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Radiographic Comparison of Partial Versus Complete Second Digit Amputation

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Statement of Purpose

To compare radiographic and clinical outcomes of patients with complete second digit amputation (disarticulation at the level of the metatarsophalangeal joint) versus those with partial amputation of the a complete second digit.

Literature Review

Amputation of the second digit for infection, vascular disease and hammertoe deformity is a common surgical procedure. The second toe acts as a buttress to stabilize the hallux and first metatarsophalangeal joint against abductory forces. It is believed that removal of the second toe can lead to lateral drift of the hallux and the formation, or progression, of hallux valgus. The development of hallux valgus deformity, especially in a patient with history of previous amputation, puts the patient at an increased risk of new ulceration development and possible subsequent infection. Often, it is at the surgeon's discretion whether the amputation should be performed as a complete amputation (disarticulation at the level of the metatarsophalangeal joint) or as a partial amputation. Partial amputation constitutes amputation transecting the proximal phalanx or disarticulation at the interphalangeal joint.

No formal study has compared the development of hallux valgus after partial versus complete amputation of the second digit. This possible sequelae of digital amputation has been previously explored in the literature to a limited extent. Seligman et al published a case report describing the development of severe hallux abducto valgus secondary to amputation of the second metatarsal head and toe¹. Seligman argued that the amputation must be followed by use of a prosthetic space filler to prevent lateral drift of the hallux. Gallentine performed a retrospective review of 17 complete second digit amputations to address hammertoe deformity in FAI 2005². They reported 12 incidences of valgus drift of the great toe post-operatively and 4 cases of medial movement of the third toe². Beyaert recorded the development of hallux valgus in children after amputation of the second toe and partial second metatarsal for digital reconstruction³. Seven cases of hallux valgus were observed in their 5 year follow-up time period, however 5 of those cases were also noted to have hallux valgus to the non-operative foot³.

Methodology & Procedures

Based on current procedural terminology code, the medical record numbers for all complete and partial second digit amputations in diabetic patients performed at a Gundersen Health System facility by a DPM from January 1, 2007 to December 31, 2017 were obtained. In order to be included in the study, both pre and postoperative radiographs must be available for review. Postoperative radiographs must be at least one month status post surgery. The hallux abductus angle (HAA) and transverse plane deviation angle at the third metatarsophalangeal joint were measured transverse plane deviation angle (TPA) on preoperative and postoperative radiographs (Figure 1). Other outcomes collected through retrospective chart review included: patient age at amputation, sex, hemoglobin A1C at time of amputation, time to healing, re-ulceration and re-amputation. Statistical analysis comparing the radiographic and clinical outcomes for the complete and partial amputation groups was completed using t-test and chi square analysis, with a p-value <0.05 indicating statistical significance.

Case Study

Table 1

Comparison of Radiographic Outcomes

	Pre-op HAA Avg.	Post-op HAA Avg.	Pre Vs. Post Operative	Partial Vs. Complete	Pre-op TPA Avg.	Post-op TPA Avg.
Partial (N = 14)	15.6 °	17.4 °	P = 0.56	Pre-op (P = 0.45)	13.6 °	15.0 °
Complete (N = 13)	18.3 °	24.5 °	P = 0.70	Post-op (P= 0.21)	20.0 °	19.0 °

Table 2

Comparison of Clinical Outcomes

	Time to Healing (Days)	Partial Vs. Complete	Re- Ulceration	Partial Vs. Complete	Re- Amputation	Partial Vs. Complete
Average	127.6		77.8 %		59.3%	
Partial (N=14)	87.7	P = 0.22	78.6 % (N =11)	P = 0.46	50 % (N =7)	P = 0.17
Complete (N = 13)	178.4		76.9 % (N = 10)		69.2 % (N = 9)	

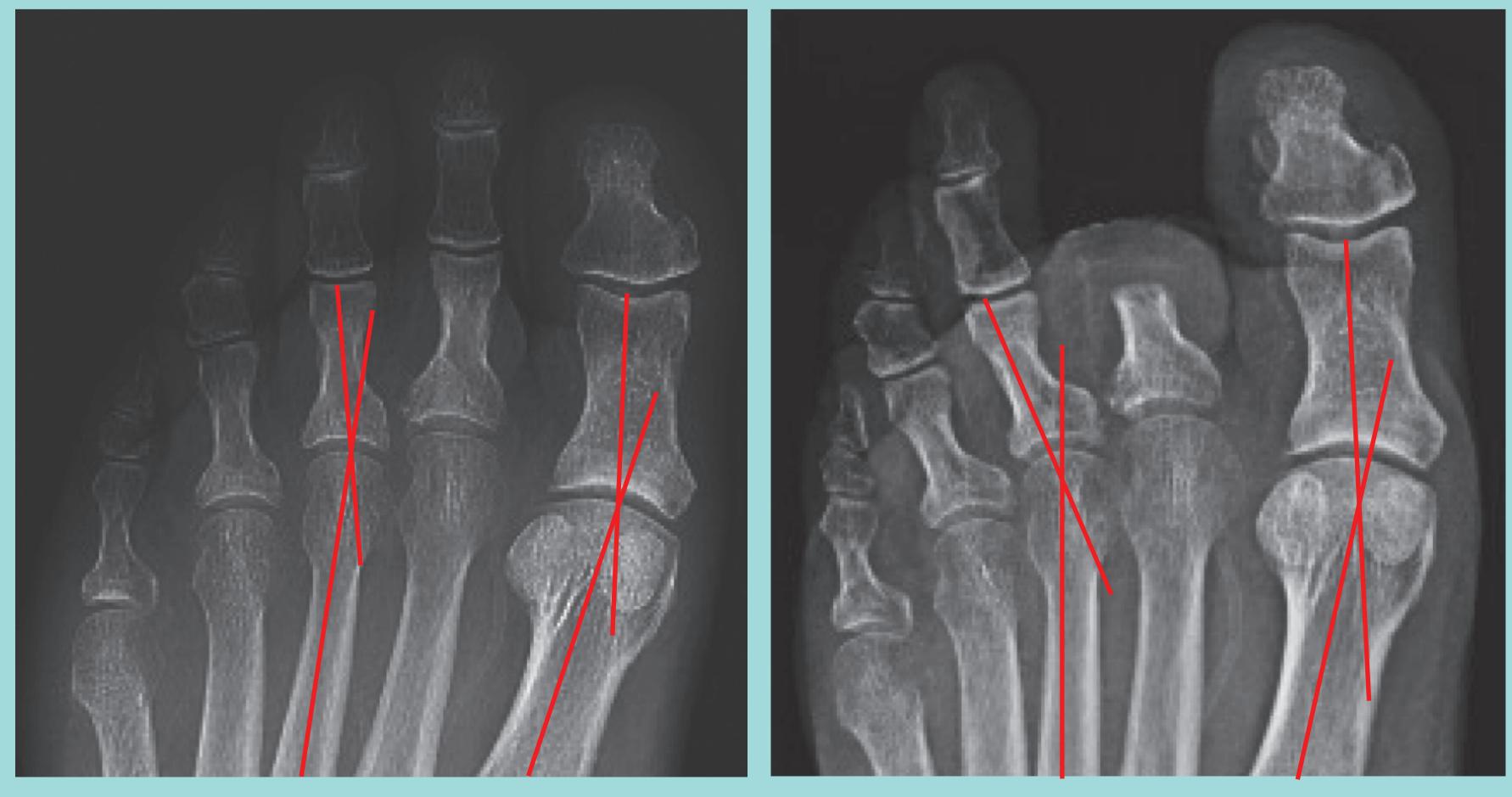


Figure 1: Example Pre and Postoperative Radiographs with HAA and TPA angle.

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Pre Vs. Post Operative	Partial Vs. Complete		
P = 0.42	Pre-Op (P = 0.028)		
P = 0.82	Post-Op (P = 0.28)		
Hemoglobin A1C (Avg.)	n Partial Vs. Complete		
7.95 %			
8.2 %	P = 0.59		
7.7 %			



Figure 2: Preoperative second digit ulceration. Postoperative development of hallux ulceration.



Results

159 amputations were identified on retrospective review. After inclusion criteria were applied, 14 partial and 13 complete amputations remained. The indication for operative intervention was osteomyelitis associated with diabetic foot ulcer for all cases. The average age at the time of amputation was 66.7 years (range 43 - 91). The majority of patients were male (7 female). 14 left toes and 12 right toes were included in the study. On preoperative radiographs, the HAA was not significantly different between the two groups (p=0.45), however the TPA was significantly larger for the complete amputation group (p=0.0279). There was no significant change in HAA or TPA in either group after surgical intervention, and no significant difference between the groups (Table 1).

The average time to healing overall was 127 days with no significant difference between groups. 2 of the patients in the complete amputation group never achieved healing of the second digit amputation before progressing to a more proximal amputation level. Overall 77.8% of cases re-ulcerated and 59.3% of cases had an additional amputation, with no significant difference between the amputation groups (Table 2). One partial digit amputation patient required a more proximal amputation at the level of the second metatarsophalangeal joint. After a partial amputation, the most common re-amputation sites were the hallux (N = 5) and third digit (N = 5), these were also the most common sites of re-ulceration in this group (N = 6 hallux; N = 8third digit). The hallux was the most common site for re-amputation in both groups (N = 4 complete amputation group), (Figure 2). After a complete second digit amputation, the most common amputation was at the transmetatarsal level.

Analysis & Discussion

There was no statistical difference between the radiographic or clinical outcomes in the complete versus partial amputation group. Results may have been skewed towards poor patient outcomes overall for both groups as those who were suffering from new ulceration and/or requiring further amputation would be more likely to obtain postoperative radiographs, our key inclusion criteria. After either procedure, the hallux was the most common site for re-ulceration indicating that this area should be carefully monitored after any second digit amputation. The most common re-amputation site after a complete second amputation was at the transmetatarsal level versus an additional digital amputation in the partial amputation group, however this did not reach a level of statistical significance. Both groups remained at a high rate of re-ulceration and re-amputation. The decision to perform a complete of partial amputation remains at the surgeon's discretion, with our results emphasizing the importance of continued monitoring for these high risk patients

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