Radiographic Changes in Tibiotalar Motion Following Achilles Tendon Lengthening and Gastrocnemius Recession in Total Ankle Arthroplasty: A Comparative Cohort Study

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Introduction/Purpose: End-stage ankle osteoarthritis is a debilitating condition that often results in limited tibiotalar range of motion. Total ankle replacement (TAR) preserves ankle range of motion and improves the patient's functionality. Tendo-Achilles lengthening (TAL) and gastrocnemius recession (GR) are concomitant procedures often performed with TAR to improve tibiotalar dorsiflexion. The purpose of this study is to determine the effect of a TAL and GR during TAR on radiographic range of motion compared to a control group without a lengthening procedure.

Methods: A retrospective review of a prospectively maintained TAR database was conducted from November 2015 - June 2020 at a single academic institution. All surgeries were performed by fellowship-trained foot and ankle surgeons. Inclusion criteria included greater than18 years of age and a minimum of one-year radiographic follow-up with both preoperative and postoperative weight-bearing, range of motion radiographs. Exclusion criteria included concomitant 1) calcaneal osteotomies, 2) hindfoot or midfoot arthrodesis, 3) prior ankle arthrodesis, or 4) revision total ankle arthroplasty. A total of seventy-five patients (TAL, n = 40; GR, n = 35) were included with a control group of seventy-five consecutive patients who underwent TAR without a lengthening procedure. Demographic and clinical data were extracted from the TAR database. Preoperative and postoperative radiographic assessment included a measurement of dorsiflexion and plantarflexion. All measurements were performed by two members of the research team.

Results: A total of 150 patients were included in this study: TAL: n = 35, GR: n = 40, Control: n = 75. Dorsiflexion significantly improved by 3.4° (p=0.0053) and by 6.7° (p < 0.0001) in the TAL and GR cohorts respectively with no significant difference in the control group (+1.3°, p=0.0857). Plantarflexion was significantly decreased by 3.6° (p=0.0378) and by 6.6° (p=0.0002) in the TAL and GR cohorts respectively with no significant difference in the control group (+0.3°, p=0.7863). The total arc of motion did not change significantly for any of the three groups postoperative (control 1.63°, GR 0.05°, TAL -0.20°; all p>0.05). There were no significant between-group differences in the change in overall arc of motion between the groups (p=0.3913). Compared to TAL group, GR resulted in a greater increase in dorsiflexion (6.7° versus 3.4°; p=0.0459) with a reciprocal, albeit non-significant, greater decrease in plantarflexion (6.8° versus 3.6°; p=0.1598).

Conclusion: Both TAL and GR significantly increased postoperative dorsiflexion; however, this was accompanied by a reciprocal significant loss in plantarflexion. GR resulted in double the improvement in dorsiflexion and loss in plantarflexion compared to TAL. The total arc of motion did not significantly change for the control, GR, or TAL cohorts. Patients should be counselled that their preoperative range of motion (ROM) will dictate their postoperative ROM, and that concomitant procedures performed to achieve an increase in dorsiflexion will do so at the expense of plantarflexion.

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Table 1. Outcomes of Achilles-Tendon Lengthening and Gastrocnemius Recession in Total Ankle Replacement.

| Preoperative Demographic and Clinical Data | Control | Gastrocnemius Recession | Tendo-Achilles lengthening | *P value |
|-------------------------------------------|---------|-------------------------|---------------------------|----------|
| Patients                                  | 75      | 40                      | 35                        |          |
| Sex, male                                 | 43 (57.3)| 23 (57.5)               | 26 (74.3)                 | 0.3160   |
| Age, y                                     | 62.0 (11.0; 59.5-64.5)| 64.6 (8.3; 61.9-67.3) | 65.9 (7.8; 63.2-68.6)     | **0.0442**|
| Follow-up, m                              | 36.3 (17.2; 32.3-40.3)| 34.5 (17.3; 29.0-40.0) | 29.6 (19.3; 23.0-36.3)     | 0.1618   |
| Body mass index, kg/m²                    | 29.8 (4.8; 28.6-30.9)| 31.2 (5.0; 29.6-32.8) | 30.7 (5.1; 29.0-32.5)      | 0.1335   |
| Tobacco use, former                       | 26 (34.7)| 12 (30.0)               | 10 (28.6)                 | 0.1446   |
| Type II diabetes mellitus                 | 8 (10.7)| 4 (2.8)                 | 6 (17.1)                  | 0.8033   |
| American Society of Anesthesiologists (ASA) Score ≥ 3 | 28 (37.3)| 23 (57.5)               | 18 (51.4)                 | 0.1978   |
| Implant                                   | 0.0550                                         |                          |          |
| Inbone                                    | 6 (8.0)| 2 (5.0)                 | 11 (31.4)                 |          |
| Infinity                                  | 11 (14.7)| 12 (30.0)               | 0                         |          |
| Salto Talaris                             | 21 (28.0)| 0                      | 1 (2.9)                   |          |
| STAR                                      | 2 (2.7)| 0                      | 8 (22.9)                  |          |
| Vantage                                   | 35 (46.7)| 26 (65.0)               | 15 (42.9)                 |          |

Range of Motion

|                | Preoperative | Postoperative | Differences |
|----------------|--------------|---------------|-------------|
|                | Dorsiflexion | Plantarflexion| Dorsiflexion| Plantarflexion |
|                | (°)          | (°)           | (°)         | (°)            |
|                | Change total arc of motion (°) | P value, intra-group difference, dorsiflexion | P value, intra-group difference, plantarflexion | P-value, inter-group difference, total arc of motion |
| Control        | 17.1 (7.0; 15.5-18.7) | 24.1 (9.1; 22.0-26.2) | 18.5 (6.1; 17.1-19.9) | 24.3 (9.0; 22.3-26.4) | +1.63 | 0.0857 | 0.7863 | 0.3913 |
| Gastrocnemius recession | 12.3 (7.7; 9.8-14.7) | 21.7 (9.2; 18.7-24.6) | 19.6 (5.4; 17.9-21.4) | 15.2 (8.4; 12.5-17.9) | +0.05 | <0.0001 | 0.0002 |          |
| Tendo-Achilles lengthening | 14.7 (5.9; 12.6-16.7) | 22.3 (7.1; 19.9-24.8) | 18.0 (6.4; 15.8-20.2) | 18.8 (6.9; 16.4-21.1) | -0.20 | **0.0053** | 0.0379 |          |

Values in No. (%) or mean (standard deviation; lower limit 95% CI- upper limit 95% CI).

* Difference between the control cohort (n=75) and any lengthening procedure (gastrocnemius recession and tendo-Achilles lengthening (n=75)
** Difference between GR or TAR compared to control
*** Difference between pre to postop

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