

Clinical Research

Unilateral Versus Bilateral First Ray Surgery

A Prospective Study of 186 Consecutive Cases—Patient Satisfaction, Cost to Society, and Complications

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Abstract: Many studies have evaluated bilateral versus unilateral surgery in large joints, but limited research is available to compare outcomes of bilateral staged foot surgeries versus synchronous bilateral foot surgery. In total, 186 consecutive cases of first metatarsal-phalangeal (MTP) joint surgery were prospectively included in this study; 252 procedures were performed: 120 were unilateral or staged bilateral operations, and 66 were synchronous bilateral operations. Patients were evaluated at 6 and 12 weeks for specific early complications and surveyed about their return to work, activities of daily living, shoe gear requirements, satisfaction, and reasons for choosing staged or synchronous surgery. In addition, a cost analysis was performed on all surgical scenarios. Student t test showed no statistical significance between groups in all clinical settings to a 95% confidence level. Complication rates were similar and few in all situations. Patients were very satisfied when choosing bilateral synchronous surgery and would elect to repeat it the same way

97% of the time. The economic costs to the health system average 25% greater when patients undergoing first MTP joint surgery have the procedure performed one foot at a time. Combined with the time lost from work, this reveals a significant economic cost to both society and patient.

Keywords: hallux valgus; hallux limitus; bunion; bilateral foot surgery; surgical cost analysis

Bilateral foot surgery for the correction of hallux valgus and hallux limitus is an often controversial subject for foot and ankle specialists. Proponents for bilateral surgery opine that there is significant benefit to patients, with respect to convalescence time and financial obligations.^{1,2} Those opposed commonly cite an anecdotal increased rate of perioperative complications with bilateral procedures.¹ Others purport a need to be able to weight bear

on the contralateral foot to protect the operated foot during the immediate postoperative period.³

Numerous studies have evaluated bilateral versus unilateral surgery in large joints, such as the knee and hip^{1,2,4}; however, limited research is available to compare outcomes of bilateral staged foot

“The procedures may be performed with high patient satisfaction and associated low morbidity.”

surgeries versus synchronous bilateral foot surgery.² Recently, Lee et al⁵ retrospectively analyzed 52 patients (69 feet) that underwent either synchronous or staged Chevron osteotomies for bilateral hallux valgus. They found no difference in angular correction or clinical outcome and advocate simultaneous correction for bilateral hallux valgus requiring surgical correction.

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The primary purpose of this study is to identify the reasons patients would select bilateral over staged-unilateral surgery, as well as measure the rate of recovery with respect to return to activities of daily living (RADL). Second, we wanted to compare rates of early complication and perform a cost analysis among these 2 groups.

Many orthopaedic publications have evaluated concomitant bilateral knee surgery. Bullock et al⁶ found that the risk of complication associated with bilateral simultaneous total knee arthroplasty slightly increased when compared with unilateral, but the mortality rates were similar. Horne et al⁷ found similar results and revealed high patient satisfaction and good functional status in those who elected single-stage bilateral total knee arthroplasty. Stubbs et al⁸ stated that bilateral knee replacement is a good choice for both patient and hospital, as it does not increase complications to the patient and reduces overall cost.

Materials and Methods

Patient Population

From March 1, 2005, to December 31, 2005, 252 procedures on the first metatarsal-phalangeal (MTP) joint were performed; 120 were unilateral or staged bilateral operations, and 66 were bilateral operations.

The inclusion criteria for the study were patients with bilateral hallux valgus or rigidus with pain, who have failed conservative care, and who are proceeding to surgical management. Patients were excluded from the study if they had any additional procedure done under the same anesthesia period, if there was a revision surgery rendered, or if there were any complicating diagnoses (peripheral vascular disease, immunosuppressive diseases, etc). Two hundred consecutive patients with a clinical history of either painful hallux valgus or limitus were prospectively included for this study. If bilateral pathology was present, the patient was given the choice of having either a staged bilateral procedure or both done at the same time. Of the patients, 120 had unilateral first MTP joint surgery (Scarf bunionectomy, Scarf-Akin

Table 1.
Demographic Information

	Unilateral Surgery, n	Bilateral Surgery, n
Total patients	120	66
Total procedures	120	132
Joint replacement	20	20
Scarf bunionectomy	52	40
Scarf-Akin bunionectomy	48	72

Figure 1.

Modified Wong-Baker Faces Visual Analog Scale (VAS) for pain.



bunionectomy, Silastic total joint arthroplasty without any other procedures performed on that foot). Within this group, 7 patients had staged bilateral procedures (range, 40-311 days), and 66 had bilateral first MTP joint surgery performed in 1 operating room session by the same surgeon. In total, 186 patients satisfied the inclusion criteria for the study, and their statistics were ultimately included in the data. Fourteen patients (7%) were unavailable for follow-up and were thus excluded from the data pool. Table 1 lists the demographic information and procedures performed in this study. All of the patients gave informed consent to participate in the study, which was approved by an internal ethics committee.

Study Design

Patients were evaluated at 6 weeks and 3 months for specific early complications that have been associated with first MTP joint surgery: infection, wound dehiscence, stress fracture, swelling +2 or greater, pain greater than 7 on the Modified Wong-Baker Faces Visual Analog

Scale (VAS; see Figure 1), and return to the operating room within 3 months of surgery. At 3 months, patients were interviewed either in person or via the telephone by a surgeon other than the one who performed the operation to limit type I error or bias. The interview consisted of questions related to RADLs and work, return to shoe gear, reasons for choosing one treatment group over the other if possible, and overall satisfaction with the early results of the surgery. A sample of the survey is shown in Figure 2.

Operative Technique: Silastic Total Joint Arthroplasty

After introduction of intravenous (IV) sedation and local anesthesia consisting of 0.5% bupivacaine plain, a pneumatic ankle tourniquet is applied and set at 250 mm Hg. A linear incision 6 cm in length is made overlying the medial dorsal aspect of the first MTP joint of the foot. The incision is deepened down to the level of the joint capsule. Using a lenticular capsule approach, the capsular structures are

Figure 2.

Sample survey.

1. When did you **RETURN TO WORK** after surgery (weeks)?

2. When did you **RETURN TO YOUR REGULAR ACTIVITIES** (food shopping, driving a car, walking short distances) of daily living after surgery (weeks)?

3. If you have a problem on **BOTH FEET**, did your **SURGEON RECOMMEND** having both done at the same time, or was it your **OWN REQUEST**?
 - Surgeon recommendation
 - Patient request
4. If you did have **BOTH FEET CORRECTED AT THE SAME TIME**, what were the **MAIN REASONS YOU CHOSE TO DO SO**?
 - Limited time off from work/home
 - Limited amount of time in pain after surgery
 - Desire to “get the problem over with sooner”
 - Self-image
 - Financial reasons
 - Other (please explain): _____
5. What type of **SHOE GEAR** did you wear after surgery?
 - Postoperative shoe
 - Gym shoe/sneaker
 - CAM walker/fracture boot
 - Regular shoes
 - a. 1 week postoperatively
 - b. 2 weeks postoperatively
 - c. 6 weeks postoperatively
 - d. 12 weeks postoperatively
6. If you had **BOTH FEET CORRECTED AT THE SAME TIME**, would you choose to do so again?
 - Yes
 - No

freed from attachments on the dorsal, medial, and lateral aspects of the first MTP joint. The base of the proximal phalanx is then freed from any attachments, and approximately 5 mm of the base of the proximal phalanx is resected. Any significant synovitis in the joint is excised. The head of the first metatarsal is then remodeled on its lateral, dorsal, medial, and anterior aspects. Resection of the anterior aspect of the first metatarsal is made in line with a 5-degree lateral tilt and 5-degree dorsal tilt to accommodate appropriate shoe wear. Canals are then formed down the first metatarsal shaft and proximal phalangeal base for fitting of

a Silastic hinged prosthesis and titanium grommets. The titanium grommets are then inserted into position on both the metatarsal head and proximal phalanx, and trial sizing is performed. The area is then thoroughly irrigated with sterile saline solution, and a total joint implant is inserted into the operative site. The total range and quality of motion is then observed. Capsulorrhaphy and capsuloplasty are then performed, securing the toe in the corrected position with multiple 2-0 absorbable sutures. Skin edges are apposed and secured using a subcuticular 5-0 absorbable suture. Surgical adhesive strips are applied to the site superficially.⁹

**Operative Technique:
Scarf Bunionectomy**

A linear incision 7 cm in length is made on the medial plantar aspect of the first MTP joint of the left foot. The incision is deepened down to the level of the superficial fascia. Using a lenticular capsular approach, the capsular structures are freed from attachments on the dorsal, medial, and plantar aspects of the first MTP joint. A sesamoid release is performed, allowing for the repositioning of the sesamoid structures, with care taken to preserve the blood supply to the sesamoid apparatus. A Reese osteotomy guide is used to perform a Scarf osteotomy on the first metatarsal, allowing for lateral and plantar displacement of the first metatarsal head-shaft segment and correction of the distal metatarsal articular angle (DMAA). The osteotomy is appropriately positioned, held in place with a bone clamp and fixated using 2 threaded-head bone screws. The redundant bone on the medial portion of the first metatarsal head is resected, and all rough edges of bone are smoothed using a rotary burr. Capsulorrhaphy and capsuloplasty are performed, maintaining the toe in the corrected position, and are reapproximated with multiple sutures of 2-0 Vicryl. Skin edges are brought into apposition and maintained using a subcuticular 5-0 absorbable suture. Surgical adhesive strips are applied to the site superficially.¹⁰

**Operative Technique: Scarf
Bunionectomy With Akin
Phalangeal Osteotomy**

A Scarf bunionectomy is performed as described above. The addition of the Akin phalangeal osteotomy addresses an increased hallux interphalangeus angle and creates a more rectus toe. A closing osteotomy is performed on the medial aspect of the base of the proximal phalanx of the great toe. Approximately 1 to 2 mm of bone is removed as a wedge, preserving the lateral cortex as a hinge and avoiding the flexor tendons. The osteotomy is closed and held in position

with a threaded-head screw. The structures are closed as previously described above.¹¹

Postoperative Course

Postoperatively, the patient wears a compressive bandage and hard-soled postoperative shoe for 1 week with strictly limited activity and full weight bearing. A nonsteroidal anti-inflammatory medication is prescribed for a period of 10 days and augmented with an analgesic as needed. The field block of bupivacaine given during surgery typically lasts from 12 to 20 hours postoperatively, significantly reducing postoperative surgical pain.

After 1 week, the bandages are removed, and the patient is permitted to bathe. The surgical adhesive strips are trimmed back as they loosen from the skin edges and are completely removed from the wound after 3 weeks. Physical therapy with a licensed physical therapist is started 1 week postoperatively. Therapy sessions include strength training, gait training, and balance, with special emphasis on plantar flexion of the toes. A home physical therapy program is initiated, where the patient performs exercises using an elastic therapy band to strengthen the toe in plantarflexion. The patient is instructed to perform the physical therapy exercises twice daily for 10 to 15 minutes while at home.

Patients are told to wear a roomy athletic shoe to assist in swelling reduction and to aid in comfort. They are to avoid physical activity with extensive periods of weight bearing for the next 5 to 6 weeks. The patient, as expected, will supinate until the first ray is able to offload the medial side of the foot in a comfortable and confident manner. A radiograph is taken at the 6-week mark to examine the progress of the healing bones and, barring any untoward events, the patient is instructed to proceed to full weight bearing in all shoes as tolerated. High-impact activity, such as running or kickboxing, is limited for a total of 12 weeks. The physical therapy is to be continued for a total of 8 weeks postoperatively. Complete reduction in swelling and acquiring full

Table 2.

Statistical Analysis

Group	B/L TJR RTW	U/L TJR RTW	B/L TJR RADL	U/L TJR RADL
Mean	16.8	22.4	18.2	22.4
SD	13.3	21.97	12.52	23.56
SEM	2.98	4.91	2.8	5.27
n	20	20	20	20
<i>P</i> value	.3754		.5153	
CI, %	95		95	
Group	B/L Scarf RTW	U/L Scarf RTW	B/L Scarf RADL	U/L Scarf RADL
Mean	16.8	13.12	16.1	19.06
SD	11.07	13.87	11.45	12.79
SEM	1.75	1.92	1.81	1.74
n	40	52	40	52
<i>P</i> value	.2557		.2665	
CI, %	95		95	
Group	B/L Scarf-Akin RTW	U/L Scarf-Akin RTW	B/L Scarf-Akin RADL	U/L Scarf-Akin RADL
Mean	18.28	20.71	14.39	18.08
SD	12.01	16.27	0.42	10.4
SEM	1.42	2.35	0.76	1.5
n	72	48	72	48
<i>P</i> value	.4753		.031	
CI, %	95		95	

B/L, bilateral; CI, confidence interval; RADL, return to activities of daily living; RTW, return to work; SD, standard deviation; SEM, standard error of the mean; TJR, total joint replacement; U/L, unilateral.

range of motion can be expected in 3 to 5 months but can take up to 1 year in some patients.

Results

Statistical analysis using a 2-tailed Student *t* test was performed to analyze the difference between unilateral and bilateral surgery with respect to RADL, return to work (RTW), and return to shoe gear. There was no statistical significant difference between any of the groups with a 95% confidence interval (Table 2). Data for RTW, RADL, and return to shoe gear are summarized in Figures 3 and 4.

The most common complication was dehiscence, with 4 cases in each group. Two cases of stress fracture of the second metatarsal were documented in the bilateral group, and 1 stress fracture of the fifth metatarsal occurred in the unilateral series. The unilateral group had 2 instances of severe pain with a visual analog pain score greater than 7 and 1 case of increased swelling. One superficial skin infection happened in the unilateral group, which was treated with oral antibiotics, uneventfully. One hospital admission occurred in the bilateral group for an acute deep venous thrombosis, which was resolved with anticoagulants without

Figure 3.

Return to work and activities of daily living. RTW, return to work; RADL, return to activities of daily living.

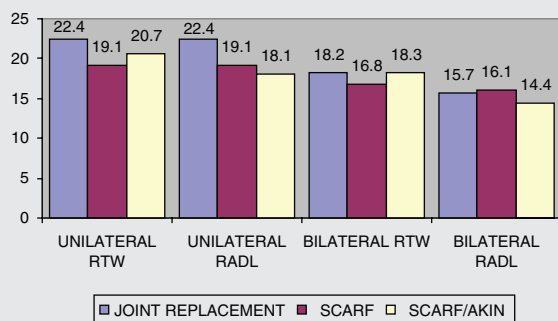


Figure 4.

Return to shoe gear. POS, postoperative shoe; GYM, gym shoe/sneaker; REG, regular shoe.

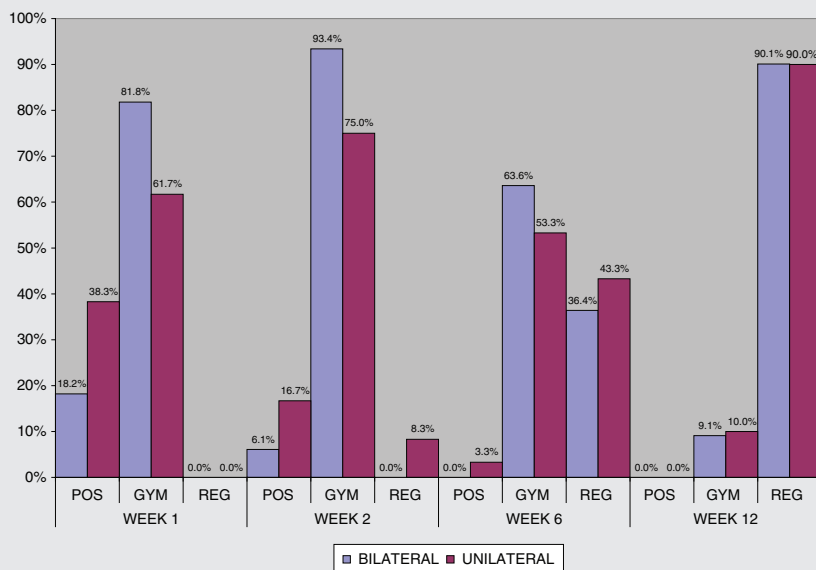
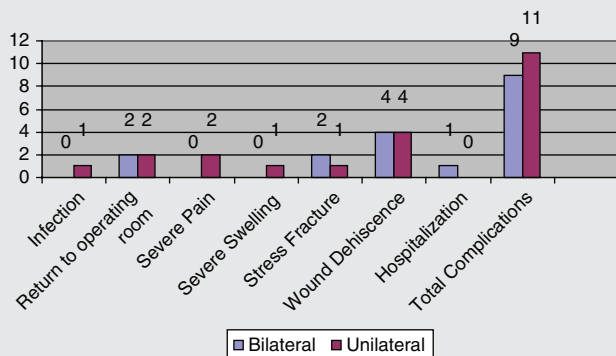


Figure 5.

Complications.



any complication (Figure 5). Both groups were identical to the number of physical therapy sessions at 1.8 sessions per patient (Figure 6). Of the patients, 97% stated that they would have bilateral surgery again, if given that choice. Two participants stated that they would elect to do a staged procedure because they had “difficulty getting around with two bad feet.” Of the bilateral set, 63% of patients polled requested to have synchronous bilateral surgery prior to discussion with the surgeon; 37% elected to have both feet operated on simultaneously after surgeon consultation and informed consent was obtained. The most common reasons for patients to choose single-session versus staged bilateral surgery are listed in Figure 6, with “wanting to get the entire problem over with sooner” the most popular rationale at 82%.

Discussion

Complications and Patient Satisfaction

Our research showed no statistical significant difference between unilateral and bilateral foot surgery with respect to RADL and RTW. In addition, complication rates were few and similar in both groups, with a lower incidence in the bilateral group. These rates correlate well with other similar studies in the orthopedic knee literature.⁶⁻⁸ Lee et al⁵ related low complication rates in their study of unilateral versus synchronous hallux valgus surgery. The difference between our study and Lee et al’s is that only 1 group had bilateral surgery in their study, and synchronous bilateral bunion surgery was being compared to unilateral surgery alone.

Patient satisfaction was very high, with 97% of patients in the single-session bilateral set choosing to have repeat surgery the same way. In addition, 93.4% of the bilateral and 75% of the unilateral patients were in athletic shoes at 1 week postoperatively, and 90% were in their typical shoes at 12 weeks in both groups. It is apparent that patients would prefer bilateral single-session surgery, as

Figure 6.

Physical therapy sessions.

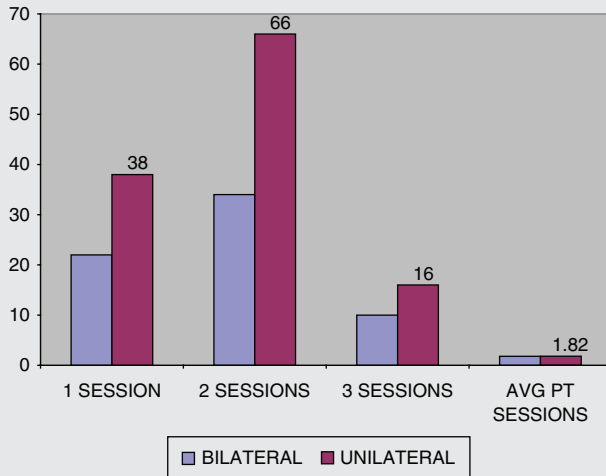


Figure 7.

Most common reasons to choose synchronous versus staged bilateral surgery.

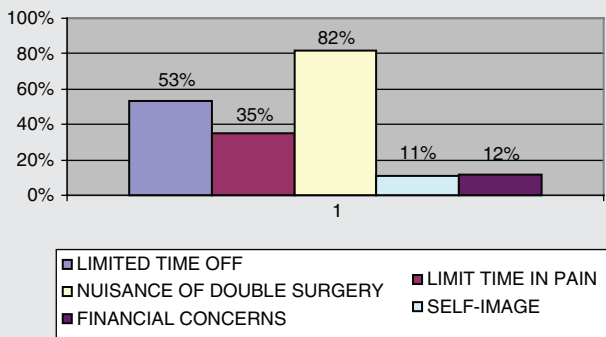


Table 3.

Cost Analysis

Procedure	Surgeon Cost	Anesthesia Cost	Hospital Cost	Total Surgery Cost
Unilateral surgery	\$1000	\$500	\$1600	\$3100
Staged bilateral surgery	\$1000 × 2 = \$2000	\$500 × 2 = \$1000	\$1600 × 2 = \$3200	\$6200
Simultaneous bilateral surgery	\$1000 + \$500 = \$1500	\$625	\$1600 + 800 = \$2400	\$4525

they request it 63% of the time without any surgeon recommendation. This is in conflict with Coughlin and Mann,¹² who reported that 84% of patients with moderate to severe hallux valgus had bilateral deformities, but only 18% had simultaneous bunion correction.

An expeditious return to activities of daily living and work is the main motivation behind these requests, and given the data shown, this is effectively achieved through bilateral simultaneous surgery.

There are limitations to the study. First, there was no randomization of patients to either of the study groups, as they selected whether they wanted to have synchronous or staged surgery. Second, the postoperative evaluation was performed by the same surgeon, which introduces an inherent bias. Third, multiple-type first ray procedures were performed in this study, which may confound some of the data if one wanted to study one particular category of surgery.

Cost Comparison

Finally, a cost comparison analysis was undertaken between single-session bilateral hallux valgus surgery and staged hallux surgery (Figure 7). Amounts used for calculation were the following: average surgeon’s cost to insurance companies for a hallux valgus surgery = \$1000, average anesthesiologist cost to insurance carriers = \$500/h, and average hospital outpatient or surgery center cost to insurance companies for hallux valgus surgery = \$1600. The average anesthesia time calculated is 45 minutes for unilateral surgery and 1.25 hours for bilateral simultaneous hallux valgus surgery. In cases of bilateral synchronous foot surgery, the surgeon and facility fee are reduced by half for the second foot. Using these data, the average total unilateral surgery cost is \$3100, or \$6200 for staged surgery, and the average total cost for simultaneous bilateral surgery is \$4525 (see also Table 3).

In conclusion, bilateral single-session hallux valgus foot surgery is a viable and safe option for those patients who would

like a more rapid return to activities of daily living and work. The procedures may be performed with high patient satisfaction and associated low morbidity. The economic costs to the health system average 25% greater when patients undergoing hallux valgus surgery have the procedure performed one foot at a time. Combined with the time lost from work, this reveals a significant economic cost to both society and patient. **FAS**

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