for reasons other than severe peripheral vascular disease and/or diabetes related manifestations. However, in cases where the procedure is being performed for the latter entities, it is important to confirm the patient's healing capacity for this level of amputation; such requirements have been outlined by Wagner and later modified by Dickaut et al and Pinzur et al.[15-18]

Wound healing parameters have been designed to predict whether the patient has the immunocompetence, nutritional status and arterial inflow to heal the amputation (Table 1). Immunocompetence is predicted by an absolute lymphocyte count greater than 1500. The absolute lymphocyte count may be calculated by multiplying the total white blood cell count by the percentage of lymphocytes. A low total lymphocyte count may significantly impair a patient's risk to

Figure 1. Preoperative x-ray demonstrating severe total collapse of the talus secondary to diabetic charcot neuroarthropathy. The patient had been essentially wheelchair bound for approximately one year and developed ulceration over the fibular malleolus. Due to extensive comorbid conditions including diabetes mellitus and blindness, amputation was recommended. She subsequently passed away several years following the amputation but did enjoy improved quality of life during this time.

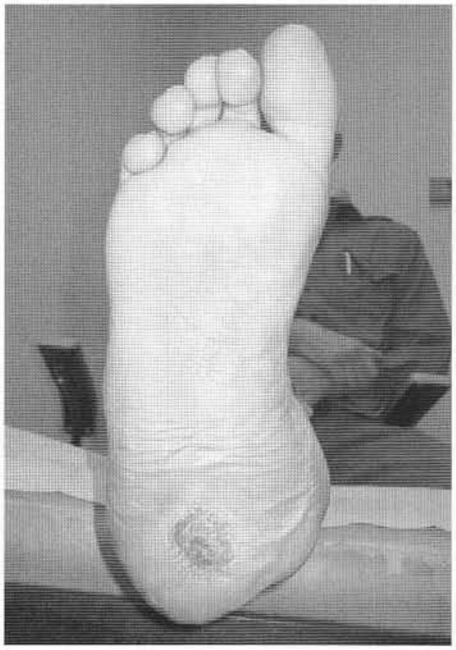

Figure 2A. Clinical and radiographic appearance of a patient with severe diabetes with multiple medical complications. The patient had sustained a severe diabetic mal perforans ulcer with chronic underlying osteomyelitis and sustained multiple surgeries. Complete atrophy of the plantar fat pad with adherence of the skin to the underlying bone was present, precluding the use of the plantar fat pad as the distal weightbearing stump in the Syme's amputation.

Figure 2B.

Table 1

PREOPERATIVE REQUIREMENTS AND PREDICTORS OF SUCCESS

Ankle-Brachial Index	> 0.5
Transcutaneous Oxygen Pressure	30 mmHga
Total Lymphocyte Count	1500
Serum Albumin Level	3.0 g/dl
Prealbumin level	16-35 mg/dL
Serum Glucose Level	< 250 mg/dL
Highly motivated patient	
Access to a highly skilled prosthetist	

ªWound healing parameters for lower extremity amputations

combat infection. A serum albumin level of greater than 3.0 g/dl (3.5-5.0 g/dL) and a total protein level of 6.0 g/dL (6.4-8.3 g/dL) or higher are required to assure a minimum level of tissue nutrition. Neither serum albumin nor total protein levels should be used singly as indicators of nutritional competence.

It has been shown that both albumin and total protein levels are affected by hepatic and renal disease, over and underhydration and should, therefore, only be used as nutritional indicators if used in conjunction with other markers.[19,20] Measuring the prealbumin level should be considered in all patients with a borderline or questionable nutritional competence. Normal serum prealbumin level should fall between 16-35 mg/dL, and generally a level under 10mg/dL is indicative of moderate to severe nutritional deficiency. The prealbumin level is not generally influenced by external factors and it provides an accurate representation of nutritional deficiency; it also can be used to monitor the effect of dietary supplementation. The authors recommend that all patients not meeting these minimum guidelines should undergo nutritional supplementation in the form of multivitamins, hyperalimentation of protein rich foods and L-arginine supplementation. L-arginine has been shown to promote wound healing and increase the immune response by creating a positive nitrogen balance and enhancing T-lymphocyte function.[21]

Optimum blood glucose levels should be maintained throughout the perioperative period to furthur augment healing of the surgical wound. If, after proper wound preparation, antibiotic management of acute infectious processes and adjunctive nutritional measures have been implemented and the patient fails to achieve the minimum recommended guidelines, a more proximal amputation might be warranted.

Adequate blood flow for healing is indicated by a palpable posterior tibial or dorsalis pedis pulse, an ankle-brachial index > 0.5and/or a transcutaneous oxygen concentration of at least 30 mm Hg. The ankle-brachial index has traditionally been most useful in identifying those patients who suffer from disease of the macrocirculatory system and would benefit from some type of revascularization procedure prior to any planned amputation. The ABI, however, is not a direct reflection of tissue perfusion. ABI's can be inadvertently elevated in the face of calcified vessels, making them difficult to occlude.[6,10,17] Measuring the transcutaneous oxygen tension may eliminate the concern of this variable.

Transcutaneous oxygen tension is measured through the application of superficially applied sensors on room air at multiple sites on the operative limb representing the various options for level of amputation; for example, the tibial crest, the anterior ankle and the dorsal midfoot. The sensors directly measure the oxygen delivering capacity or perfusion to the skin.[18] The general accepted value for healing an amputation site is >30mm Hg on room air.[3,6,10] Infected wounds, however, pose an additional challenge in that the increased bacterial load may falsely suppress the TcpO2 value secondary to increased oxygen consumption by macrophages and invading organisms.[10,18,22] Other considerations include operator error, proper device calibration, position of the limb and room temperature. All of the above factors may compromise the validity of the measured TcpO2 values.[22] Some authors feel that careful control of such variables will significantly improve diagnostic accuracy, making the transcutaneous oxygen measurement the most valuable tool in preoperative screening.[10,18,22]

One of the most important criteria for performing this procedure is the presence of a viable plantar heel pad as this will be the ultimate weightbearing interface between the tibia/fibula and prosthetic device. The plantar fat pad is composed of a meshwork of fat that is enclosed within fibroelastic septae arranged in a closed-cell configuration.[23] It is this unique anatomical configuration that allows the plantar fat pad to function as a shock-absorbing structure during ambulation. Given its importance in pain-free weightbearing, every effort must be made to maintain the structural integrity of the plantar fat pad during the Syme's procedure. This is best accomplished by employing subperiosteal dissection when removing the calcaneus. Various modifications to the standard incisional approach including an anterior ankle flap for use in patients in whom it is not possible to use the heel as a flap have been described.[24] While the anterior flap may provide adequate soft tissue coverage for an ankle amputation in which the heel pad is non-viable, it must be remembered that anterior flap does not contain the same shock-absorbing qualities of the plantar fat pad and may result in an uncomfortable stump, thereby eliminating a favorable aspect of the Syme's amputation (Figure 3).

Postoperatively, the first several weeks are critical for the Syme's amputation. It is during this time that the wound is most at risk for dehiscence, slough or other related complications. Hematoma and seroma formation are not uncommon occurrences and must be managed appropriately. Meticulous hemostasis and the use of a surgical drain will help to minimize this occurrence. In addition, wound healing complications can be

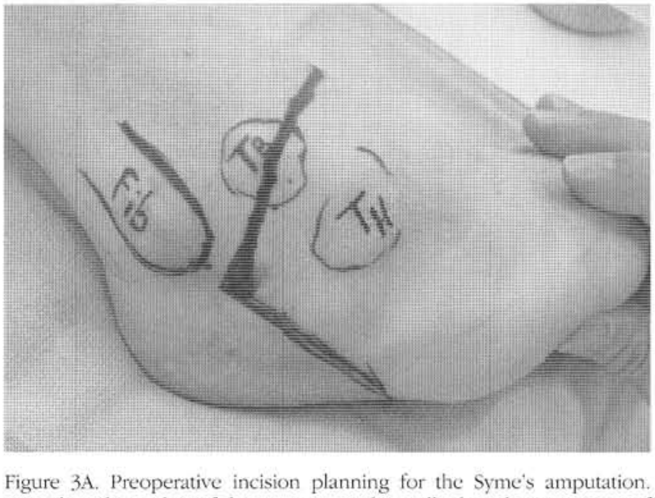

Figure 3A. Preoperative incision planning for the Syme's amputation. Note the relationship of the incisions to the malleoli and preservation of the plantar heel pad. The anterior incision is distal to the tibial plafond.

Figure 3B.

lessened by employing an atraumatic surgical technique; gentle tissue handling is essential. Inadvertent transection of the posterior tibial artery proximal to the distal aspect of the plantar flap may also compromise healing in the early days following the procedure. However, provided vascularity is maintained in the flap, predictable stability of the wound is typical following healing of the initial incision site.

Late complications may also occur. They include mobility/improper location of the plantar fat pad, stump sensitivity, neuroma formation and phantom pain; these complications are not, however, unique to this type of amputation and are associated with amputations in general.

PROSTHETIC CONSIDERATIONS

The prosthetic management of the Syme's level amputee must encompass several objectives. The prosthesis should compensate for the loss of foot and ankle motion while providing the propulsive energy required for ambulation. It is also necessary to compensate for the limb length discrepancy created by this level of amputation and to suspend the prosthesis adequately during swing phase of gait. This level of amputation has many functional advantages, but also has some prosthetic componentry limitations as well as cosmetic limitations due to the nature and shape of the residual limb being managed.

There are four basic designs of prostheses that are currently used in managing the Syme's level amputee. The posterior door design, also known as the Canadian design, is more commonly used on those with large or bulbous residual limbs and is frequently used with Chopart's amputations as well. This design is used least often as it is the least cosmetic and has a heavier weight as a result of the construction parameters used.[25]

The most frequently used design is the medial opening or medial door design. This design has great suspension characteristics due to the intimate nature of the socket construction. An elastic sleeve placed over the door improves cosmesis and facilitates the donning and doffing process by allowing the door to expand.[26]

Another design employs the use of an expandable inner liner enclosed within the rigid outer shell. This design allows for the distal end of the stump to pass through expandable bladder portion. This hidden panel expandable wall design is indicated for those with small distal ends and is considered the most cosmetic of all designs.[27]

The fourth and final design often used for the prepatory prosthesis is one that uses a removable foam liner that interfaces with the external socket. This offers the prosthetist the ability to modify the insert to allow for the atrophy that takes place in the limb during the maturation process. This design offers great cosmesis, is lightweight in construction, and is highly adjustable. The medial door, hidden panel, and removable foam liner designs are best utilized on residual limbs that have had the malleoli shaved for optimum reduction of distal end size.

Due to the length of the residual limb, prosthetic management has limitations in the number of prosthetic feet available. Traditionally, standard solid ankle cushion heel (SACH) feet were employed in prepatory Syme's prosthesis due to weight and biomechanical objectives being well-served with this foot. Geriatric and low level ambulators are still well served with this foot construction. Recently, there has been a resurgence in the development of energy storing or dynamic feet for the Syme's prosthesis, which offer decreased weight and enhanced performance for the amputee. These feet best serve those amputees that will challenge the limits of prosthetic use.

The investigation into the success of Syme's amputation has led several authors to explore whether an ankle disarticulation truly leaves the patient with a more functional and efficient limb when compared to more proximal levels of amputation. Pinzur, et al. discovered that both cadence and normal walking speed were both impaired as the level of amputation extended more proximally.[28] In addition, the rate of oxygen consumption and cardiac stress also increased with more proximal amputations. This is an important consideration given that much of the involved patient population has preexisting cardiovascular disease and that an amputation at any level creates new demands on the system as a whole, most notably the cardiac and respiratory systems.[29] Devices such as canes, walkers and crutches may offer the patients assistance and stability during ambulation, however, they negatively impact oxygen consumption, heart rate and energy expenditure due to the arm movements and strength required to utilize such devices.[30] Careful considerations must be made when planning the postoperative course of weight-bearing and prosthetic management in high-risk individuals.

From a prosthetic management prospective, it is the opinion of the authors that the advantages of the Syme's level amputation far outweighs most, if not all of its disadvantages. Advantages include decreased energy expenditure, more normal gait, and increased residual limb surface area to transfer and absorb socket pressures.[7] The disadvantages of the cosmetic appearance of the prosthesis and migration of the heel pad in some, are minor in comparison.[31]

CASE ILLUSTRATIONS

Case 1

GS is a 51-year-old female admitted to our institution with a 20-year history of Type I diabetes with multiple diabetic complications including neuropathy, retinopathy, nephropathy and cardiopathy as well as gastroesophageal reflux disorder and hypercholesterolemia. She had a complicated history of pedal problems including multiple surgeries of both feet with multiple hallux and digital amputations as well as partial ray resections. Her current problem consisted of a large chronic, non-healing ulcer with associated sinus tract and underlying chronic tarsal osteomyelitis caused primarily by MRSA. She had unsuccessfully been treated parenterally for a period of 6 months with vancomycin, ticarcillin/clavulanate and ciprofloxacin. Previous attempts at periodic debridement proved unsuccessful and the patient had been essentially wheelchair bound for several months before referral to our institution.

The patient was considered to be a poor candidate for post-BKA rehabilitation due to her prior history of myocardial infarction, ischemic heart disease and multiple comorbid conditions. She was taking numerous medications for diabetes. Physical examination revealed morbid obesity with stable vital signs. A large 2.5 cm cone shaped ulceration was present on the left foot with granulation tissue and a deep sinus tract. Exuberant serous drainage was present. Multiple digits were missing from prior amputations. Post surgical scars were also noted. There were no open wounds present on the right foot. Her WBC count was 11,000 on admission. Remaining laboratory studies were within normal limits. Non-invasive vascular studies revealed tibial vessel occlusive disease though digital PPG's suggested adequate perfusion for healing.

Pedal radiographs correlated with clinical observations, demonstrating multiple digital amputations and severe bony destruction (Figure 4). These findings were consistent with Charcot neuroarthropathy with a superimposed chronic osteomyelitis (Figure 5).

Reconstructive surgery was not considered a realistic option. Previous recommendations were for BKA. However, given her significant medical history, it was felt that a pedal amputation would be more appropriate with less compromise to her cardiorespiratory function. The patient readily accepted an option of Syme's amputation in lieu of a BKA. Prophylactic bracing with a custom ankle-foot orthosis and extra-depth shoe was instituted for her contralateral extremity. In December, 2002, she underwent a Syme's amputation under general anesthesia without immediate postoperative complications. Final pathology report was consistent with chronic ulceration, sinus tract formation and extensive acute and chronic osteomyelitis. Atherosclerosis and calcification of the medium sized arteries were also noted. She went on to successfully heal the surgical site uneventfully and without complication (Figures 6, 7). The patient was fitted with a temporary prosthesis at approximately 6 weeks after surgery but suffered several prosthetic complications including ill fit and back pain secondary to a persistent limb length discrepancy. After several adjustments she became fully ambulatory without gait assistive devices at approximately 1 year postoperatively.

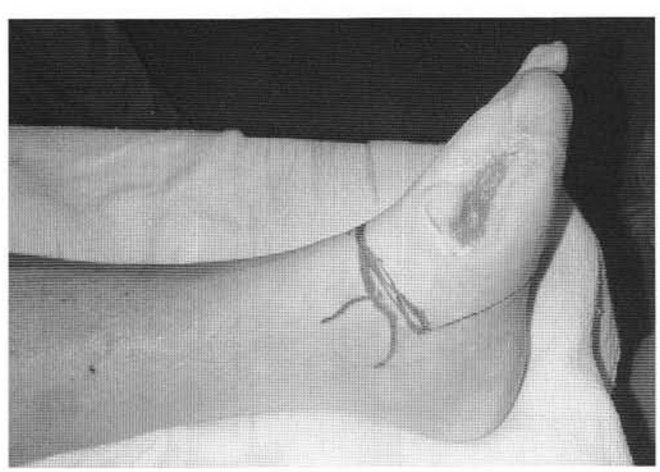

Figure 4. Preoperative clinical photograph of a chronic wound of the left foot. The patient has undergone multiple previous surgeries for debridement and partial amputations unsuccessfully.

Figure 5A. Preoperative x-ray demonstrating prior surgical resection with extensive chronic osteomyelitis extending into the tarsus and metatarsal bases of the foot. Further testing via MRI confirmed osteomyelitis.

Figure 5B.

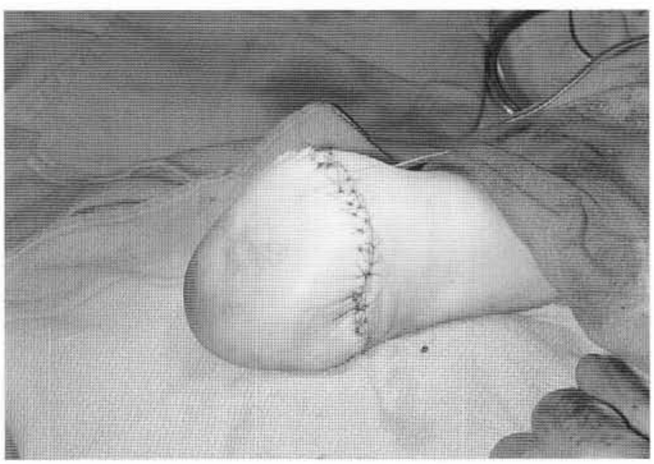

Figure 6. Intraoperative appearance following completion of the Syme's procedure and closure of the wound. Uneventful healing occurred. No further extension of the osteomyelitis occurred

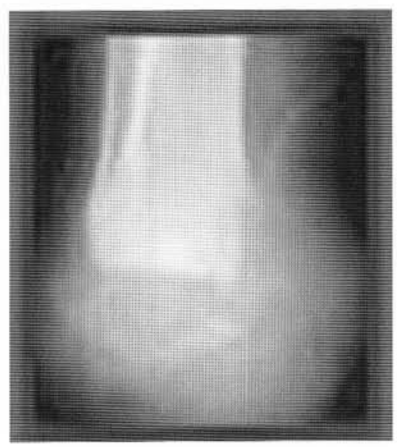

Figure 7. Following completion of the Syme's amputation, note the tapering and configuration of the distal stump with resection of the malleoli.

Case 2

LG is a 52-year-old male with past medical history of Type II NIDDM for two years, diabetic neuropathy, hypertension and hypothyroidism. On initial presentation the patient related a one-year history of redness and swelling about the right foot and leg but was not recognized as having an acute Charcot process until presentation to our institution in mid-2003. The delay in proper treatment resulted in significant pedal collapse and loss of structural integrity. The patient had multiple pedal complications beginning with a deep abscess, which went on to an extensive incision and drainage of the plantar foot in early 2003. Postoperative wound cultures revealed MRSA. The patient also underwent a third digit amputation of the same foot.

At the time of presentation the patient was taking multiple medications for his several medical conditions. Physical exam revealed a morbidly obese male with stable vital signs. There was a hyper-granular, full-thickness deep ulceration on the plantar aspect of the right foot measuring 5.0 x 6.0 cm in diameter with a large amount of serous drainage. The wound probed directly to bone. Conventional pedal radiographs, CT scans, indium scanning and bone biopsy confirmed the presence of widespread osteomyelitis of the tarsal bones (Figure 8).

A Syme's amputation was recommended in order to provide the patient with the best functional outcome and to minimize strain on the cardiovascular and respiratory systems. He was fully amenable to amputation and underwent a Syme's amputation in September of 2003. The patient did sustain a minor postoperative infection and wound dehiscence. A second surgery consisting of wound debridement and scar revision was performed approximately one month later. The patient went on to heal completely and was fitted with a temporary prosthesis in November of 2003. He has since been fitted with a permanent prosthesis and has no functional limitations to date. He is very pleased with his prosthesis and his current level of function (Figures 9, 10).

Case 3

GT is a 52-year-old male who presented to the office reporting severe right clubfoot deformity since birth. Correction via posteromedial release had been attempted at age 15 but was unsuccessful and the deformity had continued to progress. The patient had been treated with a CROW device but suffered chronic irritation and pain despite multiple adjustments and alterations. His symptoms were aggravated with ambulation and he complained

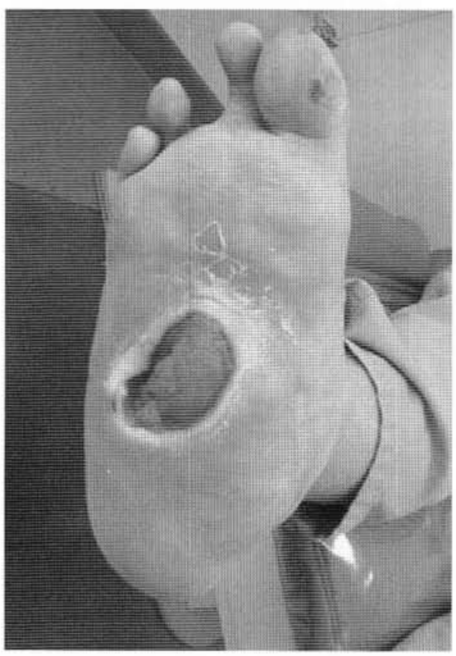

Figure 8A. Preoperative clinical appearance and lateral radiograph demonstrating severe mal perforans ulceration secondary to underlying diabetic Charcot neuroarthropathy with total collapse and fragmentation of the midtarsus and longstanding chronic osteomyelitis. The patient has had extensive chronic care without success and multiple bouts of oral and parenteral antibiotics.

Figure 8B.

Figure 9. Postoperative wound dehiscence necessitating revision including excision of the lesion and primary closure. The patient subsequently healed with further local wound care.

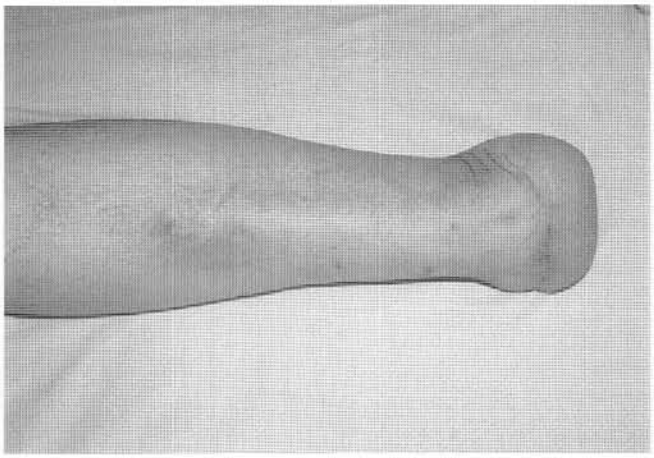

Figure 10. The final appearance of the stump following compete healing. No further breakdown or wound complications were experienced. The patient resumed full activites of daily living.

Figure 11A. Weightbearing preoperative radiographs of the ankle and foot demonstrating severe fixed deformity with joint dislocation. Previous surgical intervention failed. The patient had poor skin integrity overlying the medial aspect of the foot and ankle.

Figure 11B.

specifically of instability and loss of balance while walking. He had a PMH of spastic cerebral palsy, mitral regurgitation, obsessive compulsive disorder and hypertension. His current medications included Celexa and Wellbutrin. The patient was unemployed and on disability, he had strong familial support at home.

Initial physical exam revealed that the right foot was in severe equinus, adduction and varus malalignment. Overall, the foot was found to be quite rigid with significant fixed contractures of the medial tendons and ligaments compounded by contracture of the overlying skin. There was found to be severe muscle and soft tissue atrophy and severe digital deformities with complete dislocations at all of the metatarsophalangeal joints. Radiographs confirmed a complete medial subtalar and midtarsal joint dislocation as well as a ball and socket ankle joint with significant adaptive changes throughout (Figure 11).

Several options for staged surgical treatment were offered, including pantalar arthrodesis with probable talectomy followed by relocation arthrodesis of the hallux and lesser toes with a probable first metatarsal osteotomy. After explaining the high likelihood of medial wound complications and the prolonged recovery and convalescence period following this multistage reconstructive surgery, the patient and family expressed a major concern over his physical, mental and emotional limitations and his probable inability to remain NWB for any significant period of time due to mental impairment. Previous consultations with an orthopedic surgeon resulted in a strong recommendation for BKA. Multiple consultations with the patient and his family were performed. The option of a Syme's amputation was offered. The patient and family were amenable to amputation and decided to proceed with a Syme's disarticulation with the hope of attaining a quick return to full function without gait-assistive devices and to relieve pain.

The patient underwent a Syme's ankle disarticulation procedure in January of 2002. He had an uneventful post op course and successfully healed the surgical site. He was fitted with a temporary prosthesis in April of 2002 and progressed to full weight-bearing without assistive devices and no functional limitations (Figure 12). He has been very appreciative of his markedly improved quality of life and frequently refers to the prosthesis as his "new foot."

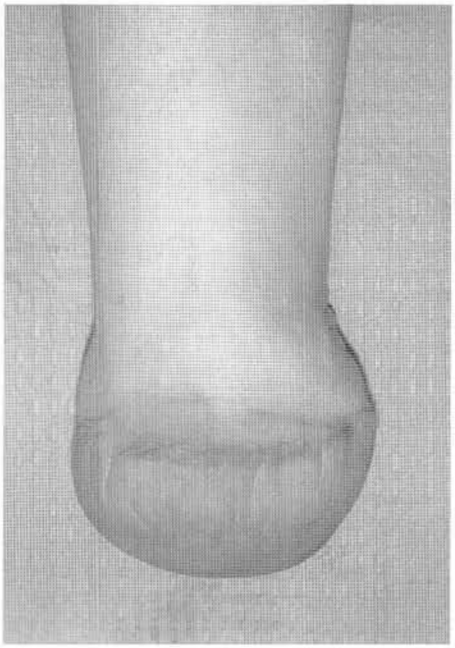

Figure 12. Final clinical appearance of the stump following successful uncomplicated healing. The patient resumed full weightbearing activities and was extremely pleased with the final outcome.

RESULTS

A retrospective review of ten cases performed at our institution between 1999-2003 was performed. Of the ten patients, 4 were female, 6 were male with an average age of 50. 4 years (range 22-76). Co-morbid conditions included diabetes mellitus (7 patients), hypertension (6 patients), ESRD (2 patients), RA (1 patient), morbid obesity (2 patients), CAD (2 patients), and hypercholesterolemia (3 patients). One patient had undergone a pancreas and kidney transplant seven years earlier and a second was status post CVA 8 years prior. Additional complicating factors included non-compliance with prior care and mental handicap secondary to CP (Table 2).

Of the ten patients studied, six underwent a Syme's amputation secondary to severe Charcot neuroarthropathy with or without underlying osteomyelitis; one patient had a non-salvageable foot secondary to deep space infection and osteomyelitis; one patient suffered both osteomyelitis and squamous cell carcinoma underlying a chronic, non-healing wound; one patient suffered a severe crush injury and traumatic amputation at the midfoot; one patient had a painful rigid severe clubfoot deformity secondary to spastic CP. All patients went on to successfully heal the surgical site, none of the patients progressed to a higher level amputation.

The most common postoperative complication was wound dehiscence which occurred in 5 patients, 2 patients required wound debridement and/or stump revision. One patient required revisional surgery due to a hypermobile stump.

Another common postoperative complication involved an ill-fitting prosthesis. Two patients developed minor wounds secondary to their ill-fitting prosthesis; three additional patients complained of a loose device, a heavy device or unstable foot prostheses. The average length of time before each patient was fitted with a temporary proxthesis was 10 weeks. One patient did not become ambulatory for 1.5 years due to an active contralateral Charcot process. Each of the remaining patients became fully ambulatory in a permanent prosthesis without gait assistive devices between 4-6 months postoperatively.

Overall, long-term follow-up was very encouraging, with 7 patients relaying improved quality of life postoperatively and ability to perform activities of daily living without limitation or assistance (Table 3). Two patients were lost to follow-up as of this study; both had progressed well postoperatively and had been fitted with temporary prosthetic devices, the third had difficulty ambulating due to the weight of her prosthesis and was using a wheelchair at the time of her last visit. One patient expired due to comorbid medical conditions approximately two years following the Syme's amputation.

DISCUSSION

Following its introduction in the late nineteenth century, many surgeons largely discarded the Syme's level amputation. This was due to the perception that there is high number of wound failure rates and difficulty fitting the residual stump with a functional prosthesis following the procedure. Since that time, two major technological advancements have helped to rekindle interest in the procedure. The first deals with the improved assessment of the various wound-healing parameters that help the surgeon to accurately predict the success of various amputation levels. The other development was an improvement in the materials, methods and techniques used to manufacture the prosthetic devices, providing an improved functional outcome for the amputee. Advances in prosthetic materials and technology have enabled the creation of highly functional prosthetic devices. However, it is important to remember that creating a quality prosthetic device requires a prosthetist with experience in the management of this level of amputation. Accordingly, the surgeon must ensure that a qualified prosthetist is available to ensure a well-fitting, functional device.

A rapid return to functional activity with decreased morbidity and mortality and a potential for full weight-bearing on a near normal length stump make the Syme's amputation the procedure of choice in many patients. Minimizing the metabolic cost of walking should be an important goal in the diabetic patient population with multi-system disease, especially those with limited cardiopulmonary reserve. The Syme's procedure provides a more energy efficient gait than mid-foot and higher-level amputations and requires minimal postoperative physical therapy. The ease of rehabilitation is associated with the decreased energy demands required from this amputation level when compared to a more proximal level of amputation. More current literature suggests longer survival rates in patients having undergone a Syme's procedure than a more proximal level amputation. A comprehensive review and study of the literature to date strongly suggests that it can markedly enhance the quality of life for high-risk patients requiring amputation of the foot when preservation of the foot and ankle are not possible.

The Syme's amputation procedure has proven to be valuable in the management of severe foot and ankle deformities that would otherwise require a higher level of amputation. Predictable healing of this procedure can be expected if proper wound healing parameters are met and the procedure is properly performed. Additionally, the ankle amputation is more likely to be accepted by patients as opposed to higher-level amputations, although female patients may be disappointed with the final cosmetic appearance. Furthermore, if this amputation should fail, it can be converted to a traditional below-the-knee or above-the-knee amputation without difficulty.

A final beneficial aspect of procedure is that patients can be weightbearing for short periods of time without the prosthetic device if necessary, further enhancing the overall quality of life for the patient. While ambulation is not likely to be normal or progress for a significant period of time, the stump is certainly capable of accepting weight-bearing loads for a short period of time or in an emergent situation when time does not permit application of the full prosthesis.

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