CHAPTER **33**

EVALUATION OF FIRST METATARSOPHALANGEAL RANGE OF MOTION PRE AND POST BUNION SURGERY: A Clinical and Radiographic Correlation with Stress Lateral Dorsiflexion Views

Roodabeh Samimi, DPM
Donald R. Green, DPM
Richard M. Green, DPM
Donna L. Agan, EdD

INTRODUCTION

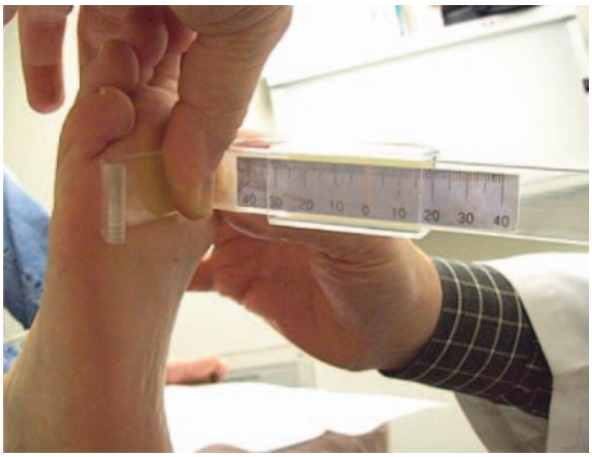
Hallux valgus was shown to have diminished first metatarsophalangeal joint (MTPJ) total range of motion (ROM), deviated center of rotation and abnormal metatarsosesamoid center of rotation, compared with normal controls in cadavers. These dynamics were attributed to the prominent medial eminence and periarticular capsuloligamentous scarring with articular degenerative changes, which also are a result of the pathomechanical forces. Although in this study we are addressing hallux limitus pathology, they similarly are attributed to limited dorsiflexion in hallux rigidus patients primarily due to the dorsal mechanical block (exostosis). According to Taranto et al in 2007, the hallux abductus angle (HAA), first intermetatarsal angle (IMA), and lateral stress dorsiflexion views were the only variables found to be significantly different between hallux valgus and hallux limitus and thus predictors of these processes. Changing the dynamics of the first MTPJ surgically and parameters for measuring its accuracy perioperatively are worth investigating, namely the stress lateral dorsiflexion view radiographically. No previous study has used this parameter perioperatively to quantify preservation of first MTPJ motion with clinical correlation, after bunion surgery.

Based on our retrospective study, we have preliminary data suggesting that first MTPJ ROM is maintained and increases postoperatively within 1 year, although not statistically significant. These results are further elaborated on with this prospective study, again evaluating first MTPJ ROM both pre- and postoperatively for bunion surgery, using a lateral stress radiographic view (Figure 1) for first MTPJ dorsiflexion for clinical comparison. The type of bunion procedure in relation to motions will also be investigated, which the preliminary study showed no significant clinical decrease at one year (except the Keller procedure), and no significant radiographic decrease (except in the Keller and Green-Waterman procedures).

With more perioperative data collection, including first ray position, we can see how other specific factors play a role pre and post bunion surgery. We are also going to correlate radiographic stress lateral dorsiflexion views to clinical measurements of first MTPJ ROM pre and post-operatively specifically at 6 weeks, 3 months, 6 months, and 1 year postoperatively.

Figure 1. Lateral stress DF view.

Figure 2. Clinical DF measurement with tractograph, nonweight bearing.



Figures 3. Using Whitney device to measure first ray range of motion.

Figures 4.

Figure 5. Lateral stress DF view.

METHODS

A total of 58 patients (70 feet) who underwent bunion surgery by Drs. Donald R. Green and Richard M. Green at the San Diego Podiatry Group between November 2007 and December 2008 were included in the study. Similar to a previous study, excluded patients were those who had or were diagnosed with first MTPJ nonosteoarthritic conditions, dysplasias, or infection involving the first MTPJ or first metatarsal bone, ulceration of the foot or ankle, significant trauma causing fracture to the first metatarsal bone or first MTPJ (preoperatively), or causing break or backing out of fixation (postoperatively), or patients with nonambulatory status (such as wheel-chair bound, for whatever reason).

Clinical data was obtained preoperatively, intra-operatively, at 6 weeks, 3 months, 6 months, and 1 year postoperatively (see Worksheet). These data include nonweight bearing (NWB) and in subtalar joint neutral: 1) First MTPJ ROM (resting, DF and PF) measurements NWB: assessing assisted DF/PF using a hand-held goniometer at subtalar neutral position with force placed on or beneath the base of the proximal phalanx of the hallux, and angle measured between the lateral longitudinal axes of the hallucal proximal phalanx and first metatarsal bone (Figures 3, 4). 2) Quality of first MTPJ ROM: including crepitus, soft tissue or osseous impingement or tracking versus trackbound (the hallux manually reduces to a rectus position or not). 3) First ray position: assessed by first placing the subtalar joint in neutral and assessing DF and PF of the first metatarsal head relative to the second metatarsal head with thumb and index finger of each hand, using a Whitney biomechanical device (Figure 3). 4) Position of the second toe: evaluated as no contact, abutting, underlying or overriding the first and for positive Lachman's test (that the proximal phalanx translocates dorsally by 2 mm or more relative to the second metatarsal head at the second

MTPJ). 5) Other forefoot lesion pattern such as to the medioplantar hallucal IPJ. Other parameters assessed include: first metatarsocuneiform prominence, deformities in the lesser toes, and hallux purchase (easy, resistant or "not moveable" ability to pull paper out from beneath patient's hallux) (see Worksheet). Intra-operative clinical data (see Worksheet) included primarily dorsiflexion and plantarflexion ROM of first MTPJ, using a sterile goniometer; however, procedural data was also collected at that time.

Radiographic study was performed preoperatively and postoperatively at 6 weeks, 3 months, 6 months, and 1 year, prospectively. Views evaluated include: dorsoplantar (DP), medial oblique (MO), lateral (lat) foot views and lateral stress DF (at the first MTPJ) view (Figure 5). The DP view was assessed for: first metatarsal length and width, shape of the first metatarsal head and base (round, oblique or square), first and second MTPJ congruity (congruous, deviated, or subluxed), signs of first MTPJ degeneration (subchondral cysts, erosions, sclerosis, joint space narrowing), metatarsus primus adductus (MPA), hallux abductus angle (HAA), metatarsus primus declination (MPD), hallux interphalangeus angle (HIA), tibial sesamoid position (TSP), metatarsus adductus (MAA), calculation of true IMA (IMA + MAA – 15), Engle's angle (second met-cuneiform), forefoot adductus angle (FAA), first metatarsal-calcaneal angle, tibial sesamoid-second metatarsal distance, talocalcaneal angle (TCA), talonavicular coverage angle, and cuboid abduction angle (CAA), all as previously described in the literature. The medial oblique view was used to evaluate for dorsiflexion of the toes.

Similarly, the lateral view was assessed for: metatarsus primus elevatus (MPE), first metatarsal declination angle, talo-first metatarsal angle or Meary's angle, Seiberg Index, calcaneal inclination angle (CIA), Kirby's sign, and dorsal first MTPJ lipping/spurring. Then the lateral stress DF view was used to measure first MTPJ DF in stance with the STJ in neutral (see radiographic worksheet.)

Questionnaires filled by all patients on each visit include the preoperative questionnaire and either the Modified McGill Questionnaire or the Bristol Foot Score (BFS), with the BFS replacing the Modified McGill Questionnaire several months into the study. This study was IRB approved (#4471) and appropriate consent obtained.

ANALYSIS AND RESULTS

SPSS software was used for all statistical analysis. The T test paired sample statistics between pre and postoperative measurements, Pearson R correlation coefficient for determining association between variables (bunion procedure or fixation choice, first ray position, and other factors as mentioned previously). *P* values less than 0.05 were considered significant. Data at 1 year had too few cases to be included in the majority of the analysis. Of 58 patients, 70 feet: 47 patients (57 feet) had clinical data (81%), 44 patients (51 feet) had radiographic data (76%), 47 patients (57 feet) had intraop data (81%), the preoperativequestionnaire was filled out 47 times (for 47 feet, only 3 were bilateral), or 67%, and 48 patients (59 feet) had filled out either the McGill questionnaire (15 patients, 22 feet or 26%) or Bristol Foot Score (33 patients, 37 feet, 57%), or 83% total.

Results showed significant 7 degree decrease in clinical DF at 6 weeks compared with preoperative on average ($P = 0.003$), 6 degree decrease in clinical DF at 3 months compared with preoperative ($P = 0.022$), and 4 degree decrease in clinical DF at one year compared with preoperative ($P = 0.023$). A high correlation (0.704) was found between preoperative clinical DF and 1 year postoperative clinical DF ($P = 0.027$). A high correlation (0.832) was also found between preoperative clinical DF and preoperative radiographic stress lateral view ($P < 0.001$) and between clinical and radiographic measurements at 6 months (correlation 0.794, $P < 0.001$). A moderate correlation (0.657) was found between clinical and radiographic DF at 3 months ($P < 0.001$), and between preoperative and 1-year clinical PF (correlation 0.689, $P = 0.027$) (Tables 1-7). Clinical plantarflexion measurements were significantly decreased at 6 weeks (mean 15.44°, $P = 0.003$) and 3 months (17.0°, $P = 0.022$) from preoperative (22.0°).

Table 1

MEAN RADIOGRAPHIC DF MEASUREMENTS (DEGREES)

Radiographic DF (°)	Preop	6wks P.O.	3mo	6mo	1Yr
# Feet	52	29	42	23	8

Table 2

MEAN CLINICAL DF MEASUREMENTS (DEGREES)

Clinical DF (°)	Preop	Intraop	6wks P.O.	3mo	6mo	1Yr
# Feet	54	48	46	41	23	11

Table 3

CLINICAL DF VALUES (DEGREES): MEAN (RANGE)

Preop DF (°)	Intraop	6wks P.O.	3mo	6mo	1Yr
68 (8-105)	72 (28-92)	57 (30-85)	58 (10-90)	61 (25-93)	65 (20-95)

Table 4

RADIOGRAPHIC DF VALUES (DEGREES): MEAN (RANGE)

Preop DF (°)	6wks P.O.	3mo	6mo	1Yr
65 (21-94)	44 (5-72)	52 (8-76)	55 (28-92)	54 (43-71)

Table 5

MEASURED DF (MEAN, DEGREES), N= # FEET

	DF	N
Clinical Preop	68.06	54
Clinical Intraop	72.29	48
Clinical, 6wks	56.87	46
Clinical, 3mo	58.10	41
Clinical, 6mo	60.91	23
Clinical, 1yr	65.09	11
Xray Preop	65.00	52
Xray, 6wks	44.38	29
Xray, 3mo	52.12	42
Xray, 6mo	54.65	23
Xray, 1yr	54.38	8

Table 6

PREOP TO POSTOP CHANGE IN DF (MEAN, DEGREES), ALL DECREASED. N= # FEET.

	DF	N
Clincial, 6wks	-8.35	43
Clinical, 3mo	-9.21	38
Clinical, 6mo	-5.85	20
Clinical, 1yr	-6.60	10
XRay, 6wks	-24.17	29
XRay, 3mo	-13.19	42
***XRay, 6mo**	**-10.09**	**23**
XRay, 1yr	-4.13	8

**Statistically significant (P = 0.034) using T-test for Equality of Means.*

Table 7

PATIENTS (%) WHO HAD DECREASE IN DF

Clincial, 6wks	67.4
Clinical, 3mo	76.3
Clinical, 6mo	65.0
Clinical, 1yr	60.0
XRay, 6wks	86.2
XRay, 3mo	85.7
XRay, 6mo	69.6
XRay, 1yr	62.5

When separating the data by diagnosis, for hallux valgus and/ MPA diagnoses, there was a significant decrease in clinical DF postoperative at 6 weeks, 3 months, and 6 months clinically and at all times postoperative radiographically. For hallux limitus patients however, there was a significant increase in DF again at all postoperative times except the clinical 1 year (Table 8). Though separating the data by procedure, the Austin and CBW showed significant decrease in clinical DF postoperative at 6 weeks and 3 months, as well as in radiographic DF at 6 weeks, 3 months and 6 months postoperative (Figures 6-10). In contrast, the Keller and Green Waterman procedures showed significant increased DF at these same times (Table 9, Figures 11-14). All significance was shown through Post-Hoc Scheffe testing.

All of these differences were significant except the clinical 1 year, using the ANOVA test. It is also important to note that the difference in X-ray DF at 6weeks had no homogeneity of variance, however this may be due to the fact that this time period was most immediately postoperatively.

Table 8

CHANGE (+: INCREASE, -: DECREASE) IN DF BY DX (MEAN, DEGREES), N= # FEET

	HAV only	HAV + MPA	HL, or HL + HAV	N
Clinical, 6wks	**-16.20**	**-16.89**	**7.69**	**20, 9, 13**
Clinical, 3mo	**-18.14**	**-7.17**	**5.10**	**21, 6, 10**
Clinical, 6mo	**-14.43**	**-17.17**	**12.43**	**7, 6, 7**
Clinical, 1yr	-8.20	-10.75	18.00	5, 4, 1
XRay, 6wks	**-27.21**	**-35.25**	**3.00**	**14, 4, 6**
XRay, 3mo	**-21.25**	**-20.14**	**3.56**	**14, 7, 9**
XRay, 6mo	**-21.86**	**-15.25**	**7.29**	**7, 4, 7**
XRay, 1yr	**-8.50**	**-24.00**	**7.67**	**2, 1, 3**

Figures 6. AP and lateral stress DF after closing base wedge ostetomy.

Figure 7.

Figure 8.

Figure 9.

Table 9

CHANGE (+: INCREASE, -: DECREASE) IN DF BY PROCEDURE (MEAN, DEGREES), N= # FEET

	Austin	MMcB+CBWO	Keller	Mod Green Wtr	N
Clinical, 6wks	**-15.55**	**-17.50**	**8.67**	**9.00**	**22, 6, 6, 7**
Clinical, 3mo	**-18.86**	**-7.60**	**.20**	**14.67**	**21, 5, 5, 6**
Clinical, 6mo	-19.00	-9.00	3.57	8.50	6, 5, 7, 2
Clinical, 1yr	.60	-26.00	-36.00	18.00	5, 2, 1, 1
XRay, 6wks	**-27.31**	**-39.40**	**-21.00**	**2.40**	**16, 5, 2, 5**
XRay, 3mo	**-17.14**	**-22.57**	**-11.50**	**5.80**	**21, 7, 4, 5**
XRay, 6mo	**-20.44**	**-15.00**	**1.67**	**7.67**	**9, 3, 6, 3**
XRay, 1yr	**-8.00**	**-24.00**	**8.00**	**7.50**	**4, 1, 1, 2**

**Statistically significant, using ANOVA.*

Figure 10.

Figures 11. AP and lateral stress DF after Green-Waterman.

Figures 12.

Figure 13.

Figure 14.

Table 10

SURGEONS (DRG, RMG) AND # PTS (TOTAL 58), FEET (TOTAL 72)

Surgeon	DRG	RMG	Total
Patients	31	27	58
Feet	37	33	70
Bilateral	6	6	12

Other includes: Modified McBride (alone; 2), Lapidus (2), Silver (1), and combination Keller + CBWO (1) procedures. Abbrev: MMcB = Modified McBride, CBWO = Closing Base Wedge Osteotomy, Mod Green Wtr = Modified Green Waterman.*

Table 11

DIAGNOSES, # FEET

HAV	37 (52.9%)
HL	16 (22.9%)
HAV + MPA	15 (21.4%)
HAV + HL	2 (2.9%)

HAV = Hallux Abducto Valgus, MPA = Metatarsus Primus Adductus, HL = Hallux Limitus.

Table 12

PROCEDURES PERFORMED, # FEET

Austin	34 (48.6%)
MMcB + CBWO	11 (15.7%)
Mod Green Wtr	11 (15.7%)
Keller	8 (11.4%)
Other*	6 (8.6%)

No favoring of surgeon to right or left foot or to time of examination was noted (did not get more dorsiflexion faster with one surgeon than the other). Total: 38 (54%) Right, 32 (46%) Left. (Table 10). The most common diagnosis was HAV only, and three-quarters of patients had HAV and/ MPA (Table 11). The most common procedure performed was the Austin (almost half), and enough to perform analysis on the closing base wedge (CBW), Keller, and Green-Waterman procedures (Table 12).

For other intraoperative data, the majority had no adjunct procedure (70.9%), the most used a threaded Kirschner-wire (48.1%), had one method of fixation (64.8%), and no recorded intraoperative complications. Cartilaginous degeneration was noted 22.2% of the time, the majority had lateral capsular release (69.8%), fibular sesamoidal ligament release (63.6%), without adductor tendon release (61.8%), majority medial capsulorrhaphy (90.9%), and majority without FHB release (98.2%), obtained from recorded data. A total of 76.4% were fully weight bearing in a surgical shoe, and the rest in a CAM walker (5.6% partial weight bearing and 20.0% nonweight bearing). Using the ANOVA, patients scored significantly lower (improved) on the BFS and Modified McGill surveys at 3 months (n = 31) and 6 months (n = 21) postoperative, compared with preoperative (N = 42) ($P = 0.003$)(with n = 36 at 6 weeks, thus a total n = 38 for this analysis).

Physical examination significant differences include: Non-weight bearing first MTPJ passive DF degree is significantly decreased at 6 weeks (M = 56.87) than preoperative(M = 68.06; F [4,171] = 3.290, $P = 0.013$) - ANOVA. There was more pain on the end range of motion in the first MTPJ on the preoperative physical examination ($X^2 = 16.748$, $P = 0.033$). There was significantly more overlapping second toes preoperatively that were corrected to having no contact 6 weeks postoperatively ($X^2 = 57.111$, $P < 0.001$). At 6 weeks postoperative, there was a significant correcting from overlapping second toe weight-bearing to no contact ($X^2 = 26.586$, $P = 0.009$). No difference on Lachman test (only done preoperative and at 6 weeks; $X^2 = 0.507$, $P > 0.05$). Significant loss of hallux purchase power at 6 weeks postoperative ($X^2 = 23.915$, $P = 0.002$), but strength was regained to preoperative status at 3 months and maintained thereafter.

For the non-numerical physical examination data: There was significantly more crepitus at the first MTPJ preoperative than any postoperative time ($X^2 = 13.193$, $P = 0.040$). There

was significantly more osseous impingement at the first MTPJ preoperative than any postoperative time (X^2 = 17.516, P = 0.041). With second toe position relative to the hallux, there was significantly more second toes overlying the first and significantly less "no contact" at preoperative, significantly more "no contact" and significantly less abutting at 6 weeks, but significantly more abutting at 6 months postoperative (X^2 = 53.791, P < 0.001). There was significantly less "no contact" at preoperative and significantly more "no contact" at 6 weeks with the second toe position relative to the hallux weight-bearing (X^2 = 25.783, P = 0.002).

Radiographic examination significant differences include: There was a significant decrease in lateral stress dorsiflexion at 6 weeks (M = 44.38) and 3 months (M = 52.12) than at preoperative (M = 65.00; F [4, 149] = 8.190, P < 0.001). The first metatarsal length was significantly shorter at 3 months postoperative (M = 60.74) than at preoperative (M = 64.46; F [4,149] = 4.418, P = 0.002). There was more deviated and subluxed first MTPJs preoperative and fewer congruous first MTPJs preoperative than at any post-surgical measurement (X^2 = 32.626, P < 0.001). There is less narrowing of the first MTPJ at 6 months than at preoperative (X^2 = 12.645, P = 0.013). The hallux abductus angle is significantly decreased at 3 months (M = 15.29) and 6 months (M = 13.42) postoperative when compared with preoperative measurements (M = 23.94, F [4,149] = 5.793, P < 0.001). There is a significant decrease in the true IMA from preoperative (M = 14.79) to 6 weeks (M = 11.45; F [4,149] = 3.627, P = 0.007). There was significantly more dorsal first MTPJ lipping and spurring preoperative than any postoperative measure (X^2 = 9.658, P = 0.047). There was a significant decrease in first IM angle from preoperative (M = 15.30) to 6 weeks (M = 7.00), 3 months (M = 8.50), and 6 months (M = 8.33; F [3,22] = 10.297, P < 0.001).

When separating the data out by procedures, these findings were significant:

For the Austin, significant differences were seen in hallux abductus angle (Mpre = 24.76, M3 mos = 15.90; F [3,67] = 4.766, P = 0.005) or decreased postoperative, and metatarsal protrusion distance (Mpre = -2.52mm, M6 mos = -5.44mm; F [3,67] = 4.184, P = 0.009) or shorter first metatarsal postoperative, as well as lateral stress dorsiflexion (Mpre = 72.72, M6 weeks = 47.19, M3 mos = 53.86, M6 mos = 52.44; F [3,67] = 16.450, P < 0.001), again decreased postoperative radiographically. Chi-square values on the Austin revealed significant differences in congruity of the first MTPJ preoperative (X^2 = 24.832, P < 0.001). The closing base wedge procedure yielded significant differences in the first IM angle (Mpre = 15.30, M6 weeks = 7.00, M3 mos = 8.50, M6 mos = 8.33; F [3,22] = 10.297, P < 0.001), HAA (Mpre = 36.10, M6 weeks = 19.80, M3 mos = 23.13, M6 mos = 18.33; F [3,22] = 8.356, P = 0.001), true IMA (Mpre = 19.30, M6 weeks = 9.00; F [3,22] = 5.146, P = 0.008).

Chi-square values on CBW showed significantly fewer patients with incongruity of first MTPJ preoperative, significantly more patients with subluxed first MTPJ preoperative, and significantly more deviated first MTPJ at 3 months postoperative (X^2 = 25.503, P < 0.001). For the CBW, the tibial sesamoid position (TSP), rated from 1 to 7, was significantly higher preoperative than at the 6 week postoperative visit (Kruskal-Wallis X^2 = 10.940, P = 0.012). The Keller procedure yielded no significant results, most likely due to sample size (n = 8). Chi-square values on the Keller demonstrated more first MTPJ DJD preoperative (X^2 = 10.286, P = 0.016 as well as more first MTPJ space narrowing preoperative (X^2 = 13.846, P = 0.003). For the Green Waterman procedure, the only significant difference was seen in first metatarsal length (range from Mpreop = 65.75 to M6 mos = 57.00; F [3,18] = 4.254, P = 0.019) but no difference could be detected in post-hoc Scheffé testing, probably due to sample size (n = 8 at pre-operative, n = 3 at 6 months). For the GW procedure, the dorsal first MTPJ lipping/spurring was significantly higher preoperative (X^2 = 19.242, P < 0.001)(Figures 15 & 16).

When separating the data out by diagnosis, these findings were significant. For the HAV only, significant results were seen in hallux abductus angle which decreased postoperative (Mpreop = 25.73 to M3 mos = 16.55; F [3,71] = 4.701, P = 0.005) and lateral stress dorsiflexion,

Figures 15. Decreased dorsal 1st MTPJ lipping/spurring after Green-Waterman.

Figure 16.

which also decreased postoperative (Mpre = 73.38, M6 weeks = 46.88, M3 mos = 52.95, M6 mos = 54.20; F [3, 71] = 18.078, $P < 0.001$). For HAV only, there were significantly fewer congruous and more deviated first MTPJ's preoperative ($X^2 = 24.88$, $P < 0.001$).

Looking at the combined diagnosis of HAV and MPA, significant decreases over preoperative values were seen at the first IMA (Mpre = 15.30, M6 weeks = 7.00, M3 mos = 8.50, M6 mos = 8.33; F [3,22] = 10.297, $P < 0.001$), HAA (Mpre = 36.10, M6 weeks = 19.80, M3 mos = 23.13, M6 mos = 18.33; F [3,22] = 8.356, $P = 0.001$), between preoperative and 6 weeks for the true IMA (Mpre = 19.30, M6 weeks = 9.00; F [3,22] = 5.146, $P = 0.008$), and lateral stress DF (Mpre = 74.10, M6 weeks = 40.80; F [3,22] = 4.556, $P = 0.013$). In addition, the TSP was significantly higher preoperative than at 6 weeks postoperative (Kruskal-Wallis $X^2 = 10.940$, $P = 0.012$), the same value as was seen for the CBW. There were significantly fewer congruous and more subluxed first MTPJ's preoperative ($X^2 = 25.503$, $P < 0.001$).

When combining the 2 diagnoses, HAV only and HAV plus MPA, differences were significantly decreased in first metatarsal length (Mpreop = 64.08 to M3 mos = 60.73; F [3,97] = 3.865, $P = 0.012$), first IMA (Mpre = 13.83, M6 weeks = 10.59, M3 mos = 11.07; F [3,97] = 5.190, $P = 0.002$, HAA (Mpre = 28.61, M6 weeks = 19.09, M3 mos = 18.30, M6 mos = 19.46; F [3,97] = 9.255, $P < 0.001$), true IMA (Mpreop = 16.06 to M6 weeks = 11.91; F [3,97] = 5.662, $P = 0.001$), TN coverage (Mpreop = 17.11 to M6 weeks = 10.73; F [3,97] = 4.264, $P = 0.007$), and lateral stress DF (Mpre = 73.58, M6 weeks = 45.50, M3 mos = 52.40, M6 mos = 58.08; F [3,97] = 20.666, $P < 0.001$). There were significantly fewer congruous, more deviated, and more subluxed first MTPJ's at preoperative ($X^2 = 32.943$, $P < 0.001$). The TSP was significantly higher preoperative than at 6 weeks postoperative (Kruskal-Wallis $X^2 = 10.322$, $P = 0.016$).

For the hallux limitus diagnosis, dorsal first MTPJ lipping/spurring was significantly more frequent preoperative ($X^2 = 25.335$, $P < 0.001$). Likewise, first MTPJ DJD was significantly more frequent preoperative ($X^2 = 16.845$, $P = 0.001$), first MTPJ narrowing was less frequent at 6 months ($X^2 = 8.009$, $P = 0.046$), and dorsal lipping/spurring was significantly more frequent preoperative ($X^2 = 25.335$, $P < 0.001$) (Figures 17-20).

With data obtained from the preoperative questionnaire (44 patients), no difference was found between age to change in dorsiflexion nor to the responses in the surveys (Bristol foot score, Modified McGill) using ANOVA. The BMI was divided into 3 groups: normal (BMI <25, or 35% of patients), overweight (BMI between 25 and 29, or 40%), or obese (BMI >29, or 25%). Using ANOVA, the stress lateral dorsiflexion (radiographic) at 6 weeks postoperative was found to be significantly increased by 5° in overweight individuals (n = 6), and increased by 34.5° in patients with normal BMI (n = 6), with F(2,13) = 4.167 ($P = 0.04$). Since

Figures 17. The Green-Waterman showed significantly less 1st MTPJ narrowing at 6 months, and more dorsal lipping/spurring preoperative.

Figure 18.

Figure 19.

Figure 20.

there were only 4 patients in the obese group (not all questions were answered on all questionnaires), no difference could be calculated. No difference was found between males or females in regard to DF values and surveys using the paired T test. Also using the paired T test, there was a significant difference in clinical DF between the two surgeons, with an average of 4° (13 cases) for DRG, and 28° (3 cases) for RMG, however in addition to the different number of patients, the RMG patients scored an average 42 mm on the pain scale (maximum 113 mm), whereas they scored 75 mm on average in the DRG patients, on the preoperative questionnaire. So perhaps the DRG patients were the more difficult patients.

Among patients who indicated a chief complaint (CC) of bump pain, a significant decrease in clinical DF was noted at 6 weeks (n = 29) of 13.8° (versus 1.6° increase in those not indicating CC of bump pain, $P = 0.022$), at 3 months (n = 27) of 14.1° decrease (versus 3° increase, $P = 0.045$), at 6 months (n = 16) of 13.8° decrease (versus 6.8o increase, $P = 0.042$), and decrease radiographically at 6 weeks of 28.4° (versus .6° increase, $P = 0.003$). Only 4 indicated CC of nerve pain and could not be analyzed. Also among these CC of bump pain patients, a significant increase in preoperative pain was noted (average 74.3 mm), versus 44.4 mm (n = 23, $P = 0.05$), with the paired sample T test). Among those with CC of joint pain, a significant higher (worse score) cumulative postoperative BFS (n = 27) was noted (21.8 cumulative postoperative score, versus 14.6 in patients without CC joint pain, $P = 0.04$). A significant smaller decrease in DF radiographically was noted in these patients of CC joint pain at both 3 months (5.35° decrease, versus 23° decrease, $P = 0.035$) and 6 months (2.89° versus 22° decrease, $P = 0.037$). Among the CC limited motion patients, a significant increase in radiographic DF was noted at 3 months postoperative (3.4° increase, versus 15° decrease in those without CC limited motion, n = 26, $P = 0.035$) and 6 months postoperative (9° increase, versus 14.82 decrease without this CC, $P = 0.024$).

For duration of having the bunion, the longer the patients had the bunion, the more pain they had preoperatively, using the surveys (Bristol Foot Score, and Modified McGill Pain questionnaires), with all P values > 0.05 using ANOVA. No significant change was noted in dorsiflexion or survey results on those who had previously used orthotics or tobacco. Those patients who had undergone foot surgery for the first time had higher cumulative postoperative Bristol Foot Score (worse score, 19.4 versus 14.5) than those who had had prior foot surgery (total n = 27, $P = 0.039$, paired T test). For work type, those who had a desk job had significantly less decrease in clinical DF at 3 months postoperative (2.6° decrease, n = 27, versus 18.4° in the standing work type, n = 8, $P = 0.046$), using the paired sample T test. Too few were in the heavy duty (n = 1) and sedentary (n = 2) work types to be analyzed for comparison. Among the 10 patients who indicated they were retired, a significantly higher decrease in clinical DF was noted at 3 months (30.7° decrease, versus 2.8° decrease in the rest) using the paired sample T test, but please note that this was affected by age, which as mentioned before, did not play a role in change in DF before and after bunion surgery. No difference was found between the 17 patients who indicated they occasionally exercised and the 23 regularly-exercising patients between change in DF and survey scores (and not enough patients who indicated they did not exercise, n = 4), using paired sample T test. Among the reason for surgery, no difference was noted using sample paired T tests between appearance and difficulty with shoegear (and all but 2 patients indicated pain as not being a reason for surgery).

Complications, which required returning to the operating room, include (5 total): 2 delayed healings (1 of which healed with bone stim, the other was a Lapidus that was redone 9 months later), 2 fractures of capital fragment (in an 73 year-old osteopenic patient bilateral, both requiring ORIF), and 1 varus (Figures 21 & 22). Problems, not requiring return to the O.R., (14 total) included: 3 hypertrophic scars, 1 neuritis (which resolved with injection), 1 continued pain (which resolved when swelling improved), 1 painful fixation (which was removed), 4 recurrences not requiring surgery, 1 subsecond pain, 1 suture reaction (resolved after 1 week) and 1 transfer metatarsalgia (improved with padding, but may or may not have been directly due to the bunion surgery).

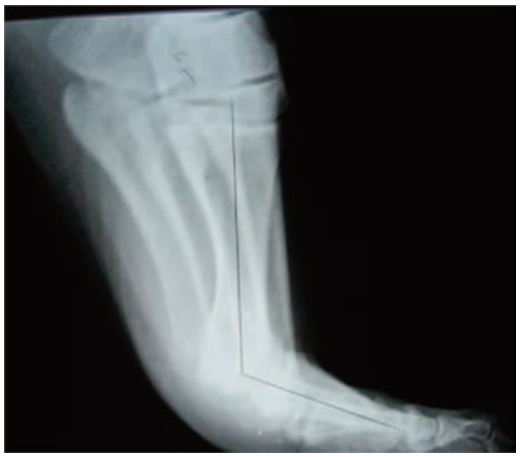
Figures 21. Varus complication.

Figure 22.

DISCUSSION

We accept our hypothesis that clinical DF measurements decrease postoperatively, significantly at 6 weeks, 3 months, and one year clinically, compared with preoperatively. A high positive correlation was found between preoperative clinical and radiographic measurements, giving some value to obtaining a stress lateral radiograph, to gauge the amount of DF available preoperatively, as well as at 6 months and one year. Notably, PF also significantly decreased at 6 weeks and 3 months. However important to note that when the data was divided between hallux valgus from hallux limitus patients, the hallux valgus had significant decreases in clinical and radiographic dorsiflexion postoperative and significant increases in hallux limitus patients, suggesting that the hallux valgus pathology is a precursor for limited postoperative dorsiflexion and the hallux limitus diagnosis, as expected, improved in their dorsiflexion postoperative as this was addressed surgically. Likewise, the hallux valgus procedures including Austin and CBW produced decreased ranges of motion, whereas the joint eliminating Keller and joint decompressing Green-Waterman unsurprisingly showed increased dorsiflexion postoperatively.

Patient's scores improved significantly postoperative for both the BFS and Modified McGill surveys, so that a reduction in pain and more function was attained surgically. Patients also regained hallux purchase power by 3 months. At 6 weeks postoperative, no significant increase in DF was found in the 4 obese individuals, however a significant lateral stress DF increase was found in overweight (5°) and much higher (34.5°) in normal weight individuals, of the 40 patients (69%) who reported their height and weight in the preoperative questionnaire. There was a significant decrease in clinical DF at 6 weeks, 3 months, and 6 months as well as decrease in radiographic DF at 6 weeks in those with chief complaint of bump pain, similar to the hallux valgus patients, since 28 out of the 34 with CC bump pain (or 82%) had hallux valgus (+ MPA). Also similar to hallux limitus patients, those with a chief complaint of joint pain had a significantly less decrease in 3 and 6 month radiographic DF. Only 10 of the 27 who had CC joint pain were HL patients, or 37%, which may indicate that shortening or plantarflexion of the metatarsal may also be indicated in hallux valgus patients (since 7 of the 11 Green Watermans were in this group, or 64%). Also significant increase in radiographic DF at 3 and 6 months postoperative were noted in patients with limited motion as chief complaint, and of these 8, six were hallux limitus patients (75%), which corresponds to prior hallux limitus patients having significant increase in DF postoperative (Figures 23-25). As expected, the longer the patient had the bunion pain, the more pain they had preop. Interesting to note, those who had never had foot surgery before their bunion surgery had worse (higher) BFS postoperative by 5 points. This finding may be due to those never having had foot surgery prior perhaps having higher than realistic expectations postoperative.



Figures 23. Significant increase seen in hallux limitus patients postoperatively.

Figure 24.

Figure 25.

Contrary to our first study that showed those with a weight-bearing job (>4 hours continuous activity) had higher DF rates, in this prospective study we found that those with a desk job had a smaller decrease in 3 months postoperative clinical DF than those with a standing job. Even the retired patients had a significantly higher decrease in clinical DF at 3 months than non-retired patients. However we did use different analysts and different analysis tests in the two studies. Our first study also indicated that patients who exercised regularly had significantly improved satisfaction with the surgery, however in this study, not enough patients indicated that they did not exercise, but no difference in DF values were found between occasional and regularly exercising individuals. Perhaps exercise or activity is not as important a factor as originally thought.

Radiographic studies showed shorter first metatarsal lengths 3 months postoperative, as well as significant reduction of the HAA at 3 months and 6 months, true IMA at 6 weeks, and the IMA at 6 weeks, 3 months, and 6 months postoperative, as well less dorsal spurring at all postoperative times, showing successful correction of pathology and deformity. Likewise, the Austin and CBW showed significant reduction in HAA (at 3 months for Austin, and at 6 weeks, 3 months, and 6 months for CBW) postoperative when divided by procedure. The CBW alone had significant reduction in IMA, at 6 weeks, 3 months, and 6 months, for the true IMA, at 6 weeks only, as well as for the TSP at 6 weeks only (Figures 26, 27). More preoperative arthritic changes were noted for the Keller and Green-Waterman procedures as well, again supporting surgical benefit, as well as significant shortening in first metatarsal length for the Green-Waterman at 6 months. The differences in diagnoses were very similar to the breakdown by procedure, with the HAV only similar to Austin outcomes, HAV + MPA similar to CBW outcomes, and HL similar to Green-Waterman outcomes.

Limitations include less followup at one year, and short followup time of one year, as well as small population size, i.e., for breaking up into procedure, and less variety in procedure. Many times in the data analysis, the one year data had to be excluded due to small sample size, and also any procedure other than the 4 most common ones (Austin, CBW, Keller, Green-Waterman), had to be excluded due to small number. Again, the Keller had to be eliminated from post-hoc tests on many accounts due to small number (Figures 28-31). Minimal complications were noted.

Figure 26. The closing base wedge had significant decrease in IMA, true IMA and reduction of tibial sesamoid position post-operative.

Figure 27.

Figure 28. The Keller procedure had to be excluded from majority of data analysis due to too few cases (n = 8, 11.4%).

Figure 29.

Figure 30.

Figure 31.

CONCLUSION

When combining all the data, we accept our hypothesis that bunion surgery decreases motion at the first MTPJ postoperatively up to one year both clinically and radiographically. A significant decrease at 1 year was found in clinical DF compared with preoperatively, which supports our hypothesis. Division of data by diagnosis and procedure showed significant decreased clinical and radiographic DF postoperatively in hallux valgus, Austin and closing base wedge patients but significant increase in hallux limitus, Keller and Green-Waterman patients. A positive correlation was found between clinical and radiographic measurements preop, 6 weeks postoperative, and 1 year postoperative, showing that a stress lateral radiographic view has some value in quantifying DF perioperatively.

BIBLIOGRAPHY

Banks AS, Downey MS, Martin DE, Miller SJ. McGlamry's Comprehensive Textbook of Foot and Ankle Surgery3rd Ed, Philadelphia,: Lippincott, Williams Wilkins; 2001.

Buell T, Green DR, Risser J. Measurement of the first metatarsophalangeal joint range of motion. J Am Pod Med Assoc 1988;78:439-48.

Christman RA. Foot and ankle radiology. Chicago: Churchill Livingstone; 2003.

Coughlin MJ, Jones CP. Hallux valgus: demographics, etiology, and radiographic assessment. Foot Ankle Int 2007;28:759-77.

DiGiovanni JE, Smith SD. Normal biomechanics of the adult rearfoot: a radiographic analysis. J Am Podiatric Med Assoc 1976;66:812-24.

Gerbert J. Textbook of bunion surgery. Philadelphia: WB Saunders; 2001.

LaPorta DM, Melillo TV, Hetherington VJ. Preoperative assessment in hallux valgus. in: hetherington vj: hallux valgus and forefoot surgery. New York: Churchill Livingstone;1994.

Roukis TS. Metarsus primus elevatus in hallux rigidus. J Am Pod Med Assoc 2005;95:221-8.

Seiberg M, Felson S, Colson JP, Barth AH, Green RM, Green DR. Closing base wedge versus austin bunionect for met primus adductus. J Am Pod Med Assoc 1994;84:548-63.

Shereff MJ, Beijani FJ, Kummer FJ. Kinematics of the first metatarsophalangeal joint. J Bone Joint Surg Am 1986;68:392-8.

Taranto J, Taranto MJ, Bryant AR, Singer KP. Analysis of dynamic angle of gait & radiograph features in subjects with hav & hallux limitus. 2007;97:175-88.

Yu GV, Judge MS, Hudson JR, Seidelman FE. Predislocation syndrome: progressive subluxation/dislocation of the lesser metatarsophalangeal joint. J Am Pod Med Assoc 2002;92:182-99.

Worksheet San Diego Podiatry Group Bunion Study
Survey Check List

Date	Evaluation (Physical Exam)	X-rays (Stress DF view)	Pre-Op Questionnaire	Bristol Foot Score Questionnaire	Done
	PREOPERATIVE	☐	☐	☐	☐
	INTRAOPERATIVE				☐
	1ST POSTOP VISIT	☐		☐	☐
	6-WEEK POSTOP	☐		☐	☐
	3-MONTH POSTOP	☐		☐	☐
	6-MONTH POSTOP	☐		☐	☐
	1-YEAR POSTOP	☐		☐	☐
	COMPLICATIONS	☐		☐	☐

Pre-Operative Physical Exam #: _____
Date of Examination: _____ Surgeon:_____
Date of Surgery: _____ Examiner:_____
Extremity: Right Left

NWB Exam

1st MTPJ ROM in STJN: Resting position _____° DF / PF
DF _____°
PF _____°

1st Ray Motion in STJN: Resting position _____ mm DF / PF
Use Whitney device DF _____ mm □ crepitus
PF _____ mm □ crepitus

1st MTPJ motion:
- ❑ Painful DF / PF / mid / end-range
- ❑ Crepitus DF / PF / mid / end-range
- ❑ Soft tissue / osseous impingement DF / PF / mid / end-range

1st MTPJ axis deviation: □ Unrestricted □ Tracking □ Trackbound
1stMTPJ prominence: □ Dorsal □ Dorsomedial □ Medial
□ Erythema □ Bursa □ Callus □ Tenderness

Presence of:
- ❑ 1st Met-cuneiform prominence
- ❑ 4th toe adducted / varus mild / moderate / severe
- ❑ 5th toe adducted / varus mild / moderate / severe
- ❑ Bunionette mild / moderate / severe
- ❑ Hammertoes 1 2 3 4 5
- ❑ Submet head callus 1 2 3 4 5
- ❑ Medial pinch callus hallux
- ❑ Sub-IPJ callus hallux

2nd toe position relative to hallux: Weightbearing
- ❑ No contact □
- ❑ Abutting □
- ❑ Underlying 1st □
- ❑ Overlying 1st □
- ❑ Positive Lachman's test (Proximal phalanx 2mm dorsal translocation relative to 2nd metatarsal head at 2nd MTPJ)

WB Exam

1st MTPJ ROM: RCSP _____° DF
NCSP _____° DF

Hallux purchase power: □ Easy □ Resistant □ Not Moveable
Paper can be pulled out from beneath patient's hallux without resistance (easy), with resistance, or not.

Pre-Operative Questionnaire (Bunion Surgery Study) #_____
Today's Date _____ Date of Surgery _____

Thank you for participating in our bunion study questionnaire. We assure that your name and results will be held confidential. Please circle where applicable, below.

Age: _____ Sex: M F Height: _ Weight: ____ Extremity: Right Left

Chief Complaint:

- ❑ Bump pain
- ❑ Joint pain
- ❑ Limited motion
- ❑ Nerve pain
- ❑ Other: ___

Duration of Bunion pain: (years) (months) Shoe size: _____

Previous treatment: Orthotics other: _____

Previous foot surgery: _____ Year of previous surgery:_____

Illnesses: Diabetes PVD Rheumatoid Osteoporosis Other:_____

_____

Medications: Steroids Other: _____

_____

Tobacco:

- ❑ Yes, currently _____ Packs/day x ___yr
- ❑ No, stopped_____years ago, and smoked for _____years.
- ❑ No, never smoked.

Occupation: _____ Exercise type: _____

Work:

- ❑ Sedentary
- ❑ Desk Work
- ❑ Standing Job
- ❑ Heavy Duty

Exercise:

- ❑ No Exercise
- ❑ Occasional Exercise
- ❑ Regular Exercise

In order of importance, using a scale of 1-5 (1 = not important, 5 = very important), please designate the reason why you are having surgery.

_____ Appearance
Pain
_____ Inability to wear all shoe types

Modified McGill Pain Questionnaire ID#_____Date_____

Activity restrictions:
- □ None
- □ Limits exercise
- □ Limits activity after 4 hours
- □ Limits activity all the time

Work restrictions:
- □ None
- □ Reduced performance
- □ Limits duties
- □ Changed jobs to foot pain

Shoe restrictions:
- □ None
- □ Restricted to sneakers/wide shoes
- □ Very limited in shoes
- □ Sandals only

Frequency of pain:
- □ No pain
- □ Mild on occasion
- □ Moderate daily
- □ Severe daily

Motion of big toe joint: □ satisfied □ limited motion w/o pain □ pain w/restricted motion

Alignment & Appearance of big toe: □ Good, pleased □ Fair □ Poor, unhappy

Swelling in big toe: □ None □ Slight □ Constant Painful callus: □ Yes □ No

Please rate pain of bunion deformity to date:

□ Throbbing	□ None	□ Mild	□ Moderate	□ Severe
□ Shooting	□ None	□ Mild	□ Moderate	□ Severe
□ Stabbing	□ None	□ Mild	□ Moderate	□ Severe
□ Sharp	□ None	□ Mild	□ Moderate	□ Severe
□ Cramping	□ None	□ Mild	□ Moderate	□ Severe
□ Gnawing	□ None	□ Mild	□ Moderate	□ Severe
□ Hot-burning	□ None	□ Mild	□ Moderate	□ Severe
□ Aching	□ None	□ Mild	□ Moderate	□ Severe
□ Heavy	□ None	□ Mild	□ Moderate	□ Severe
□ Tender	□ None	□ Mild	□ Moderate	□ Severe
□ Splitting	□ None	□ Mild	□ Moderate	□ Severe
□ Tiring-Exhausting	□ None	□ Mild	□ Moderate	□ Severe
□ Sickening	□ None	□ Mild	□ Moderate	□ Severe
□ Fearful	□ None	□ Mild	□ Moderate	□ Severe
□ Punishing-Cruel	□ None	□ Mild	□ Moderate	□ Severe

Present pain intensity: □ No pain □ Mild pain □ Discomforting
□ Distressing □ Horrible □ Excruciating

Mark on the following line your level of pain:

No pain _____ Worst pain Possible

BRISTOL FOOT SCORE (BFS)

*This questionnaire is designed to examine the impact that your **feet** are having on your health and lifestyle. There are no right or wrong answers. Please complete each question by checking only one option; see the following example:*

In the past 2 weeks, how often have you watched television?

Every day	❑
3 – 5 days	☑
1 – 2 days	❑
Not at all	❑

I would like to thank you in advance for taking the time to read and complete this questionnaire; your responses and comments will be very helpful.
Yours faithfully,

---

1. Do problems with your **feet** affect whether you go out of the house to visit family or friends? (Please check one box only)

My feet are a major problem	❑ 4
My feet are a moderate problem	❑ 3
My feet are a bit of a problem	❑ 2
My feet are not a problem	❑ 1
Does not apply because I choose not to do this	❑ 9

2. Do problems with your **feet** affect whether you walk to the shops? (Please check one box only)

My feet are a major problem	❑ 4
My feet are a moderate problem	❑ 3
My feet are a bit of a problem	❑ 2
My feet are not a problem	❑ 1
Does not apply because I choose not to walk to the shops	❑ 9

3. Do problems with your **feet** affect you when standing still? (Please check one box only)

My feet are a major problem	❑ 4
My feet are a moderate problem	❑ 3
My feet are a bit of a problem	❑ 2
My feet are not a problem	❑ 1

4. Do problems with your **feet** affect you when walking on bumpy or stony ground? (Please check one box only)

My feet are a major problem	❑ 4
My feet are a moderate problem	❑ 3
My feet are a bit of a problem	❑ 2
My feet are not a problem	❑ 1
Does not apply because I choose not to do this	❑ 9

5. During the past 2 weeks, how painful have your feet been? (Please check one box only)

Not painful	❑ 1
Very slightly painful	❑ 2
Slightly painful	❑ 3
Moderately painful	❑ 4
Very painful	❑ 5
Extremely painful	❑ 6

6. During the past 2 weeks, how often have you felt this way about your feet?
"I have felt conscious of my feet"
(Please check one box only)

All of the time	❑ 6
Most of the time	❑ 5
A good bit of the time	❑ 4
Some of the time	❑ 3
A little of the time	❑ 2
None of the time	❑ 1

7. During the past 2 weeks, how often have you felt this way about your feet?
"I have felt fed up about my feet"
(Please check one box only)

All of the time	❑ 6
Most of the time	❑ 5
A good bit of the time	❑ 4
Some of the time	❑ 3
A little of the time	❑ 2
None of the time	❑ 1

8. During the past 2 weeks, how often have you felt this way about your feet?
"I have felt worried that my feet will get worse in the future"
(Please check one box only)

All of the time	❑ 6
Most of the time	❑ 5
A good bit of the time	❑ 4
Some of the time	❑ 3
A little of the time	❑ 2
None of the time	❑ 1

9. During the past 2 weeks, have you felt this way about your feet?
"I have felt my feet are not really part of me"
(Please check one box only)

Yes	❑ 3
Some of the time	❑ 2
No	❑ 1

10. Because of your feet, have you had problems sleeping in the past 2 weeks? (Please check one box only)

Yes, very frequently	❑ 5
Yes, frequently	❑ 4
Yes, sometimes	❑ 3
Rarely	❑ 2
Not at all	❑ 1

11. In the past 2 weeks, have you been able to put your everyday shoes on easily? (Please check one box only)

Always easily	❑ 1
Usually easily	❑ 2
Sometimes easily	❑ 3
Occasionally easily	❑ 4
Never easily	❑ 5

12. During the past 2 weeks, how often have you been able to wear any shoes you liked? (Please check one box only)

All of the time	❑ 1
Most of the time	❑ 2
A good bit of the time	❑ 3
Some of the time	❑ 4
A little of the time	❑ 5
None of the time	❑ 6

13. If you could afford any shoes you wanted, how easily could you find new shoes that fit comfortably? (Please check one box only)

Very easily	❑ 1
Easily	❑ 2
With some difficulty	❑ 3
With great difficulty	❑ 4

14. In general, would you say your foot health is:
(Please check one box only)

Excellent	❑ 1
Very good	❑ 2
Good	❑ 3
Fair	❑ 4
Poor	❑ 5

15. Would you say your general health is:
(Please check one box only)

Excellent	❑ 1
Very good	❑ 2
Good	❑ 3
Fair	❑ 4
Poor	❑ 5

THANK YOU FOR TAKING THE TIME TO COMPLETE THIS QUESTIONNAIRE

Radiographic Worksheet #: _____
Prospective; Surgeon :_____ Date of Surgery: _____

		Zero						Norm	Range
R L	Date of X-ray								
DP view	1st metatarsal length cm								
	1st metatarsal width cm								
	Shape of 1st met head*								
	1st MTPJ congruity**								4-25% deviated
	1st MTPJ DJD***	+ -	+ -	+ -	+ -	+ -	+ -	-	
	Joint space narrowing	+ -	+ -	+ -	+ -	+ -	+ -	-	
	Shape of 1st Metatarsal Base*							N/A	
	Met Primus Adductus; MPA=IMA°							8	0-14
	Hallux abductus angle; HAA °							15-16	0-15
	Hallux interphal angle; HIA °							13	0-13
	Met Protrusion Dist; MPD mm							±2mm	
	Tib sesamoid position; TSP							<4	1-3
	Tib ses – 2nd met distance (cm)							fixed	
	2nd MTPJ congruity; C/D/S							congruous	
	2nd toe position; abd/add/rect							rectus	
	Met Adductus Angle; MAA °							15	10-20
	True IMA = IMA + (MAA–15°)							8	0-8
	Engle's angle; 2nd met-cunei°							18	3-4>MAA
	FF Adductus Angle; FAA °							1-2 < MAA	
	1st met – calcaneal angle °								
	Talocalcaneal angle; TCA°								
	Talonavicular coverage °							0	
	Cuboid Abduction Angle; CAA°							0	0-5
MO	DF of toes	+ -	+ -	+ -	+ -	+ -	+ -	-	
Lateral view	Met 1' Elevatus; MPE	+ -	+ -	+ -	+ -	+ -	+ -		
	Seiberg Index+; (mm) prox-dist							0	
	1st met declination angle °								
	Talo-1st met angle; Meary's °							0	
	Calc Inclination Angle; CIA°							24.5	17.0-32.0
	Talar Declination Angle; TDA°							21.1	17.5-26.6
	Talocalcaneal angle; TCA°							CIA + TDA	

	Kirby's sign +: bullet hole	+ -	+ -	+ -	+ -	+ -	+ -	0	
	Dorsal 1st MTPJ lipping/spurring	+ -	+ -	+ -	+ -	+ -	+ -	-	
	Cyma Line break	a n p	a n p	a n p	a n p	a n p	a n p	neutral	
Lateral stress DF view								65	

*R = round, O = oblique, = square; **C = Congruous, D = Deviated, S = Subluxed
***DJD = Degenerative Joint Disease (Subchondral cysts, erosions, sclerosis)
+Dorsal position of the first metatarsal is positive, plantar position is negative (mm) (Roukis)

Intra-Operative Exam Worksheet #:_____
(Prospective) Surgeon:_____
Date of Surgery:_____

Procedure:

- ❑ Silver Austin Scarf Base Wedge Keller
- ❑ Akin Kalish Mau Lapidus Implant
- ❑ Modified McBride Youngswick Sagittal-Z Crescentic McKeever
- ❑ Cheilectomy Reverdin-Green Tight-rope Cotton
- ❑ Watermann-Green Other:_____

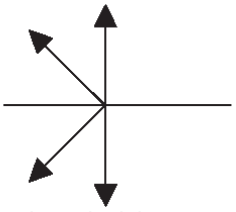
Steps performed:

- ❑ Adductor tendon release: Fib. ses. ligament release:
- ❑ Adductor transfer: Excision of fib. sesamoid:
- ❑ FHB Tenotomy (lateral): Lateral capsule release
- ❑ EHB Tenotomy: Medial capsulorraphy:
- ❑ EHL Lengthening: Subchondral drilling:

Capsulotomy type: Mediovertical Elliptical Medial U / H / L
T shaped Inverted L Lenticular Washington Monument

Evaluation of Cartilage: Intact Partial degeneration Full degeneration
Other Findings: _____

Intra-Op 1st MTPJ ROM after fixation:
DF _____°
PF _____°



Fixation:

- ❑ K-wire Screw Absorbable
- ❑ x1 0.045 x1 2.0mm x1 Orthosorb Pin: 2.0 2.4
- ❑ x2 0.054 x2 2.7mm x2 Smart Pin Screw 2.7
- ❑ x3 0.062 x3 3.0mm Allofix 3.5
- ❑ Smooth threaded 3.5mm Bionix 4.0
- ❑ Buried percutaneous 4.0mm
- ❑ Crossed Plate and Screws
- ❑ Lock pin 0.062 _____ Other fixation: Cerclage / _____

Additional Procedures: None. HT: 2 3 4. Adductovarus: 4 5. Tailor's. RF. TAL. Other: _____

- ❑ Tourniquet Epinephrine Dexamethasone Toradol

Anesthesia: General Mac Spinal Local
Complications:_____
Dressing:_____
Activity: WB PWB NWB

Complications Form Patient Name/ ID#:_____
Date of Discovery:_____ Date of Surgery:_____

Is the complication symptomatic? Y N Symptoms:_____

Soft Tissue	Bone	Result
❑ Pain	callus	hallux varus
❑ Swelling	delayed union	recurrence
❑ Stiffness	non-union	hallux limitus
❑ Dehiscence	displacement	metatarsus primus elevatus
❑ Hematoma	painful fixation	lack of hallux purchase
❑ Infection	failed fixation	hallux extensus
❑ Hypertrophic scar	fractured fixation	hallux rigidus
❑ Keloid	AVN	arthritic joint
❑ Nerve entrapment	Cyst formation	
	Decreased joint space	

Other:_____

Revisional Surgery:_____Date:_____

Other complications:_____Date:_____

Notes

1st Post-Op Visit Physical Exam #: _____
Date of Examination: _____ Surgeon:_____
Date of Surgery: _____ Examiner:_____

Extremity: Right Left

Activity on surgical foot:
- ❑ Full weight
- ❑ Partial Weight
- ❑ No Weight

Method:
- ❑ Surgical Shoe
- ❑ Equalizer boot
- ❑ Below-knee cast

Pain medications: _____ Doses:_____ # Days:_____

Edema:
- ❑ None
- ❑ Periwound
- ❑ Dorsomedial
- ❑ Entire dorsum
- ❑ Circumferential

Erythema:
- □ None
- □ Periwound
- □ Dorsomedial
- □ Entire dorsum
- □ Circumferential

Ecchymosis:
- □ None
- □ Periwound
- □ Dorsomedial
- □ Entire dorsum
- □ Circumferential

Bleeding:
- ❑ None
- ❑ Seeping, part of incision
- ❑ Seeping, whole incision
- ❑ Hematoma
- ❑ Active bleeding

Dehiscence:
- □ None
- □ <50% incision
- □ >50% incision
- □ whole incision
- □ necrosis

Infection:
- □ None
- □ Suture abscess
- □ Local cellulitis
- □ Abscess
- □ Osteomyelitis

Other complications:_____

Notes

Date of Surgery: _____ Examiner:_____

Extremity: Right Left

Exercises:
Date started: _____ Frequency: _____

Method:
- ❑ Up and down motion of great toe joint
- ❑ Up and down motion of tip of great toe joint
- ❑ Other:_____

NWB Exam

1st MTPJ ROM in STJN:	Resting position	_____° DF / PF
	DF	_____°
	PF	_____°
1st Ray Motion in STJN:	Resting position	_____ mm DF / PF
Use Whitney device	DF	_____ mm
	PF	_____ mm

1st MTPJ motion:
- ❑ Painful DF / PF / mid / end-range
- ❑ Crepitus DF / PF / mid / end-range
- ❑ Soft tissue / osseous impingement DF / PF / mid / end-range

2nd toe position relative to hallux:	Weightbearing
❑ No contact	□
❑ Abutting	□
❑ Underlying 1st	□
❑ Overlying 1st	□

WB Exam

1st MTPJ ROM:	RCSP	_____° DF
	NCSP	_____° DF

Hallux purchase: □ Easy □ Resistant □ Not Moveable
Paper can be pulled out from beneath patient's hallux without resistance (easy), with resistance, or not.

- ❑ Patient presents to clinic with orthotics inside shoes.