Two for One: Bilateral Simultaneous versus Staged Total Ankle Arthroplasty, are Patient-Centered Outcomes Equivalent?

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Introduction/Purpose: The utilization of total ankle arthroplasty has increased over the past decade, including bilateral TARs. The risk-benefit profiles of staged versus simultaneous joint arthroplasty continues to be debated in the literature. Previous studies of the hip and knee have demonstrated simultaneous bilateral surgery is associated with shorter hospitalization, shorter recovery and rehabilitation time, and decreased cost without increasing perioperative morbidity or mortality. There are limited case series reporting outcomes after bilateral TAR with no previous comparison of simultaneous versus staged TAR. Thus, we aim to compare our experience with bilateral simultaneous versus staged TARs including perioperative complications and patient reported outcomes.

Methods: We performed a retrospective study on 62 patients (124 ankles) undergoing primary TAA (CPT 27702) from 2008 at a single academic center. Inclusion criteria were primary bilateral TAA performed in staged or simultaneous fashion in patients over the age of 18 years-old. Exclusion criteria were patients with less than one-year follow-up. Patient demographics, comorbidities, concomitant procedures, perioperative complications, and patient reported outcomes were also collected. Patient reported outcomes included preoperative and postoperative visual analog scale (VAS) for pain, the Short Form-36 (SF-36) Health Survey, the American Orthopaedic Foot & Ankle Society (AOFAS) score, the Foot and Ankle disability Index (FADI) score, and the Short Musculoskeletal Function Assessment (SMFA) bother and function sub-scores. Every patient had separate outcome scores available for each ankle. Univariate and multivariable tests of significance were used to relate patient and operative characteristics to outcomes. Separate subgroup analyses were performed comparing stages versus simultaneous surgeries.

Results: The mean age was 63.7 years-old with a mean duration of 40.5 months of clinical follow-up. There were no significant pre-operative differences between simultaneous and staged groups in terms of age, gender, BMI, ASA classification, or arthritis etiology (p>0.05). The majority (54.5%) of patients had primary or secondary arthritis. Comorbidities were similar between the two groups with the exception of the simultaneous cohort having a higher proportion of previous smokers (56.3 vs 26.1, p=0.0020) and coronary artery disease (19.8 vs 6.5, 0.0447). There was no difference in perioperative complications between the groups(p= 0.4652). Both cohorts significantly improved in all reported patient reported outcomes at final follow-up (<0.001) without a difference in overall improvement between groups (p >0.05) (Table 1).

Conclusion: The prevalence of osteoarthritis (primary arthritis) and inflammatory arthritis (secondary arthritis) was higher in patients with bilateral end-stage arthritis necessitating a TAR than previous reports of unilateral TAR. The results of bilateral simultaneous TAA, including perioperative complications and patient reported outcomes, are comparable to patients undergoing staged TAA. We advocate that simultaneous bilateral TAA is a safe and effective method the treatment of bilateral end-stage ankle osteoarthritis in a setting where experienced surgeons are available. Potential benefits of simultaneous TAR for further investigation include decreased: anesthesia events, surgery time, length of hospitalization, recovery and rehabilitation time, and overall cost.
### Preoperative Demographics, Clinical Data, and Comorbidities

|                         | All Ankle   | Staged      | Simultaneous | P value* |
|-------------------------|-------------|-------------|--------------|----------|
| N ankles                | n=124       | n=92        | N=32         |          |
| Follow-up, y            | 40.5 (28.7) | 43.0 (30.3) | 33.3 (22.7)  | 0.0818   |
| Age, y                  | 63.7 (10.5) | 64.0 (11.2) | 62.7 (8.3)   | 0.4904   |
| Sex, male               | 76 (61.3)   | 58 (63.0)   | 18 (56.3)    | 0.4985   |
| Primary Diagnosis **    |             |             |              | 0.1551   |
| Post Traumatic          | 45 (40.9)   | 34 (43.6)   | 11 (34.4)    |          |
| Inflammatory (Secondary)| 14 (12.7)   | 14 (18.0)   | 0 (0)        |          |
| Osteoarthritis (Primary)| 46 (41.8)   | 25 (32.1)   | 21 (65.6)    |          |
| Other                   | 5 (4.6)     | 5 (6.4)     | 0 (0)        |          |
| Race, white             | 122 (98.4)  | 90 (97.8)   | 32 (100.0)   | 0.4023   |
| Body Mass Index, mg/m²  | 29.0 (5.2)  | 29.1 (5.0)  | 28.5 (5.7)   | 0.5796   |
| Previous tobacco use    | 42 (33.9)   | 24 (26.1)   | 18 (56.3)    | 0.0020   |
| Type II diabetes mellitus| 18 (17.3) | 14 (18.9)   | 4 (13.3)     | 0.4972   |
| Coronary artery disease | 12 (9.7)    | 6 (6.5)     | 6 (19.8)     | 0.0447   |
| Hypertension            | 67 (54.0)   | 52 (56.5)   | 15 (46.9)    | 0.3476   |
| American Society of Anesthesiologists (ASA) Score, ≥ 3 | 45 (36.3) | 33 (35.8) | 12 (37.5) | 0.8693 |

Values in No. (%) or mean (± standard deviation).

* Difference between surgical groups preoperative demographics

** Primary diagnosis: 14 missing

### Clinical Outcomes: Bonferroni Pairwise Comparisons

|                      | Mean Score (95% CI) | Improvement, P Value* | Operative Group Difference, P value** |
|----------------------|---------------------|-----------------------|---------------------------------------|
|                      | Staged              | Simultaneous          | Staged                                | Simultaneous                          |
| SF-36 total Preoperative | 52.9 (48.8-57.0) | 46.6 (43.7-49.4) | <0.0001                               | <0.0001                               | 0.2389 |
| Final follow-up      | 68.9 (63.9-73.9)  | 70.4 (62.3-78.5)     | <0.0001                               | <0.0001                               |          |
| VAS                  | 64.4 (59.5-69.2)   | 74.2 (68.9-79.6)     | <0.0001                               | <0.0001                               | 0.3785 |
| Preoperative         | 7.1 (4.3-9.8)      | 13.3 (6.1-20.6)      | <0.0001                               | <0.0001                               |          |
| Final follow-up      | 76.7 (72.6-80.8)  | 73.8 (66.1-81.6)     | <0.0001                               | <0.0001                               | 0.7805 |
| AOFAS total          | 40.7 (37.1-44.3)   | 40.2 (34.2-46.2)     | <0.0001                               | <0.0001                               |          |
| Preoperative         | 18.7 (14.0-22.3)   | 7.9 (-2.16.2)        | <0.0001                               | 0.0009                                 | 0.0676 |
| Final follow-up      | 19.0 (15.5-22.7)  | 18.4 (13.4-23.2)     | <0.0001                               | <0.0001                               | 0.3079 |
| SMFA function index  | 34.0 (31.0-37.0)   | 35.9 (31.5-40.3)     | <0.0001                               | <0.0001                               |          |
| Preoperative         | 19.0 (15.5-22.7)   | 18.4 (13.4-23.2)     | <0.0001                               | <0.0001                               | 0.3079 |
| Final follow-up      | 35.4 (31.8-39.0)   | 40.4 (34.4-46.4)     | <0.0001                               | <0.0001                               | 0.0880 |

* Pairwise difference between most recent and preoperative time points within each surgical group

** Difference between surgical groups improvement from preoperative to most recent follow-up