

## A Retrospective Study of Claw Toe Repair Combining Partial Proximal Phalangectomy (PPP), Proximal Interphalangeal (PIP) Joint Interpositional Arthroplasty and Kirschner Wire Fixation

Reuven Lexier\* and Amanda JL Weston

Department of Orthopaedics Toronto Western Hospital Toronto, Ontario

### \*Corresponding author

Dr. Reuven Lexier, 340 College Street, Suite 210 Toronto, Ontario Canada M5T 3A9

Submitted: 24 Jan 2020; Accepted: 30 Jan 2020; Published: 04 Feb 2020

### Abstract

**Background & Objective:** Various operative methods have been used for the repair of claw toe deformities. We present a review of a combination of three operative procedures performed for the correction of this deformity.

**Methods:** A review was conducted examining 105 patient clinical records over a ten year period. Patients who received either one or a combination of the following procedures: Partial Proximal Phalangectomy (PPP), Proximal Interphalangeal Joint (PIP) interpositional arthroplasty, and k-wire fixation were included.

**Results:** Over a ten year span, a total of 86 PPP, 124 PIP and 29 k-wire fixations were performed on 96 patients. Of the 105 clinical cases reviewed, there were only 4 recurrences of claw toe deformity. Early complications included k-wire backout/breakage, reversible avascular toe in the recovery room, and pin site infection.

**Conclusions:** The combination of the three procedures presented, are an optimal operative treatment for the repair of claw toe deformity in various patients. Assessments can be made during surgery to determine if the procedures should be used solely or in combination based on the level of deformity. This customizable technique presented a minimal level of early complications and a low recurrence rate.

**Keywords:** Proximal Interphalangeal Joint Arthroplasty; Partial Proximal Phalangectomy; Kirschner Wire.

### Introduction

A variety of operative methods have been used in the past for the repair of claw toe deformities of the lesser toes [1-6]. Operative repair of the lesser toes is in fact, the most commonly conducted orthopaedic intervention in practice today [5]. Claw toes in particular, are one of the most common problems seen in patients by foot and ankle surgeons [1]. Although there is a high prevalence of claw toes observed in patients, there is currently no uniform definition of the deformity in the literature. A review conducted by cited 23 articles providing a clear definition of claw toe deformity [5]. For the purposes of this review we will refer to the general consensus for the essential characteristics of claw toe deformity which was defined as: metatarsophalangeal extension and flexion of the proximal Interphalangeal and distal Interphalangeal joints [5].

As a result in the lack of uniformity in the definition of claw toe, it is not surprising that there are also many operative treatments used for the correction of claw toe [1, 5]. In spite of the fact that various

authors have presented a variety of techniques for the correction of claw toe deformity, there is still no unanimity as to which treatment is most preferred [7]. This is perhaps due to the fact that patients who present with this deformity can range in age and medical history [1]. The ideal and optimal operative treatment should be a procedure that not only relieves physical pain and deformity, but also provides a high level of patient satisfaction [1, 7, 8]

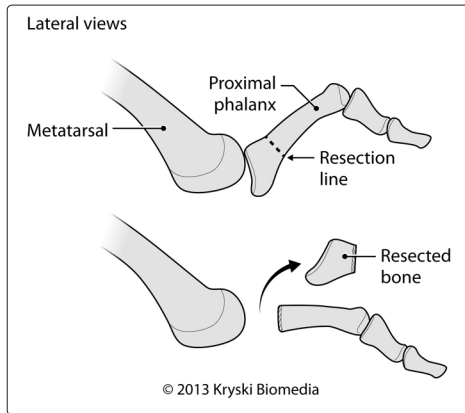
This review will present a new method for the correction of the deformity, which uses a combination of three operative procedures: Partial Proximal Phalangectomy (PPP), Proximal Interphalangeal Joint (PIP) arthroplasty and Kirschner Wire (k-wire) fixation. The three procedures offer an optimal solution for the majority of patients who suffer from claw toe deformity because they can be used solely or in combination with one another based on the requirement of the individual patient. Furthermore, a chart review of cases that involved any combination of these procedures will be presented. The purpose of conducting such a review is to present an alternative operative solution for patients presenting with claw toe deformity as well as to provide a quality assessment of the three operative procedures by observing the short term complication and recurrence rates of

patients that had received these treatments.

## Methods

### Partial Proximal Phalangectomy

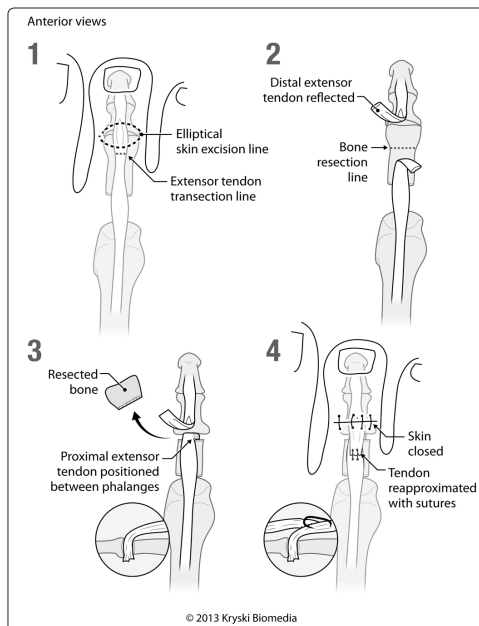
To begin, a longitudinal incision was made over the metatarsal phalangeal joint of the affected toe. A capsulotomy was performed and the base of the proximal phalanx was exposed. Using an oscillating saw, five millimeters of the base of the proximal phalanx was resected (Figure 1).



**Figure 1:** Partial Proximal Phalangectomy (PPP) operative procedure as performed on patients between 2001-2011

### Proximal Interphalangeal Joint Arthroplasty

If a fixed flexion deformity greater than 15 degrees remains after the PPP procedure, then the surgeon also performed a PIP arthroplasty. To begin, an elliptical skin incision was made at the Proximal Interphalangeal joint of the toe. The extensor tendon was then transected, five millimeters proximal to the PIP joint. The collateral ligaments were then resected, allowing us to remove the distal five millimeters of the head and neck of the proximal phalanx with a rongeur (Figure 2). The joint was then irrigated and placed in anatomical position so we could determine if an adequate excision of bone was performed.



**Figure 2:** Proximal Interphalangeal joint (PIP) arthroplasty operative procedure in four steps as performed on patients between 2001-2011

### Kirschner Wire Fixation

In order to stabilize the toe for adequate healing, a 1.6 (0.063) diameter smooth k-wire was used and inserted from the middle phalanx base retrograde to underneath the nail distally. At the PIP joint level the extensor tendon was reapposed and imbricated into the joint affecting an interpositional arthroplasty. This maintained the PIP joint in neutral degrees. The k-wire was then driven antegrade up through the proximal phalanx and into the respective metatarsal shaft while holding the toe in anatomical position. Finally, the subcutaneous tissues, any remaining capsule and skin were closed with sutures in the standard fashion. The k-wire was trimmed and bent into an upward 90 degree position. The k-wires were typically left in the foot for six weeks postoperatively. Patients were provided with hard soled Velcro shoes postoperatively and advised to weight bear as tolerated (WBAT) during this time.

### Chart Review

A chart review was completed that examined 105 surgeries of 96 (non-consecutive) patients that underwent operative repair for claw toe over a ten year period (2001-2011). The patient must have presented with claw toe deformity in one or more of the lesser toes on either foot; only cases that involved one or a combination of the three procedures (PPP, PIP and k-wire) were included in the review. The study protocol was approved by the Research Ethics Board of University Health Network.

### Data Collection

The data collected from eligible patient charts included: age (at time of surgery), gender, operative procedure, date of surgery, location of toes/feet operated on, follow up date(s), type of anaesthetic, complications and recurrence rate if applicable. Complications were defined as: early if they occurred within six weeks postoperative, and late if they occurred beyond six weeks postoperative.

### Results

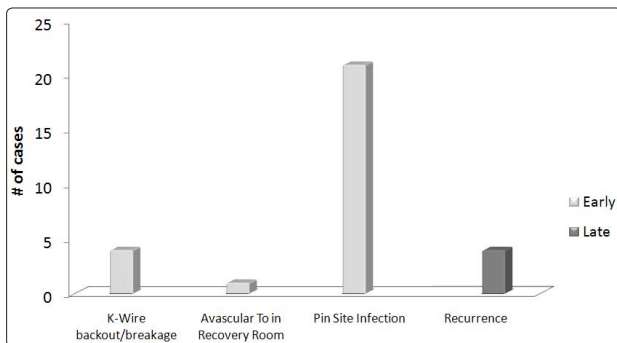
Our sample of 105 surgical cases included 96 patients in total. Of those patients, 81 were female with a mean age of 60 years (range 28 to 87, SD 12.253); the remaining males had a mean age of 59 years (range 25 to 79, SD 12.586). The majority of the cases were bilateral (45%), while 34 percent were right feet only, and the remaining 21 percent left feet only. Patients presented with one of more of the following: varus or valgus deformity, callouses and/or skin breakdown, metatarsalgia, and dislocation of the joint.

All cases reviewed involved at least one of the three operative procedures described in the methods section (Table 1). Some patients underwent concurrent surgeries (chevron osteotomies and Marin fusions). However, the use of k-wire for operative repair stabilization was not utilized until 2008. The type of anaesthetic used was typically a popliteal block alone or in combination with general anaesthetic. Follow-up visits ranged from two and half months to four years with an average of two and a half months. Standard follow up regimen was visits at one, three and six weeks and three months.

**Table 1: Surgical Procedures by Date**

Year	# of cases	PPP	PIP	K-Wire
2001	1	1	1	---
2002	8	7	14	---
2003	11	2	16	---
2004	9	7	14	---
2005	9	7	9	---
2006	18	12	26	---
2007	13	12	14	---
2008	8	8	9	7
2009	5	7	6	5
2010	11	10	10	7
2011	12	13	5	10
Total	105	86	124	29

Complications were observed in 30 cases. Early complications included: pin site infection (superficial within the soft tissue, antibiotics were prescribed), k-wire back out or breakage, and reversible avascularity of the toe (Figure 3). The only late complication observed was a recurrence of the claw toe deformity. There were four recurrent cases in total with revision of each case being undertaken within the span of the chart review (Table 2). These recurrent cases did not involve patients with neurologic disease, compartment syndrome or stroke.



**Figure 3:** Complications from 2001-2011 operative claw toe cases

**Table 2: Recurrent cases by date**

Year	Recurrent cases	Date of revision
2001	---	
2002	1	
2003	1	
2004	---	2002 case revised
2005	---	7
2006	---	12
2007	2	2003 case revised
2008	---	2007 1 <sup>st</sup> case
2009	---	revised
2010	---	2007 2 <sup>nd</sup> case
2011	---	revised
Total	4	

**Discussion**

Many types of operative interventions have been used to treat claw toe deformity. The ideal treatment should not only relieve the deformity, but improve or eliminate patient pain and discomfort [9]. The combination of PPP, PIP arthroplasty and k-wire fixation utilized in this review offers a novel solution for the operative treatment of claw toe deformity, with an overall positive outcome for patients. Based on the data we reviewed, we focused mainly on the elimination of the deformity in these cases as patient satisfaction and pain could not be assessed retrospectively.

Partial Proximal Phalangectomy historically has posed problems due to the recurrence of extension deformity in some cases [10]. Poor results with PPP were first noted by Cahill and Connor in 1972; 50 percent of their PPP cases presented with bad results [11]. A 1994 study presented results from 52 patients reporting 29 percent of patients as unsatisfied [12]. A study reviewed by Shirzad et al stated a 75 percent failure rate when PPP was used alone [6]. Observed a 35 percent rate of patient satisfaction in cases where PPP was utilized for mild rheumatoid forefoot deformities; however, it was noted that the state of rheumatoid disease in the patient could have been a factor in the success of the procedural outcome [4]. In this review, only 86 PPP procedures were performed, most in combination with PIP and/or k-wire fixation.

PIP arthroplasty has been implemented in previous cases of claw toe deformity. O’Kane et al reviewed 100 that utilized Proximal Interphalangeal joint excisional arthroplasty [13]. They observed patient satisfaction of 9.3 on a rating scale from zero to ten. They also recorded an AOFAS clinical rating change from 46 preoperatively to 94 at clinical follow up. In our review of 105 cases there were 239 procedures of which 124 were PIP arthroplasties; accounting for the majority of the procedures completed. The PIP arthroplasty procedure appeared to provide our patients with a successful outcome as well, and could have contributed to the low recurrence rate observed. All short term complications observed were also noted in patients examined by Feldbrin et al, who also utilized k-wire fixation [14].

Due to the early recurrences observed, the use of k-wire fixation was implemented in cases from 2008 to 2011. Freiberg notes advantages of k-wire fixation as providing semi-rigid fixation, the main disadvantage being the need for a follow up to remove the k-wire [9]. K-wire fixation is the most common technique used in other procedures for the repair of claw toe deformity [14, 15]. An example of pre and postoperative K-wire fixation is shown in (Figure 4). In this review, we noticed that the only recurrent cases occurred prior to the introduction of supplementary k-wire fixation.



**Figure 4:** X-ray image of the pre and post operative claw toe

Some authors have stated a preference for PIP arthrodesis for the surgical correction of claw toe deformity [14, 16]. However there are still competing ideas with regards to the use of k-wire versus intramedullary devices using this technique [16]. Ellington admits that the best surgical technique for claw toe deformity has yet to be determined, and that treatment should be uniquely tailored to each patient's needs [7].

Recurrence of deformity is often a good way to measure a successful operative outcome, as the patient will often return to complete a revision [17]. A ten percent recurrence rate of deformity using the flexor tenotomy procedure [17]. Their procedure offered a quick and efficient technique for claw toe repair in complex foot cases, however complications such as lack of toe grasping were observed in ten percent of cases. During the ten year span of this chart review, patients only encountered a recurrence rate of four percent, with minimal short term complications, however more exploration is needed to assess the patient's toe function postoperatively. The patients in this review were seen in the fracture clinic of a teaching hospital within a large city. Due to the nature of this practice, it was difficult to obtain long-term contact with patients. Patients that did experience any complications or recurrences did tend to return to the original surgeon on their own accord.

## Conclusion

This review suggests a new combination of techniques for operative claw toe repair with a low short term complication rate. However we are limited in that this was only a chart review. This study included a wide age range of patients (25 to 87). Future studies should examine this technique using a prospective experimental design for various age cohorts to determine the ideal group to receive such a treatment. We would also recommend an extended period for clinical follow up to observe long term complications, if any. No statements regarding patient satisfaction can be made from the data available; this is a possible avenue for further exploration in the future.

There are a variety of treatment options available for patients who suffer from claw toe deformity, both conservative and operative. This paper presented a new operative alternative that utilized three procedures in combination to treat this common deformity. This grouping provides a novel alternative for patients as it allows the surgeon to assess the severity of the patient's deformity intraoperative and provide treatment customized to their needs. This treatment is recommended for patients who experience pain, calluses, metatarsalgia, or varus or valgus deformity/dislocation due to claw toes. With a low observed complication and recurrence rate, this procedure offers surgeons an alternative option for the operative treatment of claw toe deformity.

## References

1. Angirasa AK, Augoyard M, Coughlin MJ, Fridman R, Ruch J, et al. (2011) Hammer toe, mallet toe and claw toe. *Foot & Ankle Specialist* 4: 182-187.
2. Arnis Freiberg (2007) Management of proximal interphalangeal joint injuries. *Canadian Journal of Plastic Surgery* 15: 199-203.
3. Myerson MS, Sheredd MJ (1989) The pathological anatomy of claw and hammer toes. *Journal of Bone and Joint Surgery America* 71: 45-49.
4. Saltzman CL, Johnson KA, Donnelly RE (1993) Surgical treatment for mild deformities of the rheumatoid forefoot by partial phalangectomy and syndactylization. *Foot & Ankle*

- 14: 325-329.
5. Schrier JCM, Verheyen C (2009) Definitions of hammer toe and claw toe: An evaluation of the literature. *Journal of the American Podiatric Medical Association* 99: 194-197.
6. Shirzad K, Kiesau CD, DeOrio JK, Parekh SG (2001) Lesser toe deformities. *Journal of the American Academy of Orthopaedic Surgeons* 19: 505-514.
7. Dodd L, Atinga M, Foote J, Palmer S (2011) Outcomes after the Stainsby procedure in the lesser toes: An alternative procedure for the correction of rigid claw toe deformity. *Journal of Foot & Ankle Surgery* 50: 522-524.
8. Hossain S, Dhukaram V, Sampath J, Barrie JL (2003) Stainsby procedure for non-rheumatoid claw toes. *Journal of Foot & Ankle Surgery* 9: 113-118.
9. Briggs PJ, Stainsby GD (2001) Metatarsal head preservation in forefoot arthroplasty and the correction of severe claw toe deformity. *Journal of Foot & Ankle Surgery* 7: 93-101.
10. Trimble KT, Talbot NJ, Parsons SW (2005) A modification to the stainsby technique for arthritic or dislocated metatarsophalangeal joints of the lesser toes. *Journal of Bone and Joint Surgery Britain* 87: 370.
11. Cahill BR, Connor DR (1972) A long term follow-up on proximal phalangectomy for hammer toes. *Clinical Orthopaedics and Related Research* 86: 191-192.
12. Conklin MJ, Smith RW (1994) Treatment of the atypical lesser toe deformity with basal hemiphalangectomy. *Foot & Ankle International* 15: 585-594.
13. O'Kane C, Kilmartin T (2005) Review of Proximal Interphalangeal Joint Excisional Arthroplasty for the Correction of Second Hammer Toe Deformity in 100 Cases. *Foot & Ankle International* 26: 320-325.
14. Feldbrin Z, Lipkin A, Hendel D, Lakstein D (2013) Precise technique for simple and accurate pip arthrodesis using a blunt KW technique. *Foot & Ankle Surgery* 19: 62-64.
15. Queally JM, Zgraj OS, Walsh JC, Butt AJ, D'Souza LG (2009) Use of the modified Stainsby procedure in correcting severe claw toe deformity in the rheumatoid foot: A retrospective review. *Foot (Edinburgh, Scotland)* 19: 110-113.
16. Ellington JK (2011) Hammer toes and claw toes: proximal interphalangeal joint correction. *Foot and Ankle Clinics* 16: 547-558.
17. Debarge R, Philippot R, Viola J, Besse JL (2009) Clinical outcome after percutaneous flexor tenotomy in forefoot surgery. *International Orthopaedics* 33: 1279-1282.

**Copyright:** ©2020 Reuven Lexier, Amanda JL Weston. This is an open-access article distributed under the terms of the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original author and source are credited.