

# Improved Postoperative Radiographic Alignment associated with Patient-Specific Instrumentation in Total Ankle Arthroplasty

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INTRODUCTION: The rate of total ankle arthroplasty (TAA) is projected to continue to increase globally over the next several decades. While the most significant predictor of complications after total ankle arthroplasty is implant malalignment, intra-operative evaluation of alignment can be technically challenging to achieve. Patient-specific instrumentation (PSI) was designed to improve the accuracy of implant positioning in TAA. Therefore, we sought to compare radiographic alignment and postoperative function in patients who underwent TAA with PSI guides versus standard instrumentation.

METHODS: We retrospectively reviewed 80 ankles who underwent TAA using PSI compared to 80 ankles who underwent TAA without PSI. Demographics, radiographic alignment, range of motion (ROM), complications, and postoperative American Orthopaedic Foot and Ankle Society (AOFAS) scores were compared. All patients had minimum 1-year follow-up. Demographics were similar between cohorts, including gender (p=0.155), body mass index (p=0.943), laterality (p=0.873), preoperative diagnosis (p=0.080), and history of diabetes mellitus (p=0.725). Patients in the PSI group were older (mean=68.66 versus 64.75, p=0.010) and had a higher American Society of Anesthesiologists score (mean=2.36 versus 2.15, p=0.004). Preoperative dorsiflexion (mean=8.86° versus 8.79°, p=0.941), plantarflexion (mean=28.99° versus 27.50°, p=0.308), and total ROM (mean=37.86° versus 36.29°, p=0.463) were similar between cohorts. The PSI cohort had more preoperative talar tilt (mean=7.78° versus 4.38°, p=0.001), but similar coronal angle (mean=-2.77° versus -0.09°, p=0.171) and sagittal translation (mean=3.24° versus 1.30°, p=0.062).

RESULTS: Postoperative coronal angle (mean=0.22° (range=-8.16°-5.42°) versus 1.38° (range=-4.19°-9.14°), p=0.003) and sagittal angle (mean=-2.07° (range=-9.01°-3.94°) versus -4.51° (range=-13.0°-2.0°), p<0.001) were more accurate and had a narrower range with the PSI guides compared to the manual guides. Postoperative ROM was similar between the PSI and manual groups, including dorsiflexion (mean=10.66° versus 10.83°, p=0.851), plantarflexion (mean=29.13° versus 29.83°, p=0.520), and total ROM (mean=39.79° versus 40.67°, p=0.586). Patients with PSI had improved AOFAS alignment scores (mean=9.74 versus 8.89, p=0.003), but there were similar AOFAS pain (mean=29.49 versus 31.51, p=0.150), function (mean=40.74 versus 38.79, p=0.199), and total scores (mean=79.97 versus 79.19, p=0.753) between cohorts. There were similar numbers of patients who required revision (1.25% versus 8.75%, p=0.070) or irrigation and debridement (3.75% versus 8.75%, p=0.327) between cohorts.

DISCUSSION AND CONCLUSION: PSI is associated with more accurate postoperative coronal and sagittal alignment compared to manual instrumentation TAA. While patients with PSI had improved AOFAS alignment scores, both cohorts had similar postoperative ROM and overall AOFAS scores. While there were a similar number of revisions and irrigation and debridement procedures in each cohort, this retrospective review was limited to shorter term follow-up. Further research is needed to determine if the improved alignment with the use of PSI implants is associated with better survivability

long

term.

Demographics				
	Patient Specific Instrumentation n=80	Manual n=80	Total n=160	p-value
Age (years), mean (range)	68.66 (49-97)	64.75 (35-80)	66.71 (35-97)	<b>p=0.010</b>
Gender, n (%)				p=0.155
Female	36 (45.00)	46 (57.50)	82 (51.25)	
Male	44 (55.00)	34 (42.50)	78 (48.75)	
Body mass index (kilograms/meter²), mean (range)	29.42 (19.31-45.42)	29.35 (19.0-48.7)	29.39 (19.0-48.7)	p=0.943
Laterality, n (%)				p=0.873
Left	36 (45.00)	34 (42.50)	70 (43.75)	
Right	44 (55.00)	46 (57.50)	90 (56.25)	
American Society of Anesthesiologists score, mean (range)	2.36 (2-3)	2.15 (1-3)	2.26 (1-3)	<b>p=0.004</b>
Diabetes, n (%)				p=0.725
No Diabetes	76 (95.00)	74 (92.50)	150 (93.75)	
Diabetes	4 (5.00)	2 (2.50)	6 (3.75)	
Diagnosis, n (%)				p=0.080
Osteoarthritis	29 (36.25)	38 (47.50)	67 (41.88)	
Other	1 (1.25)	0 (0.00)	1 (0.63)	
Posttraumatic Arthritis	47 (58.75)	32 (40.00)	79 (49.38)	
Psoriatic Arthritis	0 (0.00)	1 (1.25)	1 (0.63)	
Rheumatoid Arthritis	3 (3.75)	0 (0.00)	3 (1.88)	
Follow-up (days), mean (range)	411.31 (314-795)	459.37 (83-1574)	435.19 (83-1574)	p=0.133

Preoperative range of motion and radiographic alignment

	Patient Specific Instrumentation n=80	Manual n=80	Total n=160	p-value
Preoperative dorsiflexion (degrees), mean (range)	8.86 (-5.0-20.0)	8.79 (-5.0-20.0)	8.83 (-5.0-20.0)	p=0.941
Preoperative plantarflexion (degrees), mean (range)	28.99 (10.0-50.0)	27.50 (10.0-50.0)	28.34 (10.0-50.0)	p=0.308
Preoperative total range of motion (degrees), mean (range)	37.86 (5.0-70.0)	36.29 (10.0-65.0)	37.17 (5.0-70.0)	p=0.463
Preoperative coronal angle (degrees), mean (range)	-2.77 (-33.7-25.0)	-0.09 (-16.6-16.9)	-1.63 (-33.7-25.0)	p=0.171
Preoperative total range of motion (degrees), mean (range)	7.78 (0.0-33.0)	4.38 (0.0-16.9)	6.34 (0.0-33.0)	<b>p=0.001</b>
Preoperative sagittal translation (degrees), mean (range)	3.24 (-12.81-20.3)	1.30 (-13.0-14.0)	2.43 (-13.0-20.3)	p=0.062

Outcomes

	Patient Specific Instrumentation n=80	Manual n=80	Total n=160	p-value
Postoperative coronal angle (degrees), mean (range)	0.22 (-8.16-5.42)	1.38 (-4.19-9.14)	0.75 (-8.16-9.14)	<b>p=0.003</b>
Postoperative sagittal angle (degrees), mean (range)	-2.07 (-9.01-3.94)	-4.51 (-13.0-2.0)	-3.18 (-13.0-3.94)	<b>p&lt;0.001</b>
Postoperative dorsiflexion (degrees), mean (range)	10.66 (0.0-20.0)	10.83 (0.0-20.0)	10.74 (0.0-20.0)	p=0.851
Postoperative plantarflexion (degrees), mean (range)	29.13 (20.0-40.0)	29.83 (10.0-40.0)	29.44 (10.0-40.0)	p=0.520
Postoperative total range of motion (degrees), mean (range)	39.79 (25.0-55.0)	40.67 (15.0-60.0)	40.18 (15.0-60.0)	p=0.586
AOFAS pain score, mean (range)	29.49 (0-40)	31.51 (0-40)	30.39 (0-40)	p=0.150
AOFAS function score, mean (range)	40.74 (13-50)	38.79 (4-50)	39.67 (4-50)	p=0.199
AOFAS alignment score, mean (range)	9.74 (5-10)	8.89 (0-10)	9.36 (0-10)	<b>p=0.003</b>
Total AOFAS score, mean (range)	79.97 (56-100)	79.19 (24-100)	79.58 (24-100)	p=0.753
Revision, n (%)	1 (1.25)	7 (8.75)	8 (5.00)	p=0.070
Incision and Debridement, n (%)	3 (3.75)	7 (8.75)	10 (6.25)	p=0.327