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Original Article

Comparison of pre-and postoperative clinical-functional results of total ankle arthroplasty for arthrosis treatment

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Abstract

Objective: Compare the pre-and postoperative clinical-functional results of total ankle arthroplasty (TAA) to treat ankle arthrosis applying the American Orthopaedic Foot and Ankle Society (AOFAS) score, the Foot and Ankle Outcome Score (FAOS), the Quality of Life Questionnaire (SF-36), and the Visual Analog Scale of Pain (VAS).

Methods: A retrospective clinical study was conducted, including 15 patients who were submitted to TAA to treat ankle arthrosis.

Results: The t-student test was used to compare the AOFAS score and the FAOS between the pre-and postoperative periods. The results showed a significant increase; the AOFAS increased from 25.8 to 79.8, and the FAOS increased from 7.2 to 69.8. When correlating the VAS and the FAOS, it was noted that the higher the FAOS in the postoperative, the lower the VAS and vice versa. When performing the positive correlation between the SF-36 (mental health) and the FAOS (quality of life), it was observed that the higher the SF-36 score, the higher the FAOS score.

Conclusion: Total ankle arthroplasty is a safe option with better results regarding limb functionality for patients in advanced stages of ankle arthrosis, improving the quality of life of these patients.

Level of Evidence IV; Therapeutic Studies; Case Series.

Keywords: Arthroplasty, replacement, ankle; Osteoarthritis; Ankle.

Introduction

The development of this study was due to the difficulty in solving the complaints of patients with ankle osteoarthritis, which is frequent for foot and ankle surgeons[1-8].

It is known that 1% of the general population develops ankle osteoarthritis due to traumatic or metabolic causes. Osteoarthritis presents with pain, dysfunction, and progressive worsening of gait, and the most common causes are post-traumatic and primary osteoarthritis[1-4, 9,10].

Additionally, in cases of advanced osteoarthritis in patients without angular changes at the ankle level, surgical options involve choices that preserve or not joint movement. Arthrodesis and ankle prosthesis are viable alternatives. Although the initial outcomes of first-generation arthroplasties were not as satisfactory, when compared to the good results obtained with arthrodesis associated with the low cost of the procedure, this is the intervention chosen to treat most cases conducted by foot and ankle surgeons[11-14].

Arthroplasty in large joints is a well-established procedure, prompting a search for total ankle arthroplasty (TTA) improvement.

Evidence shows that TAA preserves joint mobility, improves limb function, reduces pain, and presents high rates of satisfaction among patients. However, the revision rates involving TAA are significantly higher than those observed in arthrodesis; therefore, the procedure of choice remains arthrodesis[5-8]. In selected patients, however, TAA is an excellent alternative for osteoarthritis.

Study performed at the Pontifícia Universidade Católica de Campinas, Departamento de Ortopedia e Traumatologia, Campinas, SP, Brazil.

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Thus, considering the challenge of selecting the appropriate technique to treat patients with osteoarthritis and the advent of less invasive surgical materials and instruments for the ankle joint, arthroplasty has been increasingly integrated into treatment planning[15-18].

This study, therefore, aims to evaluate the functional outcome of patients submitted to TAA. The objective is to contribute to the growing utilization of this surgical alternative in treating osteoarthritis and to provide valuable insights into this procedure for foot and ankle surgeons. In addition, the aim of the study is to compare the pre-and postoperative clinical-functional results of total ankle arthroplasty (TAA) to treat ankle arthrosis applying the American Orthopaedic Foot and Ankle Society (AOFAS) score, the Foot and Ankle Outcome Score (FAOS. The Quality of Life Questionnaire (SF-36) and the Visual Analog Scale of Pain (VAS) were also used to investigate whether there was an improvement in quality of life in the first three postoperative months.

Methods

This study was approved by the Institutional Review Board under the number CAAE 45265021.0.0000.5374. All patients included in the study signed an informed consent form.

Fifteen patients with a mean age of 55.7 years were included, varying between 37 and 72 years old. The selection process was conducted in a private hospital from December 2018 to January 2023. All included patients were arthrosis grade 4 according to the Takakura classification (obliteration of the joint space with complete bone contact), without previous hindfoot and midfoot deformities, with good bone alignment, without indication of osteotomies corrections or intraoperative talonavicular or calcaneocuboid arthrodesis, evaluated with anteroposterior (AP) and profile ankle radiographs with weight-bearing and Saltzman incidence, with a mean preoperative range of motion of 25º plantar flexion and 5º dorsiflexion.

Patients were submitted to TAA to treat ankle arthrosis in a private hospital. Considering that TAA is typically performed exclusively at specialized foot and ankle surgery centers and entails high expenses due to the materials utilized and the technical complexities it presents, the pool of patients eligible for this treatment remains limited.

There was no follow-up loss during the study.

Inclusion criteria

Patients of both sexes diagnosed with ankle osteoarthritis Takakura grade 4, confirmed on AP and profile ankle radiographs with weight-bearing and Saltzman incidence, associated with clinical symptoms such as pain in the ankle region, joint stiffness, and functional ankle limitation.

Exclusion criteria

Patients who did not agree to participate in the study and/or had avascular necrosis of the talus, acute or chronic tibiotarsal joint infection, paralysis, and severe misalignment of the tibia and talus or neurological changes.

Surgical procedure

All patients that met the inclusion criteria were submitted to the laboratory tests. The ankle radiographs for surgical planning with the implant templates followed the standardization: AP and profile ankle radiographs with weight-bearing and Saltzman incidence.

In the initial analysis for indication of arthroplasty, patients were clinically evaluated according to a thorough physical examination in which skin changes, axis deviations of the lower limbs, and the range of motion were observed.

The technique used in TAA was the anterior access route of the ankle in dorsal decubitus, with exsanguination and tourniquet application to the limb. An anterior incision was made in the ankle joint, allowing for identification of the neurovascular bundle situated between the extensor hallucis longus and tibialis anterior tendons.

The talar and tibial components were chosen, according to pre-surgical planning, to restore ankle biomechanics. A STRYKER® INFINITY® total ankle primary prosthesis was used, with a metal vs polyethylene tribological pair (Figures 1 and 2).

It is important to note that there were no complications during surgery.

All patients were submitted to antithrombotic prophylaxis with rivaroxaban 10 mg once daily for 28 days, associated with antibiotic prophylaxis with cephalexin 500 mg every six hours for seven days. The patients wore orthopedic boots until the wound healed, a mean of 14 to 21 days, remaining with no weight-bearing during this period and undergoing motor physiotherapy since the immediate postoperative period. They were reassessed weekly during the first month, in the third and sixth postoperative months, and one year after surgery.

Clinical-functional evaluation

After the inclusion process, a preoperative clinical-functional evaluation of the ankle was performed at the foot and ankle orthopedics and traumatology outpatient clinic. The evaluation lasted approximately 40 minutes and consisted of preoperative consultation and AOFAS and FAOS application. In the third postoperative month, the SF-36 and VAS were applied to evaluate whether there was pain and quality of life improvement. Patients returned to the hospital in the sixth postoperative month for a new postoperative consultation and AOFAS and FAOS reapplication.

All pre-and postoperative analyses were included in the patient's medical records and are part of the institution's foot and ankle service routine.

Considering that the AOFAS authors did not correlate numerical values to the categories excellent, good, regular, and very bad, a generic quality of life questionnaire (SF-36) with categorization evaluated separately, whose final sum

Figure 1. Preoperative radiograph of the right ankle (A-C), image of the surgical access (D), cutting guide fluoroscopy (E), image after surgical cut (F).

Figure 2. Anteroposterior and profile postoperative radiographs.

ranged from 0 to 100 points (0 = worst and 100 = best)[2,10,19] was used to avoid confusion in the evaluation of the results[2]. Through studies of the scales and after translation and validation of the AOFAS score, it was considered valid and reproducible to evaluate the patients participating in this study regarding clinical-functional aspects[2,20]. Although some authors question the AOFAS score due to its subjectivity and the probability that the interpretation of the results and the perception of the patient's improvement can sometimes vary greatly between physicians and researchers, it remains the consensus research instrument among a wide range of health professionals, used to measure the results about ankle and foot pathologies[21, 22].

The FAOS score is a questionnaire developed to evaluate patient's perceptions regarding ankle and foot pathologies. It comprises five domains: pain, other symptoms, daily living activity, sports and recreation, and quality of life regarding the ankle and foot. The default options are data, and each question is scored from 0 to 4; a population with no changes is calculated for each subscale (100 indicates no symptoms, and 0 indicates extreme symptoms)[2,19,23].

Results

Fifteen patients diagnosed with ankle arthrosis and submitted to TAA were evaluated in our study.

Only one of the patients presented surgical wound dehiscence and, after cleaning and resuture, evolved positively without other complications at one-year postoperative follow-up. There was no need to remove the implant from any patient.

Four questionnaires were used; two were performed in the third postoperative month (VAS, SF-36), and the others were conducted in the pre-and postoperative (AOFAS, FAOS), all to evaluate general quality of life and measure the functionality of the patient's limbs.

Variability is measured by the standard deviation (SD). The closer (or higher) this value is to the mean, the greater the variability. The coefficient of variation (CV) is a statistic that assesses how much the variability represents the mean. Ideally, this index should be as low as possible (< 50%). The confidence interval (CI), sometimes added to and/or subtracted from the mean, shows the mean variation according to a statistical probability.

The mean AOFAS and FAOS showed a statistically significant improvement. In AOFAS, the mean improved from 25.8 to 79.8 (p-value < 0.001), and in FAOS, from 7.2 to 69.8 (p-value < 0.001) (Figure 3). The comparison of AOFAS and FAOS scores in the pre-and postoperative is also shown in Table 1. When the VAS and SF-36 were correlated in the third postoperative month, it was noted that the VAS score was 1.27 and the SF-36 (emotional aspect) 69.8, demonstrating good results shortly after the TAA (Figure 4).

In our study, a descriptive analysis was also performed for age, factors evaluated in the third postoperative month (VAS and SF-36), and Delta (difference in postoperative AOFAS and FAOS scores in relation to preoperative AOFAS and FAOS) both absolutely and relatively (Table 2).

It was evidenced that many factors have low variability due to the CV being less than 50%, demonstrating that the data are heterogeneous. The mean age was 55.7 ± 6.2 years, ranging from 49.5 to 61.9 years, with 95% statistical confidence. The mean AOFAS Delta was 54.0 ± 5.6 (increased by 54.0 points).

When exploring the data using Pearson's correlation to evaluate the degree of correlation between age, VAS, and SF-36 with the AOFAS and FAOS scores, it was noted that when the correlation is positive, it means that as one variable increases its value, the other correlated to it, also increases proportionally. However, if the correlation is negative, the variables are inversely proportional; as one grows, the other decreases, or vice versa.

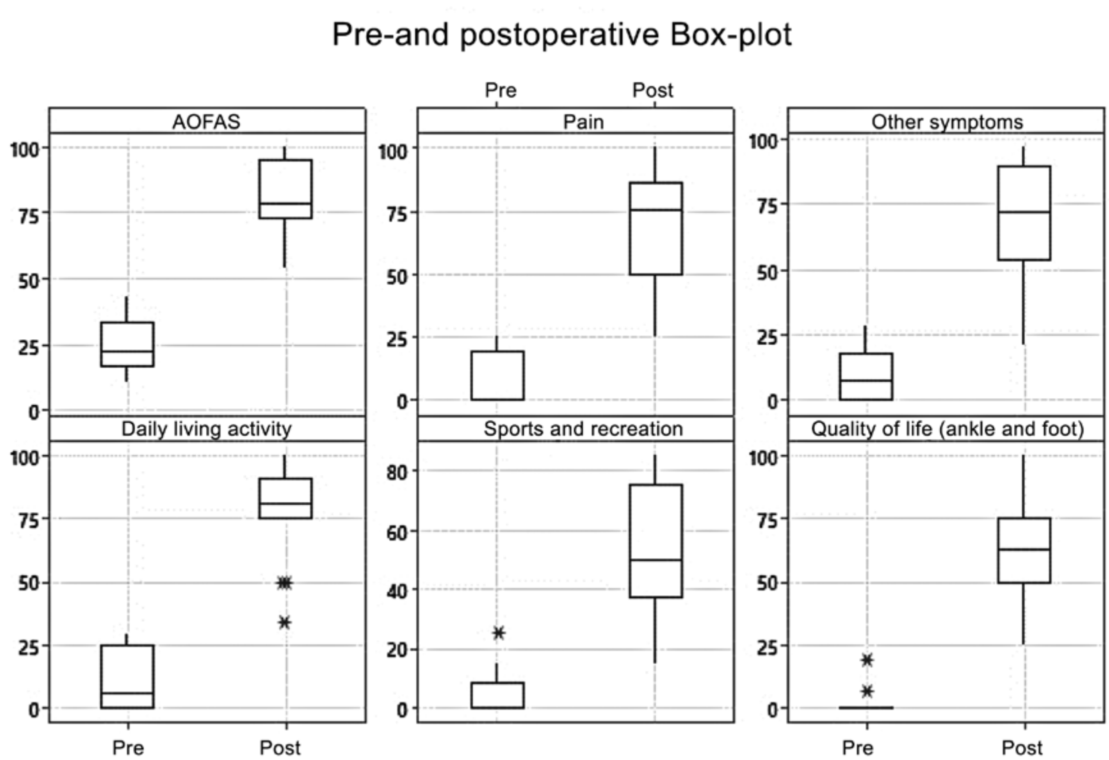

Figure 3. AOFAS scale.

Table 1. Comparison of AOFAS and FAOS

Variables		Mean	Median	SD	CV	Min	Max	n	CI	p-value
AOFAS	Pre	25.8	22	10.5	41%	11	43	15	5.3	< 0.001
	Post	79.8	78	13.2	17%	54	100	15	6.7	
Pain	Pre	7.2	0	10.3	143%	0	25	15	5.2	< 0.001
	Post	69.8	75	21.9	31%	25	100	15	11.1	
Other symptoms	Pre	9.5	7.1	10.7	112%	0	28.6	15	5.4	< 0.001
	Post	68.1	71.4	20.8	30%	21.4	96.4	15	10.5	
Daily living activity	Pre	11.6	5.9	12.3	107%	0	29.4	15	6.2	< 0.001
	Post	77.5	80.9	19.1	25%	33.8	100	15	9.7	
Sports and recreation	Pre	4.6	0	8.1	177%	0	25	12	4.6	< 0.001
	Post	53.8	50	22.2	41%	15	85	12	12.5	
Quality of life (ankle and foot)	Pre	1.7	0	5	300%	0	18.8	15	2.5	< 0.001
	Post	62.9	62.5	22.1	35%	25	100	15	11.2	

AOFAS: American Orthopaedic Foot and Ankle Society; SD: Standard deviation; CV: Coefficient of variation; CI: Confidence interval.

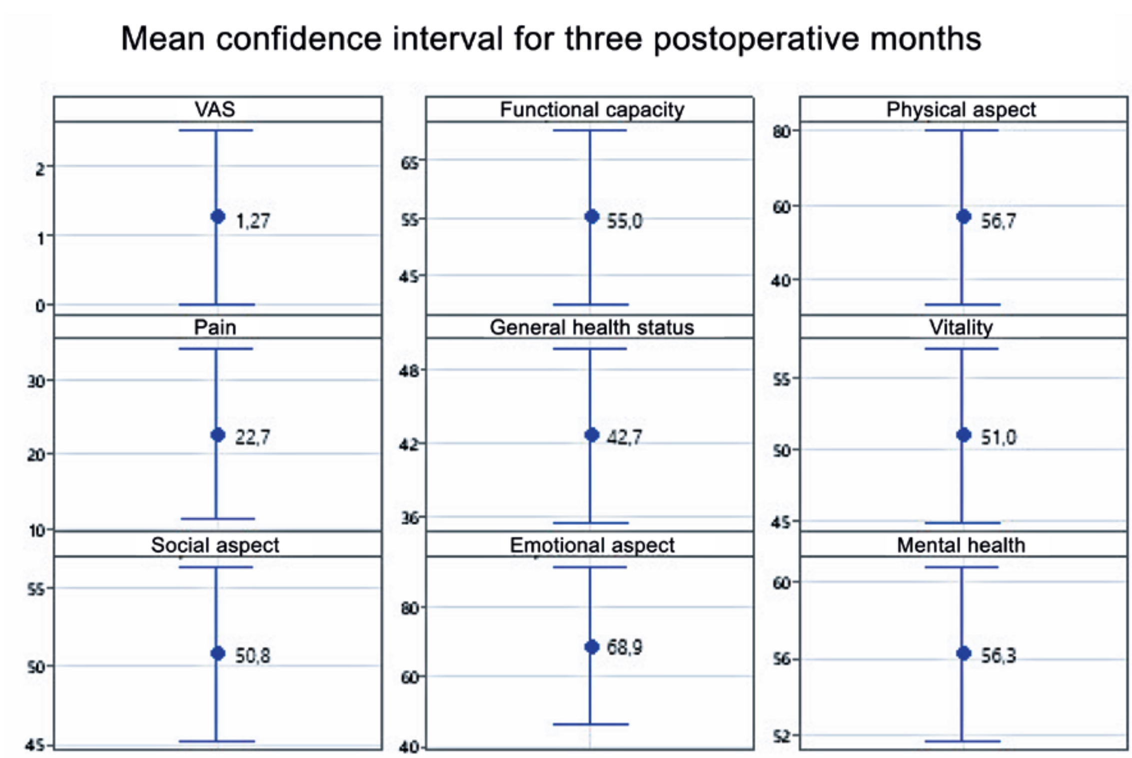

Figure 4. AOFAS comparison in the three postoperative months.

It was concluded that there are some statistically significant correlations, such as between VAS and FAOS (sports) in the postoperative with r = -0.761 (p-value = 0.004). Because the value is negative, the higher the FAOS (sports) score in the postoperative, the lower the VAS and vice versa. It can be classified as a strong correlation.

Similarly, when performing the positive correlation between the SF-36 (mental health) and the FAOS (quality of life) in the postoperative with r = 0.641 (p-value = 0.010), it is clear that the higher the SF-36 (mental health) score, the higher the FAOS (quality of life) score and vice versa (Table 3).

Table 2. Descriptive data for age, AOFAS/FAOS Delta, and three postoperative months

Variables		Mean	Median	SD	CV	Min	Max	n	CI
Age		55.7	55	12.2	22%	37	72	15	6.2
Delta	AOFAS	54	54	11.1	20%	32	76	15	5.6
	Pain	62.6	72.2	18.1	29%	25	86.1	15	9.2
	Other symptoms	58.6	53.6	19.9	34%	21.4	89.3	15	10.1
	Daily living activity	65.9	66.2	17.6	27%	33.8	94.1	15	8.9
	Sports and recreation	49.2	50	26.5	54%	0	85	12	15
	Quality of life (ankle and foot)	61.3	62.5	21.2	35%	25	100	15	10.7
Three postoperative months	VAS	1.27	0	2.25	178%	0	6	15	1.14
	Functional capacity	55	55	27.3	50%	0	95	15	13.8
	Physical aspect	56.7	75	41.7	74%	0	100	15	21.1
	Pain	22.7	20	20.5	91%	0	60	15	10.4
	General health status	42.7	45	12.7	30%	10	60	15	6.4
	Vitality	51	50	10.9	21%	20	70	15	5.5
	Social aspect	50.8	50	10	20%	37.5	75	15	5.1
	Emotional aspect	68.9	100	40.8	59%	0	100	15	20.6
	Mental health	56.3	60	8.1	14%	44	68	15	4.1

AOFAS: American Orthopaedic Foot and Ankle Society; SD: Standard deviation; CV: Coefficient of variation; CI: Confidence interval; VAS: Visual Analog Scale of Pain.

Table 3. Correlation of age, VAS, and SF-36 with AOFAS and FAOS

Variables			Age	VAS	Functional capacity	Physical aspect	Pain	General health status	Vitality	Social aspect	Emotional aspect	Mental health
AOFAS	Pre	r	0.002	-0.178	0.122	0.166	-0.149	0.194	0.039	-0.261	0.256	0.437
		p-value	0.995	0.525	0.666	0.555	0.596	0.488	0.89	0.347	0.357	0.103
	Post	r	-0.151	-0.419	0.283	0.204	0.142	0.065	-0.262	-0.134	0.072	0.156
		p-value	0.59	0.12	0.307	0.466	0.613	0.817	0.345	0.633	0.8	0.578
FAOS Pre	Pain	r	0.252	-0.063	0.299	0.491	-0.584	-0.621	-0.078	-0.255	0.289	0.423
		p-value	0.364	0.823	0.279	0.063	0.022	0.014	0.783	0.359	0.296	0.116
	Other symptoms	r	0.283	0.131	0.179	0.305	-0.555	-0.465	-0.077	-0.14	0.163	0.525
		p-value	0.307	0.642	0.523	0.268	0.032	0.081	0.786	0.62	0.562	0.045
	Daily living activity	r	0.377	0.036	0.477	0.156	-0.5	-0.326	0.06	0.257	0.071	0.47
		p-value	0.166	0.898	0.072	0.579	0.058	0.235	0.831	0.354	0.803	0.077
	Sports and recreation	r	0.295	0.667	-0.15	-0.165	0.1	-0.066	0.071	-0.357	-0.194	-0.046
		p-value	0.286	0.007	0.595	0.556	0.723	0.816	0.803	0.192	0.489	0.87
	Quality of life (ankle and foot)	r	0.113	0.514	0.115	0.318	-0.352	-0.111	0.049	-0.142	0.2	0.121
		p-value	0.689	0.05	0.684	0.248	0.199	0.695	0.862	0.614	0.475	0.667
FAOS Post	Pain	r	0.129	-0.578	0.433	0.464	-0.365	-0.168	-0.114	-0.126	0.318	0.656
		p-value	0.648	0.024	0.107	0.081	0.182	0.548	0.686	0.654	0.249	0.008
	Other symptoms	r	-0.096	-0.471	0.162	0.256	-0.133	0.187	-0.029	-0.016	0.2	0.451
		p-value	0.735	0.076	0.564	0.357	0.636	0.505	0.917	0.954	0.474	0.092
	Daily living activity	r	-0.017	-0.553	0.541	0.334	-0.194	-0.02	0.071	0.098	0.132	0.502
		p-value	0.951	0.033	0.037	0.224	0.488	0.943	0.803	0.727	0.64	0.057
	Sports and recreation	r	-0.309	-0.761	0.5	0.395	0.063	0.129	-0.108	0.405	0.176	0.366
		p-value	0.329	0.004	0.098	0.204	0.845	0.688	0.738	0.191	0.584	0.242
	Quality of life (ankle and foot)	r	-0.067	-0.469	0.307	0.433	-0.387	-0.363	-0.345	-0.078	0.164	0.641
		p-value	0.811	0.078	0.266	0.107	0.154	0.183	0.208	0.783	0.559	0.01

AOFAS: American Orthopaedic Foot and Ankle Society; FAOS: Foot and Ankle Outcome Score; VAS: Visual Analog Scale of Pain.

Discussion

Total ankle arthroplasty has been increasingly used to treat osteoarthritis due to lower failure rates and better results. However, the literature on this procedure remains heterogeneous, with great variability in the outcomes notification[24].

Fourth-generation arthroplasties, such as those performed by the foot and ankle group at the Pontifícia Universidade Católica-Campinas, São Paulo, Brazil, are characterized by the low profile and easy intraoperative radiographic control, allowing the surgery to proceed with precision and be reproducible among surgeons[15-16].

The abovementioned characteristics were decisive in defining the type of prosthesis used in this study. Although this model has been used internationally since 2013, the foot and ankle group at the Pontifícia Universidade Católica-Campinas pioneered its use in Brazil. The main reasons for choosing this model were the clinical and radiological results demonstrated in international studies, which led patients in many other countries to opt for arthroplasty to treat ankle arthrosis[17].

The complication rates and revisions in ankle prostheses were high, and with the development of implants with fixation in the tibia and talus through pegs, there was a decrease in the shear effect and consequent components loosening[16]. Studies have shown a revision rate of 3% to 10%, associated with loosening components and infections[18,25,26].

In some studies, the scores that evaluated the patient's ankle function recovery and quality of life confirm a statistically significant improvement, as demonstrated in our study through AOFAS analysis[18,25-27].

Shih et al.[24], in their meta-analysis, demonstrated an improvement in the AOFAS score in the group where the ankle prosthesis was implanted. Rushing et al.[18], in turn, evaluated 55 ankles in a 43-month follow-up period, with a prosthesis-survival rate of 97% and a revision rate of 1.8%, more detailed results when compared to the abovementioned study. A larger sample allows for a more complete analysis; however, it does not invalidate the findings of this study. Saito et al.[16] reported a revision surgery rate of 4.7% at a 25-month follow-up with a sample of 64 patients, similar to the rates observed for other implants.

Meanwhile, the United Kingdom National Joint Registry noted that only 1% of cases required revision of the INFINITY® prosthesis at a 14-month follow-up[9,16-18,25,26]. In Latin America, a 2020 study by Nery et al.[21] reported successful results in 26 patients submitted to arthroplasty using INFINITY® prosthesis, with a 100% survival rate in the first year of follow-up similar to the result found in our study. However, our study evaluated a smaller sample with a similar follow-up time.

Prostheses with fluoroscopic navigation increase the accuracy of postoperative results regarding implant alignment. In 2018, King et al.[15] found a 1.5° deviation from the 90° alignment to the anatomical tibia axis in a cohort of 20 patients with a 24-month follow-up. This deviation allows a homogeneous distribution of body weight-bearing, contributing to the preservation of the positioning of the tibial and talar components of the prosthesis. Similarly, Saito et al.[16] reported improvement in tibiotalar coronal alignment using a fluoroscopically navigated prosthesis, as shown by the prosthesis maintenance. These results are consistent with those observed in this evaluation.

TAA Indications

Total ankle arthroplasty is indicated to treat degenerative joint disease of the tibiotalar joint caused by trauma, osteoarthritis, and rheumatoid arthritis[28].

Saltzman et al., in their study, reported the main causes of ankle arthritis in order of frequency: post-traumatic (63.9%), primary osteoarthritis (27.4%), rheumatoid arthritis (5.0%), and all others (3.7%). Among the participants included in their study, 4.4% were smokers, and 9.0% had diabetes[29].

Contraindications of TAA

Contraindications related to TAA include patients with osteoporosis, smokers, diabetes mellitus, immunosuppressed, suffering from neurological disease, vascular disease, age over 50 years, severe misalignment, instability, and avascular necrosis of the talus[29]. The absolute contraindications refer to patients with active infection, Charcot's neuroarthropathy, and peripheral vascular disease[29].

TAA durability

The implant's durability is closely related to the degree of arthrosis of the patient, the type of implant, the surgical technique, and the surgeon's experience.

There is evidence in the literature that patients with moderate alterations are better candidates for TAA concerning implant durability when compared to patients with severe alterations. As for the type of implant used, the superiority of second-and third-generation and fixed-bearing implants has been noted, with a 95.6% survival rate over mobile bearing (89.4%)[30]. Regarding the patient's age, it was observed that survival was higher in older people who underwent the revisions more frequently [30].

Similarly, Brunner et al.[31] contributed data from 10 and 15 years of follow-up demonstrating an alarming drop in survival, of 53.2% and 32.2%, respectively. This suggests that survival projections do not follow a constant failure rate, as stated by Zaidi et al.[32]. Instead, survival slows down faster over time.

Mann et al.[33], in their 2011 study, reported a mean survival of mobile implants of 9.1 years, with a durability of 90% after ten years.

TAA revision

Byron et al. reported some complications and were classified as technical error (28.15%), joint sinking (16.89%), implant failure (13.28%), aseptic loosening (6.3%), intraoperative fracture (5.67%), wound problems (4.3%), deep infection (1%) and postoperative fracture (0.0001%)[30,34].

The most frequent complication described by Lawton et al.[35] in one of their studies was aseptic loosening, with an adjusted rate of 5.8%, followed by wound (5.4%) and fracture (4.9%). The adjusted reoperation rate without revision was also higher for arthrodesis (12.9% vs 9.5%).

Wood et al.[36] documented a 12% revision rate for a cohort of 200 ankles submitted to TAA with a mean follow-up of 7.3 years. Most patients required revision for aseptic loosening (7%).

Advantage arthrodesis vs total ankle arthroplasty

Lawton et al.[35] reviewed the complications of third-generation TAA implants and reported that the most common complications were aseptic loosening (5.8%), wound complications (5.4%), fracture (4.9%), and deep infection (0.9%).

The most common complications for arthrodesis were wound complications (9.8%), non-union (7.9%), infection (3.6%), and fracture (0.8%)[36].

Studies have shown a compensatory increase in hindfoot and midfoot movement after ankle arthrodesis, which can generate overload and accelerate joint degeneration. Sealey et al. suggest that ankle arthrodesis may accelerate the progression of hindfoot osteoarthritis and midfoot degeneration[37].

In their comparative study between TAA and ankle arthrodesis, Lawton et al.[35] demonstrated that the overall rate of postoperative arthrodesis complications (26.9%) was higher than TAA (19.7%)[36]. Among them are wound healing (9.8%), pseudoarthrosis (7.9%), and deep infection (3.6%)[36].

Quality of life (function) after TAA

Although, unlike arthrodesis, TAA is a complex procedure that requires expertise from the foot and ankle surgeon, it preserves ankle function and avoids overload on adjacent joints, which can lead to arthritic changes requiring future arthrodesis[36].

With the maintenance of ankle function, the patient will have a more harmonious gait, with less energy expenditure and maintaining its parameters (speed, length, cadence, and time)[36].

Limitations

Our study has some limitations, such as the small sample size, the one-year follow-up, and the study design not being a comparative or prospective study. This is mainly due to the adoption of a prosthesis that is still unused in the country. Its first implantation in Brazilian territory was reported only in 2019, with access still restricted to Brazilian hospital services and limited indications due to the high cost.

Conclusion

Total ankle arthroplasty is a good option for patients in advanced stages of ankle arthrosis, offering a significant improvement in their quality of life, mainly enhancing pain relief and limb functionality.

Therefore, whenever possible, it is necessary to consider total ankle arthroplasty as a safe option that guarantees better limb functionality.

Authors' contributions: Each author contributed individually and significantly to the development of this article: JAO * (https://orcid.org/0000-0001-9393-2170) Conceived and planned the activity that led to the study, wrote the article, participated in the review process; RGH*(https://orcid.org/0000-0003-3951-8408) Data collection, bibliographic review; MSPC *(https://orcid.org/0000-0002-0758-2547) Formatting of the article, bibliographic review; HDB *(https://orcid.org/0000-0002-1901-3309) Interpreted the results of the study, participated in the review process; AMAP *(https://orcid.org/0009-0003-9972-1245) CDCCF * (https://orcid.org/0000-0003-3522-1076) LGZ *(https://orcid.org/0009-0001-5620-0920) Performed the surgeries; data collection, statistical analysis. All authors read and approved the final manuscript. *ORCID (Open Researcher and Contributor ID) iD.

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