Figure 1.

Talectomy Procedure for Correction of Chronic Foot and Ankle Deformity:

A Retrospective Review.

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Introduction

Chronic and debilitating lower extremity deformities are a difficult problem for foot and ankle surgeons. These deformities have severe impact patient's lives and can lead to many complications[1-3]. When correcting these deformities, surgeons must be well versed in the diagnosis, management and outcomes of these deformities. Surgeons must present all treatment options including conservative and surgical. Surgical correction should be considered when bracing fails or infection forces surgery. Correcting chronic deformities can preserve limb function and can be used for limb salvage.

Soft tissue release can be used during surgical correction, however may not allow for complete reduction and can lead to high recurrence rates of deformity.[4] The talectomy procedure has been described in previous literature for many different uses.[4-8] It is a very powerful tool for correction of chronic lower extremity deformities. Many chronic deformities become rigid and irreducible. When correcting for a rigid, irreducible deformity a partial or complete talectomy may be required to get reduction. The talus can be re-implanted and/or used for autograft. Other types of graft may also be used to fill voids or correct deformity. This technique has been described for correction of talipes equinovarus, calcanealvalgus deformity, traumatic deformity, Charcot neuroarthropathy, and osteomyelitis of the foot and ankle.[4-8]

This study aims to describe the talectomy procedure for correction of lower extremity deformities performed by a single physician at a single institution. The study will also look at the different conditions treated and outcomes for deformity correction including limb salvage. The senior author on this study ,(DKW) performed these talectomies for chronic deformities between 2007 and 2016.

Materials and Methods

After Institutional Review Board approval was obtained, medical records were reviewed for patients who underwent a talectomy as part of a reconstructive procedure from 2007-2016. This represented a single surgeon series from the senior author of this paper (DKW). Patients were excluded if they had less than three month follow up or incomplete follow up for other reasons (including death or lost to follow up). Forty-five patients were identified and reviewed. All patients had a severe deformity that was non reducible. Etiology is shown in Table 1.

Patient electronic records were reviewed and the following information was extracted: cause of deformity, infection history of the involved ankle, ulceration at time of surgery, BMI, and the presence of relevant co-morbidities. Outcome measures of interest were minor and major complications and rate of functional limb at final follow up. Minor complication was defined as those not requiring unplanned return to the OR with major complications as those that did require an unplanned return to the OR. Functional limb status was defined as a limb that was stable, plantigrade ambulatory, either with or without the assistance of custom orthopaedic bracing. Other patient demographics that were extracted were age, sex, and laterality of deformity

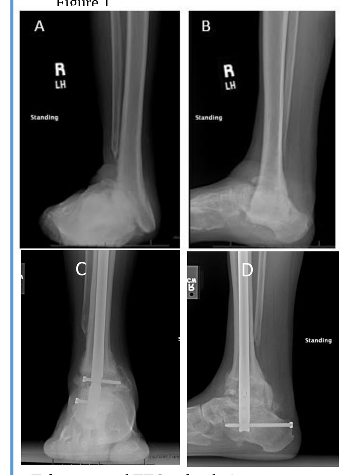
Table 1.

Underlying cause of neuropathy and/or deformity	Number of patients N=45 overall	Minor Complication N= 8/45 (17.7%)	Major Complication N= 13/45 (28.9%)	Functional Limb N= 38/45 (84.4%)
Diabetic Charcot Neuroarthropathy	24	3/24	8/24	20/24
Rheumatoid Arthritis	4	2/4	2/4	3/4
Charcot-Marie Tooth	4	0/4	0/4	4/4
Spina Bifida	3	0/3	0/3	3/3
Fetal Alcohol	1	1/1	0/1	1/1
Congenital Vertical Talus	1	0/1	0/1	1/1
Parkinson's Disease	1	0/1	0/1	1/1
Post Traumatic arthritis and deformity	2	0/2	2/2	1/2
Lumbar stenosis caused neuropathy/deformity	1	0/1	1/1	1/1
Reflex Sympathetic Dystrophy caused neuropathy/deformity	1	0/1	0/1	1/1
Unknown cause of neuropathy and/or deformity	3	1/3	1/3	2/3

Etiology of deformity and/or neuropathy leading to deformity.

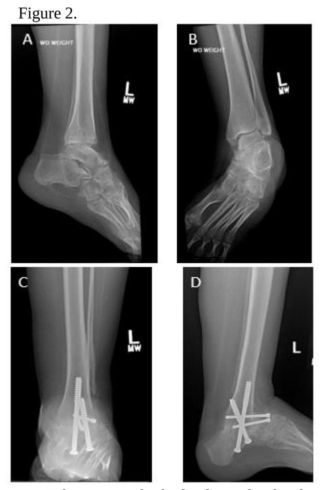
All patients in the study underwent surgery for limb salvage in an attempt to provide a functional limb for ambulation. Surgical correction varied from a single OR visit to multiple procedures for staged reconstruction. All patients required a tibio-talo-calcaneal arthrodesis (TTC) or a tibio-calcaneal arthrodesis. Fixation included internal, external, or a combination of both. A talectomy was required in all cases. Following the talectomy, the calcaneus was reduced beneath the tibia and the articular surfaces were prepared for fusion. At this point, three options were available: A) the talus was then either re-inserted (Figure 1), B) the talus was replaced with a femoral head allograft (Figure 2), or C) the talus removed without re-implantation and a tibio-calcaneal arthrodesis was performed (Figure 3). Prior to surgery, all 45 patients had a non-functional limb or a limb at high risk for amputation secondary to ulceration and infection. As a part of the preoperative evaluation and informed consent, patients were offered the choice of complex reconstructive surgery versus primary below knee amputation. This entire cohort of patients opted for the reconstructive approach.

Figure 1



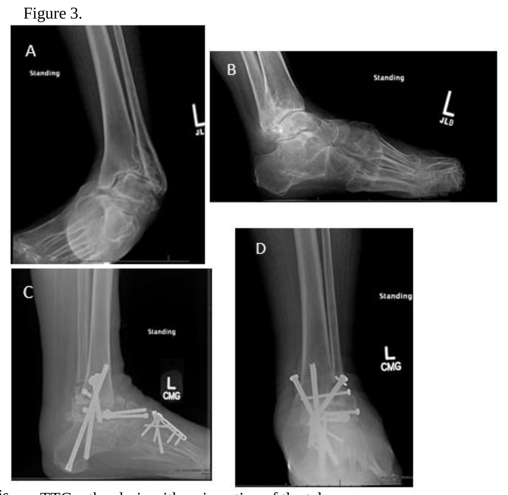
Talectomy and TTC arthrodesis with femoral head allograft.
A-B: Pre-op C-D: Post-op

Figure 2.



Talectomy with tibial-calcaneal arthrodesis
A-B: Pre-op C-D: Post op

Figure 3.



TTC arthrodesis with re-insertion of the talus
A-B: Pre-op C-D: Post op

Results are summarized into frequencies and outcomes. Statistical analysis was performed by using a Wilcoxon rank sum and Fischer's exact test to look at variables affecting selected outcome measures. The outcome measures evaluated were minor and major complications, as well as functional limb status.

Results

Average follow up was 38.3 months (range 5.5-110.3). Limb salvage with functional ambulatory status was achieved in 38 of 45 patients (84.4%) and seven patients (15.6%) ultimately underwent trans-tibial amputation. Table 2 shows patient characteristics and clinical data for the overall patient cohort, limb salvage and amputation groups. Of all variables evaluated, a history of infection and male gender were significantly associated with a non-functional limb and ultimate amputation. Of all other categorical variables, there was no statistically significant relationships with functional limb status at final follow up.

Table 2

Results	Overall N=45	Functional Limb N=38	Amputation N=7	P value
Age years (range)	54.4 (23-79)	54.2 (23-79)	57.2 (47-69)	0.96*
Gender (% male)	22/45 (48.9%)	16/38 (42.1%)	6/7 (85.7%)	0.047**
Diabetes (%)	24/45 (53.3%)	20/38 (52.6%)	4/7 (57.1%)	1.00**
Neuropathy (%)	39/45 (86.6%)	32/38 (84.2%)	7/7 (100%)	0.57**
BMI (range)	33.6 (18.1-59.6)	33.0 (18.1-59.6)	36.9 (26.4-48.5)	0.21*
Length of Follow up months (range)	38.3 (5.5-110.2)	35.2 (5.5-89.2)	55.0 (18.4-110.2)	0.11*
History of infection (%)	21/45 (46.7%)	15/38 (39.5%)	6/7 (85.7%)	0.0389**

Patient characteristics and clinical data for the overall patient cohort, limb salvage and amputation groups
* Indicates p-values from Wilcoxon rank sum test
** Indicates p-values from Fisher's exact test

Other co-morbidities that may have possible affected outcome are shown in Table 3. Neuropathy was present in 18 of 21 patients who had complications (86%). This relationship was statistically significant with a Wilcoxon rank sum test ($p=0.024$). There were no other categorical variables that were significantly related to complications.

Table 3.

Co-morbidity	Number of patients N=45 overall	Minor Complication N= 8/45 (17.7%)	Major Complication N= 13/45 (28.9%)	Functional Limb N= 38/45 (84.4%)
CAD	10/45	1/10	1/10	9/10
ESR	5/45	1/5	0/5	5/5
PVD	10/45	3/10	2/10	8/10
Hx of Infection	21/45	3/21	10/21	15/21
Wound at time of sx	18/45	4/18	6/18	15/18

Other co-morbidities and outcomes related to each

In this study, 21 patients underwent a talectomy with re-implantation of the talus and TTC arthrodesis, 12 underwent a talectomy with femoral head allograft and TTC arthrodesis, and 12 underwent a talectomy without re-implantation and subsequent tibio-calcaneal fusion. There was no statistical significance in outcomes between different procedure groups.

Discussion

Management of chronic and limb threatening foot and ankle deformities is a difficult issue facing foot and ankle surgeons. Surgical correction for limb salvage often leads to complications and limb loss[2-3]. The talectomy procedure was originally described for treating congenital deformities in children, mainly congenital talipes equinovarus and severe calcaneovalgus.[4] Others have described this in patients with severe trauma to the talus.[7] Few publications exist describing the procedure for adult chronic deformities. Mirzayan et al.[8] described the procedure for neglected adult deformity in order to provide a functional ambulatory limb. They performed a talectomy with tibio-calcaneal fusion in seven patients reporting good outcomes at nine month follow up. Kolker and Wilson[6] performed a talectomy as a salvage procedure in patients with osteomyelitis of the talus, reporting good results in three patients at an average follow up of 31 months. Talectomy has also been described in patients with Charcot neuroarthropathy.[9] To the authors' knowledge, this is the largest series describing talectomy in adults with severe foot and ankle pathology.

The current study shows that a talectomy as part of a reconstruction resulted in 84.4% limb salvage rate. Our complication rate was 46.7%, which is comparable to other studies reporting lower limb salvage and complication rates.[2,3,10] Our treatment was individualized, but in general, patients without infection and with reducible deformity after the talectomy were treated in single stage fashion. Patients with an active infection or who were unable to be reduced completely after the talectomy were treated in a staged procedure. Staged procedures often included temporary stabilization in an external fixator, using static and dynamic methods. In patients with active infection, a temporary antibiotic cement spacer was utilized along with long term systemic antibiotics to eradicate infection prior to final fixation.

Patients presenting with a history of infection had 89% lower odds of having a functional limb at final follow up ($p=0.0389$). Interestingly, patients with diabetes, CAD, ESR, and PVD did not show a statistically significant difference in functional limb status. All patients who underwent major amputation had neuropathy, however no significant correlation was found with neuropathy and functional limb status. There was also no significant relationship between functional limb status and which procedure was performed; re-inserting the talus, utilizing femoral head allograft, or performing tibio-calcaneal arthrodesis.

There are, as with every study, some limitations of the current study to discuss. First, this study was a retrospective review based on the only available data from the electronic medical records. Although only complete records were included this this study, the results rely on the accuracy of previous documentation. A second important limitation of this study is the small sample size of each subset of patients. Forty-five patients is the largest cohort to date of patients undergoing a talectomy, however there were categorical and etiological groups with only one or a few patients. This limits our ability to make broad conclusions about the observed findings related to outcomes of patients undergoing a talectomy. Additionally, as a single physician's patient series, selection bias through operative judgment on the part of the senior author is unavoidable. Since the senior author diagnosed and treated these patients, outcome bias is also a possibility.

In conclusion, patients with chronic limb threatening deformity of the lower extremity can be treated with a talectomy procedure with a high rate of limb salvage. As one may expect, this is challenging and associated with a high complication rate. Patients with a history of infection should be counselled on the possibility of requiring major amputation. Ideally, a diverse prospective population of patients with long term follow up should be studied to validate these observations and make further recommendations.

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