Comparison of Total Ankle Arthroplasty Outcomes between Patients Younger and Older than 55 years

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ABSTRACT

Objective: To compare the clinical and radiographic postoperative outcomes in two groups of patients: ≤55 and >55-year patients undergoing a third-generation total ankle arthroplasty (TAA). **Materials and Methods:** Two groups of patients were retrospectively studied: ≤55 (n=13) and >55-year patients (n=19) undergoing a third-generation TAA. Group ≤55 average age was 42.8 (SD, 6.4) and Group >55 average age was 65.7 (SD, 8.8). **Results:** The average follow-up was 36 months (IQR, 25-60). The main etiology was post-traumatic conditions in both groups. The mean score of the AOFAS scale one year after surgery was 76.69 (IQR, 58-89) in the group ≤55 and 85.22 (IQR, 67-100) in the group >55. There were no statistically significant differences between the two groups in the α, β, and γ angles measured on weight-bearing radiographs at 2-month and 2-year postoperative controls. **Conclusions:** Our study shows clinical and radiographic short-term outcomes in younger patients are similar to those in older patients. Longer-term follow-up is warranted to determine if the revision risk is greater in young patients, due to failures related to prosthesis wear.

Key words: Keywords: Ankle; arthroplasty; age; ankle arthritis.

Level of Evidence: III

Comparación de los resultados de la artroplastia total de tobillo en pacientes ≤55 y >55 años

RESUMEN

Objetivo: Comparar los resultados posoperatorios clínicos y radiográficos en dos grupos de pacientes: >55 años y ≤55 años, sometidos a una artroplastia total de tobillo de tercera generación. **Materiales y Métodos:** Se evaluó, en forma retrospectiva, a dos grupos de pacientes: ≤55 años (n = 13) y >55 años (n = 18), que fueron sometidos a una artroplastia total de tobillo de tercera generación. La edad promedio del grupo ≤55 años era 42.8 (DE 6.4) y la del grupo >55 años, 65.7 (DE 8.8). **Resultados:** El seguimiento promedio fue de 36 meses (RIC 25-60). La etiología era principalmente postraumática en ambos grupos. El puntaje promedio de la escala AOFAS al año de la cirugía fue 76,69 (RIC 58-89) en el grupo ≤55 años y 85,22 (RIC 67-100) en el grupo >55 años. No hubo diferencias estadísticamente significativas entre ambos grupos en los ángulos α, β y γ medidos en las radiografías con apoyo a los 2 meses y a los 2 años de la cirugía. **Conclusiones:** Nuestro estudio demostró que los resultados clínicos y radiográficos en pacientes más jóvenes serían comparables con los de pacientes más grandes en el seguimiento temprano. Se necesita un seguimiento a más largo plazo para determinar si el riesgo de revisión es más alto en los pacientes jóvenes, debido a la falla relacionada con el desgaste de la prótesis.

Palabras clave: Tobillo; artroplastia; edad; artrosis de tobillo.

Nivel de Evidencia: III

INTRODUCTION

The new implant designs have made TAA an increasingly utilized procedure over ankle fusion for the management of advanced articular degenerative changes, secondary to primary osteoarthritis, post-traumatic arthritis, and inflammatory arthritis.[1-3] In addition to eliminating pain, TAA allows for a mobile joint and less early wear of the

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adjacent joints. These promising results have led TAA to be seriously considered as one of the treatments of choice for end-stage ankle arthritis.

Ankle fusion is taken as the gold standard operative treatment for end-stage ankle arthritis. However, clinical studies have shown mid- and long-term problems associated with this procedure, mainly the evolution of degeneration of adjacent joint scores as well as the quality of life and satisfaction subscores due to ankle range of motion limitations. Primary ankle osteoarthritis is far less common than primary hip or knee arthritis. Post-traumatic arthritis is the most common presentation at the ankle, accounting for 65-80% of all end-stage osteoarthritis.[4,5] Patients are primarily aged 50-60 years, which involves higher functional demand and at least one previous ankle intervention.

Some studies suggest less favorable implant survivorship and functional outcomes in younger patients, with higher re-operation risk in patients ≤ 50 years and a higher risk of implant failure. There is a limited number of authors who have studied patients undergoing TAA in relation to their age.[6,7]

First-generation TAA designs produced unacceptable outcomes.[8,9] Current TAA designs produce favorable mid-term outcomes, they are less constrained designs that allow for axial rotations and require less bone resection.[10]

The Hintegra® design (Newdeal, Lyon, France) is an uncemented, nonconstrained prosthesis with a three-component system and a polyethylene mobile bearing. This mobile bearing allows for axial rotation, normal flexion-extension mobility, and provides inversion-eversion stability. Unlike other prosthetic designs, Hintegra®[11] does not use tibial intramedullary fixation, but an anatomically shaped flat tibial component that allows for wide contact with the resected tibial surface (Figure 1).[12,13]

We hypothesize that patients younger than 55 years have a clinical and radiological course of similar evolution to older patients.

The purpose of this study es to compare the clinical and radiological postoperative courses in 2 groups of patients: younger and older than 55 years.

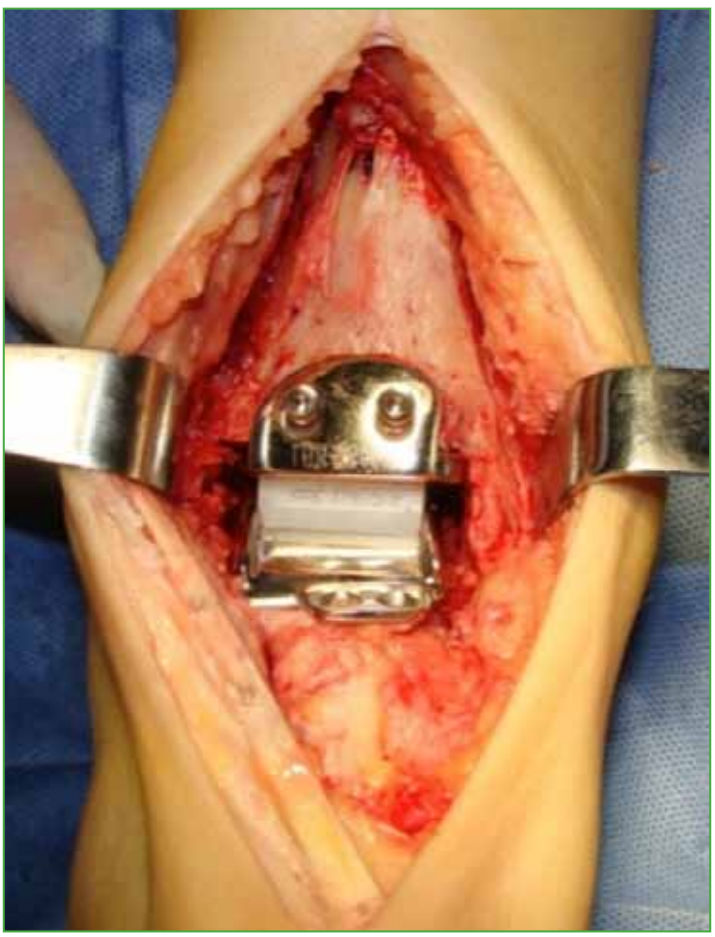

Figure 1. Prosthesis with definitive components.

MATERIALS AND METHODS

We conducted a retrospective analysis of patients undergoing TAA with an uncemented, nonconstrained prosthesis, Hintegra®. The number of operated patients who received a Hintegra® total ankle prosthesis between January 2007 and December 2014 was 35.

The inclusion criteria were: patients over 18 years of age, surgically treated with total ankle prosthesis, with a minimum of 2-year postoperative follow-up. The exclusion criteria were: incomplete electronic medical record, less than a 2-year postoperative follow-up. Four patients did not meet the inclusion criteria. The final study population comprised 31 treated patients (n=31 ankles) that were divided into 2 groups: ≤55-year (n=13) and >55-year (n=18) patients.

This study was approved by the Institutional Ethics Committee.

Surgical technique

Surgery requires hospitalization. Patient was placed in the supine position, and a pneumatic tourniquet is applied on the thigh. An anterior ankle approach is used, an incision is made between the anterior tibial tendon and the hallux extensor tendon. The joint capsule is exposed and then the joint is accessed.

First, osteophytes on the tibia and the talus are removed. Tibial and then talar bone cuts are carried out according to the cutting guide. The spacer that will allow for the necessary space for prosthetic components and a 5-mm bearing is then inserted. Control for: 1) an adequate amount of resected bone; 2) hindfoot-ankle alignment; 3) ankle stability.

In the case of ligament instability, the use of a larger bearing or the repair of the ligaments following component placement are both valid options.

Trial components are placed and alignment and position are checked with intraoperative fluoroscopy. The proper bearing size is decided. Final prosthesis components are inserted. A layered closure is carefully performed. A short plaster cast is applied.

During the first postoperative week, wound dressing changes are performed and a new cast is applied. Anteroposterior (AP) and lateral radiographs are taken. The patient wears the cast for 3 weeks. The plaster cast is then replaced by a plastic splint and patients begin weight bearing on the affected and active flexion-extension exercises of the ankle joint. At week 6, walking rehabilitation is instituted using sports shoes. Immobilization and weight-bearing periods may vary when the patient also undergoes additional procedures.

Outpatient controls are conducted at 1-, 2- and 3-month follow-ups and then at 6-, 9- and 12- month follow-ups, and from then on once a year.

Clinical evaluation

Clinical outcomes were evaluated using the American Orthopaedic Foot & Ankle Society (AOFAS) Ankle-Hindfoot Functional Scale,[14] which assesses pain, function, and alignment for a total of 100 points, during the preoperative period and at last postoperative follow-up.

We documented patient demographics, comorbidities, and preoperative diagnoses. The analysis took into account additional surgical procedures and intra- and post-operative complications.

Data collection was undertaken by 2 Foot and Ankle Specialization trainees, who were not involved in the preoperative decision making.

Radiographic evaluation

Radiographic evaluations included AP and lateral views taken before surgery and 2 months and 2 years after surgery.

Preoperative assessment included the lateral distal tibial angle and the anterior distal tibial angle, on the sagittal plane (Figures 2 and 3). The alpha, beta and gamma angles were measured postoperatively (Figures 4-6).

The AP view is used to established the alpha angle, defined as the angle between the anatomical axis of the tibia and the articular surface of the tibial component (positive values = valgus alignment; negative values = varus alignment [Value 0 = 90°, normal value of α]). On the lateral view, beta angle was determined by the tibial axis and the articular surface of the tibial component (normal value: 85°±2°). The gamma angle (normal value: 20°±2°) is used to study the position of the talar component, by using the line that goes through the anterior and the posterior edge of the talar component and the line that goes through the middle of the talar neck.

Statistical analysis

Study population was divided into 2 groups according to age: aged 55 or younger, and older than 55 years of age. If normally distributed, values for continuous variables with normal distribution are provided as mean and standard deviation. Otherwise, they are provided as median and interquartile range. Comparison analysis within groups at 2 months and 24 months after surgery was performed using the Student t test for dependent samples or the Wilcoxon

Figure 2. Lateral distal tibial angle.

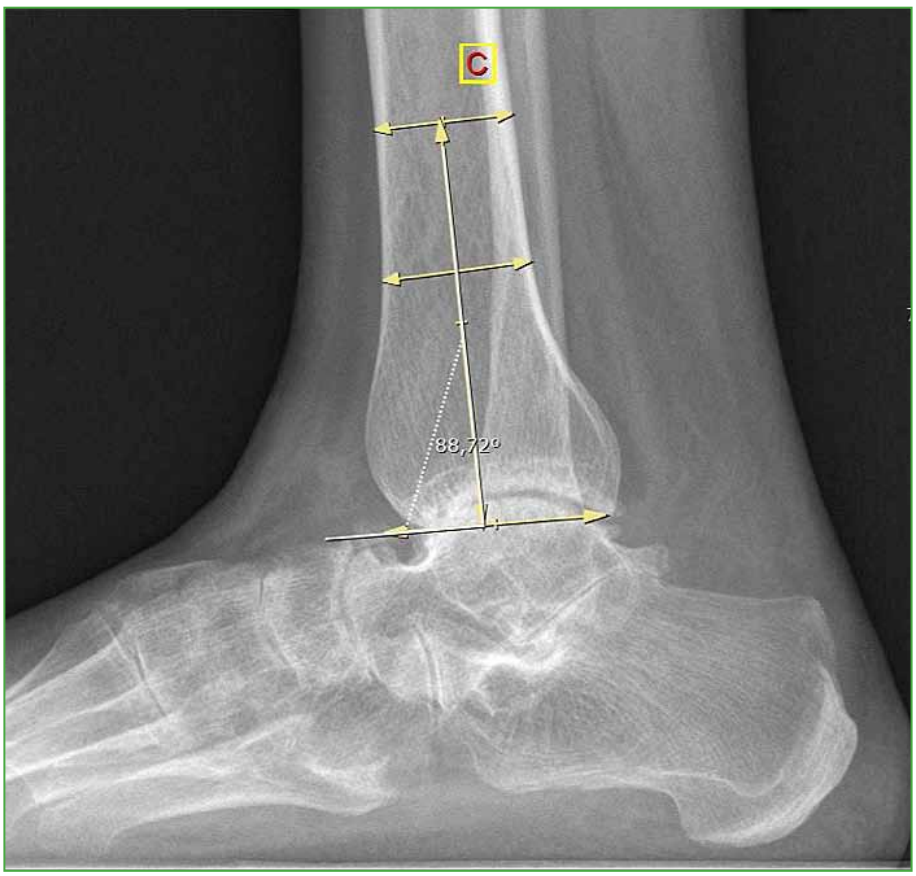

Figure 3. Anterior distal tibial angle.

test, as appropriate. Comparison analysis between groups was performed using the Student t test for independent samples or the Mann Whitney test, as appropriate.

Categorical variables are described as absolute and relative values. Categorical variables were analyzed using the Chi-square test or the Fisher's exact test, as suitable.

Values were considered to be statistically significant at $P < 0.05$. All statistical analyses were performed using SPSS statistics software version 22.0 (SPSS Inc, Chicago, IL).

RESULTS

The total number of operated patients who received a Hintegra® total ankle prosthesis between January 2007 and December 2014 was 35. Four patients were not considered as they did not meet the inclusion criteria. Study population was divided into 2 groups: ≤55-year (n=13) and >55-year (n=18) patients; 21 patients were females and 10 were males, with an average age of 56 years (SD, 13.8). Group ≤55 average age was 43 (SD, 6.4) and Group >55 average age was 65 (SD, 8.8). The average follow-up was 36 months.

Figure 4. Alpha angle.

Figure 5. Beta angle.

Figure 6. Gamma angle.

Preoperative diagnoses were post-traumatic arthritis (19 patients), primary osteoarthritis (5 patients), and inflammatory arthritis (7 patients). Patients aged 55 years or younger presented post-traumatic arthritis (9 cases) and no primary osteoarthritis. Patients aged over 55 presented post-traumatic arthritis (10 cases), inflammatory arthritis (3 cases), and primary osteoarthritis (5 cases) (Table 1).

Table 1. Demographics

Variables	Total (n = 31)	≤55 years (n = 13)	>55 years (n = 18)
Sex male, n (%)	21 (67.74)	9 (69.2)	12 (66.7)
Age, mean (SD), years	56.1 (13.8)	42.8 (6.4)	65.7 (8.8)
Right side affected, n (%)	15 (51.61)	7 (53.8)	8 (44.4)
Preoperative diagnosis, n (%)			
Post-traumatic osteoarthritis	19 (61.3)	9 (69.2)	10 (55.6)
Rheumatoid arthritis	7 (22.6)	4 (30.8)	3 (16.7)
Primary osteoarthritis	5 (16.1)	0 (0)	5 (27.8)
Follow-up, median (IQR), months	36 (25-60)	48 (31-69.5)	29.5 (25-43.5)

IQR: interquartile range; SD: standard deviation

Radiographic results

Both groups variables related to the alpha, beta and gamma angles were assessed on weight-bearing radiographs at 2-month and 2-year postoperative controls and yielded no statistically significant differences (Tables 2 and 3).

Table 2. Group results

Variable	Postoperative (2 months)	Follow-up period (24 months)	P*
Group ≤55 years			
Alpha coronal angle, tibia, median (IQR), degrees	91,2 (90.7-92.5)	90,6 (89,8-92,9)	0.65
Alpha sagittal angle, talus, median (IQR), degrees	18,8 (16,7-20,3)	17,3 (16,3-18,9)	0.17
Beta sagittal angle, tibia, mean (SD), degrees	80.6 (6.1)	82.8 (3.6)	0.19
Group >55 years			
Alpha coronal angle, tibia, median (IQR), degrees	91,0 (89-92,2)	90,1 (88.9-91.8)	0.86
Alpha sagittal angle, talus, median (IQR), degrees	19,7 (17.7-22.1)	18,7 (16-23.6)	0.33
Beta sagittal angle, tibia, mean (SD), degrees	85.9 (3.4)	85.8 (3.3)	0.73

*Student t test for matched pairs after assuming normal distribution. Otherwise, the Wilcoxon test was performed, with differences considered statistically significant at $P<0.05$.
IQR: interquartile range; SD: standard deviation

Table 3. Group comparison results

Variable	≤55 years	>55 years	P*
Alpha coronal angle, tibia, median (IQR), degrees	-0,9 (-2.1-2.11)	0,5 (-1.2-1)	0.65
Alpha sagittal angle, talus, median (IQR), degrees	-1,1 (-1.7-0.2)	-0,5 (-1.5-0.7)	0.49
Beta sagittal angle, tibia, median (IQR), degrees	0,5 (-1.4-3.6)	0,1 (-1.9-1.4)	0.2
AOFAS score, mean (SD)	45 (10.8)	52 (10.2)	0.08

*Student t test for independent samples after assuming normal distribution. Otherwise, the Mann-Whitney test was performed.
IQR: interquartile range; SD: standard deviation; AOFAS: American Orthopaedic Foot and Ankle Society.

Clinical outcomes

Preoperative AOFAS score for the entire study population was 32.58 (range, 12-41), for patients aged 55 years or younger was 31.69 (range, 12-38), and for patients over 55 was 33.22 (range, 20-41). The two-year follow-up AOFAS score for the entire study population was 81.65 (range, 58-100), for patients aged 55 years or younger was 76.69 (range, 58-89), and for patients over 55 was 85.22 (range, 67-100).

Preoperative and postoperative evaluation of AOFAS scores showed differences to be statistically significant (Table 4).

Table 4. Group comparison results

Variable	Before surgery	Follow-up period (24 months)	P*
Group ≤55 years			
AOFAS score, median (IQR)	33 (31.5-37)	79 (75-80)	0.001
Group >55 years			
AOFAS score, median (IQR)	33 (30-37)	82.5 (80-92.5)	<0.001

IQR: interquartile range; SD: standard deviation; AOFAS: American Orthopaedic Foot and Ankle Society.

Additional procedures and complications

Additional procedures were performed in 12 patients. Patients aged 55 years or younger required 3 subtalar arthrodeses and 1 triple arthrodesis, and patients over 55 required 6 subtalar arthrodeses, 2 calcaneal valgus osteotomies, 1 lateral ligament reconstruction, and 1 Achilles tendon lengthening. One patient underwent a tibial osteotomy that had been planned before the TAA.

The total number of intraoperative complications was 2: 1 in the group of patients of 55 years or younger (fibula fracture), and 1 in the group of patients over 55 (fibula fracture), both of which were resolved during the same surgical time.

There were 7 postoperative complications. The group of patients of 55 years or younger presented 6: 3 patients with heterotopic ossifications underwent re-operations; 1 bearing dislocation that required lateral ligament reconstruction and syndesmosis stabilization; 1 distal tibia fracture that caused tibial component malorientation and required internal fixation; and 1 infection that resulted in a tibio-talo-calcaneal fusion.

The group of patients over 55 years of age only presented 1 case of heterotopic ossification and 1 aseptic loosening (awaiting revision).

DISCUSSION

Ankle fusion remains the gold standard operative treatment for end-stage ankle arthritis, while TAA indication remains uncertain, especially among young active patients, although it is the treatment of choice for older patients with limited physical demands.[7] Previous published literature has suggested that both clinical outcomes and implant survivorship are inferior in younger patients. Therefore, TAA should not be considered for these patients, especially when they engage in impact sports or activities as it constitutes a risk for implant survivorship.[15,16]

This reasoning disagrees with studies on patients with hip or knee arthroplasties, which show improvements associated with pain, quality of life, and prosthetic revision to be similar in young and old patients. Hakon *et al*. studied 100 patients with a 15-year follow-up and concluded that ankle arthroplasty is a safe and reliable treatment both in young and older patients as their multivariate analysis for age, sex and diagnosis yielded no statistically significant indication of poor prognosis.[17] Tenembaum et al. not only studied the clinical outcomes in the two age groups (over the age of 70 and patients aged 50–60), but also studied their gait at 1-year follow-up, and concluded that both groups demonstrated equivalent improvements in clinical and gait outcomes.[18]

Most of our study patients underwent TAA due to arthritis secondary to trauma, which is consistent with other studies. The group of patients of 55 years or younger included no cases of primary osteoarthritis diagnosis. The group of patients over 55 years of age also had arthritis secondary to trauma as the leading diagnosis.

At 2 years after surgery, the average implant survivorship was 93%. Preoperative AOFAS scores were similar in both groups, and postoperative AOFAS scores showed a minor difference in the younger group, which was not statistically significant. This difference may be accounted by the functional limitations associated with the patients' "handling" of the prosthesis, which must be duly explained by the orthopedic surgeon. This situation may demonstrate the greater level of expectations held by younger patients in relation to the arthroplasty, which in turn may affect the functional evaluation during the postoperative period. This phenomenon has been demonstrated in patients undergoing hip and shoulder arthroplasties.[19,20]

With respect to the complications, a distinction should be made between 2 concepts: re-operation and revision. Re-operations are construed as all surgical procedures performed to prolong the implants useful life that do not require metal component replacement. Revisions are construed as implant removal and replacement or conversion to arthrodesis.[21,22]

The group of patients of 55 years or younger had 4 re-operations: 3 heterotopic ossifications and 1 case of ligament reconstruction that due to instability resulted in a bearing dislocation.[23,24] According to the consulted literature, heterotopic ossification has a prevalence of 25%, and is more common on the posterior aspect, which may result in altered functional parameter, especially regarding mobility. We believe that the higher rate of re-operations in younger patients may be accounted for a greater functional demand. With respect to conversions to arthrodesis, we had 1 case per group: 1 arthrodesis was performed in the group of patients of 55 years or younger, and 1 patient from the group of patients over 55 years has an indication for revision following an aseptic loosening.[25-27] In the group of patients over 55 years, we detected 2 cases of radiolucency and 1 with intraosseous cysts, which were less than 10mm in diameter and presented with no symptoms nor signs of prosthetic loosening.[28,29]

The limitations of our study include: its retrospective nature, a short follow-up period, a limited number of patients, not evaluating the range of motion. The strengths of our study include: all patients were operated on by the same surgical team using the same implant, the little specific literature available on comparing outcomes of TAA in different age groups.

CONCLUSIONS

Our study shows clinical and radiographic short-term outcomes in younger patients are similar to those in older patients.

Revision procedures were similar in both groups. The number of re-operations in our study was higher in the group of patients 55 years or younger. Re-operations were performed to prolong the implant useful life; therefore, we advise to warn patients of its possible need and purpose.

Conflict of interests: Authors claim they do not have any conflict of interest.

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