Clinical outcomes of surgical treatment for end-stage ankle osteoarthritis in patients aged over 75 years: a multicenter, retrospective study

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Abstract

Background

The purpose of this study was to clarify the clinical outcomes of surgical treatment for end-stage ankle osteoarthritis in patients aged ≥ 75 years and compare the outcomes with those of patients aged < 75 years.

Methods

A total of 148 patients, including 65 post-total ankle arthroplasty and 83 post-ankle arthrodesis patients, were surveyed retrospectively. Clinical outcomes were assessed using the Japanese Society for Surgery of the Foot hindfoot scale and the self-administered foot evaluation questionnaire preoperatively and at the last follow-up. Patient characteristics, including age, sex, body mass index, radiographic severity, and follow-up period, were also assessed. Patients were divided into the older age group (≥ 75 years) and the younger age group (< 75 years). Improvements in outcomes were then compared between the age groups using univariate analysis and analysis of covariance adjusted for patient characteristics. Post-total ankle arthroplasty and post-ankle arthrodesis were analyzed separately.

Results

All clinical outcome scores improved postoperatively in the older age group for both post-total ankle arthroplasty and post-ankle arthrodesis. For example, scores for pain and pain-related subscale of the self-administered foot evaluation questionnaire improved by 37 points ($p < 0.001$) for post-total ankle arthroplasty patients and by 35 points for post-ankle arthrodesis ($p < 0.001$). Furthermore, multivariate analysis showed that the improvements observed in all scores were not different between the older and younger age groups for both post-total ankle arthroplasty and post-ankle arthrodesis patients, except for the Self-Administered Foot Evaluation Questionnaire physical functioning subscale score for post-ankle arthrodesis patients.

Conclusions

Clinical outcomes improved significantly in post-total ankle arthroplasty and post-ankle arthrodesis patients aged ≥ 75 years. Moreover, the improvements were similar to those in patients aged < 75 years. Therefore, surgical treatment of end-stage ankle osteoarthritis can be a viable treatment option, even in elderly patients.

Background

End-stage ankle osteoarthritis (OA) is a disabling condition in which quality of life impairment is as severe as that associated with hip OA (1). Although the risk of developing ankle OA is lower than that of developing OA in the hip and knee joints, the number of patients with ankle OA has recently been expected to increase (2). Generally, surgical treatment for end-stage OA includes either total ankle arthroplasty (TAA) or ankle arthrodesis (AA) (3). Both techniques have advantages and disadvantages, and both have reported satisfactory clinical outcomes (3). Over the past decade, the performance of both surgical procedures has been increasing worldwide, even in Japan (4, 5).

Life expectancy has increased worldwide. The world population is aging rapidly, especially in Japan, with an average life expectancy of >80 years in 2019 (6). The number of surgical treatments for degenerative joint disease in elderly patients has also been increasing accordingly; therefore, it is not uncommon for patients in their 70s and 80s to undergo joint arthroplasty (7). However, there is little data on whether the clinical outcomes after TAA and AA in elderly patients are comparable to those in younger patients. Elderly patients may have coexisting medical conditions and reduced physical functioning, making it difficult to achieve sufficient functional recovery after surgery. Several studies have compared the clinical outcomes of TAA between older and younger age groups (8–13). However, these studies divided the patients using the 50-60 age group threshold to highlight outcomes in younger patients rather than older patients. Few studies have reported the outcomes of older patients in their 70s and 80s (14, 15). Regarding AA, patients undergoing the procedure are generally young, and only a few studies have assessed the clinical outcomes of AA in elderly patients (16, 17). The data on the outcomes of TAA and AA would provide important information on clinical decision-making for our aging population.

Therefore, the purpose of this study was to clarify the clinical outcomes of surgical treatment for ankle OA in elderly patients and compare the results with those of younger patients.

Methods

Study design

This multicenter, retrospective study was approved by the Ethics Committee of St. Luke's International Hospital (17-R164) and the participating hospitals and was conducted following the Declaration of Helsinki. Since this was a retrospective study, each hospital provided opt-out consent with no written consent. Patients were screened using data extracted from the electronic medical records of eight hospitals. Patients who underwent TAA or AA for end-stage ankle OA between January 2015 and July 2019 were included in the study. The exclusion criteria were as follows: 1) diagnoses other than OA (e.g., rheumatoid arthritis and neuropathic arthritis); 2) revision surgery; 3) talocalcaneal joint arthrodesis; 4) history of TAA or AA on the contralateral side, and 5) <1-year follow-up. Overall, 169 ankles of 169 patients met the inclusion criteria. Among these patients, three had rheumatoid arthritis, five underwent revision surgery, one had talocalcaneal joint arthrodesis, and one had a history of TAA or AA. Furthermore, 11 patients were lost to follow-up, including one patient who died. Therefore, the data of the remaining 148 patients, including 65 and 83 patients who underwent TAA and AA, respectively, were analyzed.

Patient background

Data on patient background, including age, sex, body mass index (BMI), and follow-up period, were recorded. Patients were classified into those aged ≥ 75 years or < 75 years. We used a threshold of 75 years according to the definition set for determining older senior citizens by the Ministry of Health, Labor and Welfare of Japan (18). Radiographic severity was assessed using the Tanaka-Takakura classification (19) on preoperative weight-bearing anteroposterior radiographs of the ankle. We divided the patients into those with stage 3b or less (joint space obliteration extended to the roof of the talar dome) and those with stage 4 (obliteration of the whole joint space) as the staging might affect the clinical outcomes (20).

Surgery

The types of surgery were classified as TAA or AA. Due to the retrospective nature of this study, the operative indications and the selection of surgical procedures were based on the patients' and surgeons' shared decisions. In general, TAA was performed in older, less obese, and sedentary patients. In addition, patients with moderate deformities tended to undergo TAA. In contrast, AA was performed in younger, obese, and physically active patients and those with severe deformities. Furthermore, the type of implant (TNK Ankle, Kyocera, Kyoto, Japan; Fine Ankle, Teijin Nakashima Medical, Okayama, Japan) was recorded for TAA patients. The surgical approach (arthroscopic or open) was recorded for patients with AA.

Clinical outcomes

The clinical outcomes were evaluated using the Japanese Society for Surgery of the Foot (JSSF) hindfoot scale and the Self-Administered Foot Evaluation Questionnaire (SAFE-Q) (21, 22). The JSSF hindfoot scale is a validated objective evaluation with a 40-point subscale for pain, a 45-point subscale for function, and a 15-point subscale for alignment; higher scores indicate better clinical outcomes (22). The SAFE-Q is a validated questionnaire consisting of 34 questions on foot and ankle symptoms ([21]). It has five subscale scores: pain and pain-related, physical functioning and daily living, social functioning, shoe-related, and general health and well-being—possible scores for each subscale range from 0 to 100, with higher scores indicating better clinical outcomes. We assessed the outcomes preoperatively and at the last follow-up, and the recorded improvement in scores was used for statistical analysis. Furthermore, we recorded the occurrence of revision surgery during the follow-up period. The major intraoperative complications investigated were fractures, and technical errors (iatrogenic complications). The postoperative complications included deep infection, peroneal tendon dislocation, and revision surgery.

Statistical analysis

Patients who underwent TAA and AA were analyzed separately because the indications for these surgical procedures were different, as discussed earlier. Patient characteristics were compared between patients aged ≥ 75 years and those aged < 75 years using Student's t-tests and Chi-square tests, as appropriate. The pre- and postoperative JSSF hindfoot scale scores and SAFE-Q subscale scores were compared

using paired t-tests. To compare the clinical outcomes between the older and younger age groups, the recorded improvements in the JSSF and SAFE-Q subscale scores were also compared between the age groups using Student's t-tests. Complications were compared using Fisher's exact test. Furthermore, an analysis of covariance was performed to determine the independent association between age group and clinical outcomes. The clinical outcome was entered as the objective variable, and the age group was entered as the explanatory variable, adjusting for sex, BMI, radiographic stage, and follow-up period. The statistical significance value was set at $p < 0.05$.

Results

Total ankle arthroplasty

In total, 65 patients, including 36 patients aged ≥ 75 years and 29 patients aged < 75 years, were analyzed (Table 1). Among these patients, 47 (65%) were women, and only two (3%) were obese ($\text{BMI} \geq 30 \text{ kg/m}^2$). The mean age of the older age group was 78 years. Except for the age, there were no significant differences in patient backgrounds between the older and younger age groups (Table 1). In the older age group, the JSSF hindfoot scale score improved from 53 points preoperatively to 90 points at the last follow-up ($p < 0.001$, Table 2). Similarly, all SAFE-Q subscale scores improved significantly, with the improvement in scores ranging from 30 to 37 points ($p < 0.001$ for all subscales, Table 2). There were no significant differences in the improvement of any of the outcomes between the older and younger age groups in the univariate analysis (Table 4). Furthermore, in the analysis of covariance adjusted for patient background, patient age was not associated with either of the clinical outcomes (Table 4). Four patients (11%) had major intraoperative complications in the older group, including four fractures. Two patients (6%) had major intraoperative complications in the younger group, including two fractures. During the follow-up period, four patients (11%) had major complications in the older group, including one deep infection that required debridement surgery, one peroneal tendon dislocation, and two revision surgeries to 1 aseptic loosening and one infection. Three patients (10%) had major complications in the younger group, including one removal of impinging osseous overgrowth and two revision surgeries due to aseptic loosening. There was no significant difference in the occurrence of intra- and postoperative complications between the groups ($p = 0.57$).

Table 1
Patient characteristics.

	Total ankle arthroplasty			Ankle arthrodesis		
	< 75 (n = 29)	≥ 75 (n = 36)	p	< 75 (n = 61)	≥ 75 (n = 22)	p
Age (years)*	70 ± 4	78 ± 3	<0.001	64 ± 9	79 ± 3	<0.001
Sex (women / men)	20 / 9	27 / 9	0.61	31 / 30	15 / 7	0.21
Body mass index (kg/m ²)*	23 ± 3	24 ± 3	0.18	25 ± 4	25 ± 3	0.71
Follow-up (months)*	26 ± 18	25 ± 15	0.82	18 ± 9	20 ± 9	0.23
Radiographic stage (≤3b / 4) **	17 / 12	21 / 15	0.79	22 / 39	10 / 12	0.31
Type of surgery (TNK Ankle / Fine Ankle) (Open / arthroscopic)	26 / 3	34 / 2	0.66	5 / 56	1 / 21	0.96
Values show the number of patients unless indicated otherwise. *Mean ± standard deviation. **Tanaka-Takakura classification.						

Table 2

Pre- and postoperative clinical outcomes after total ankle arthroplasty depending on patient's age.

	< 75 (n = 29)			≥ 75 (n = 36)		
	Pre	Post	p	Pre	Post	p
JSSF scale	53 ± 11	85 ± 14	<0.001	53 ± 12	90 ± 12	<0.001
SAFE-Q						
Pain and pain-related	46 ± 17	68 ± 24	<0.001	40 ± 20	77 ± 19	<0.001
Physical functioning	46 ± 18	68 ± 26	<0.001	38 ± 23	68 ± 17	<0.001
Social functioning	43 ± 25	70 ± 27	<0.001	34 ± 32	69 ± 29	<0.001
Shoe-related	58 ± 26	71 ± 31	0.04	45 ± 29	78 ± 19	<0.001
General health	48 ± 24	72 ± 28	<0.001	36 ± 27	75 ± 25	<0.001
Values are presented as mean ± standard deviation.						
JSSF, Japanese Society for Surgery of the Foot; SAFE-Q, self-administered foot evaluation questionnaire.						

Ankle arthrodesis

Overall, 83 patients, including 22 patients aged ≥ 75 years and 61 patients aged < 75 years, were analyzed (Table 1). The proportion of women was 55% (n=46), and the mean BMI was 25 kg/m², with five (6%) patients recorded as obese. The mean age was 79 years in the older age group and 15 years in the younger group. In the older age group, the JSSF hindfoot scale and all SAFE-Q subscale scores improved postoperatively (Table 3). More specifically, the SAFE-Q scores improved by 20-35 points ($p < 0.001$ for all subscales, Table 3). Similarly to the TAA patients, there were no significant differences in improving all clinical outcomes between the older and younger age groups after univariate analysis (Table 3). In the analysis of covariance adjusted for the patient background, patient age was not associated with any of the clinical outcomes except for the SAFE-Q physical functioning subscale score ($p=0.04$, Table 4). The recorded improvements in the physical functioning scores were 20 and 29 points in the older and younger age groups, respectively. In the older group, no patients had major intraoperative complications. Two patients (6%) had major intraoperative complications in the younger group, including iatrogenic complications (endosseous drill breakage). During the follow-up period, one (4%) patient in the older age group had major complications, including revision surgery due to nonunion. Also, three (5%) patients in the younger age group had major complications, including revision surgery due to nonunion, overgrowth, and two revision surgeries due to aseptic loosening. There was no significant difference in the occurrence of intra- and postoperative complications between the groups ($p = 0.62$).

Table 3
Pre- and postoperative clinical outcomes after ankle arthrodesis depending on patient's age.

	< 75 (n = 61)			≥ 75 (n = 22)		
	Pre	Post	p	Pre	Post	p
JSSF scale	53 ± 16	89 ± 10	<0.001	53 ± 15	85 ± 8	<0.001
SAFE-Q						
Pain and pain-related	43 ± 17	82 ± 22	<0.001	45 ± 18	80 ± 15	<0.001
Physical functioning	47 ± 20	76 ± 22	<0.001	43 ± 27	63 ± 22	<0.001
Social functioning	40 ± 28	81 ± 27	<0.001	36 ± 27	69 ± 33	<0.001
Shoe-related	48 ± 27	77 ± 24	<0.001	47 ± 25	74 ± 26	<0.001
General health	40 ± 26	79 ± 27	<0.001	37 ± 26	67 ± 32	<0.001
Values are presented as mean ± standard deviation.						
JSSF, Japanese Society for Surgery of the Foot; SAFE-Q, self-administered foot evaluation questionnaire.						

Table 4 Comparison of clinical outcomes between patients aged <75 years and those aged ≥ 75 years.

	Total ankle arthroplasty				Ankle arthrodesis			
	< 75 (n = 29)	≥ 75 (n = 36)	p*	p**	< 75 (n = 61)	≥ 75 (n = 22)	p*	p**
JSSF scale	36 ± 17	37 ± 15	0.14	0.13	35 ± 17	32 ± 17	0.35	0.38
SAFE-Q								
Pain and pain-related	33 ± 19	37 ± 26	0.12	0.12	39 ± 26	34 ± 20	0.69	0.84
Physical functioning	26 ± 24	30 ± 25	0.79	0.80	29 ± 24	20 ± 23	0.02	0.04
Social functioning	28 ± 40	33 ± 41	0.90	0.94	40 ± 31	33 ± 31	0.09	0.12
Shoe-related	23 ± 33	31 ± 30	0.12	0.13	30 ± 29	26 ± 23	0.62	0.70
General health	31 ± 30	37 ± 30	0.56	0.63	39 ± 30	30 ± 32	0.08	0.11

Values represent the mean ± standard deviation of the improvement in the score. *Student t-test.

**Analysis of covariance adjusted for patient characteristics. JSSF, Japanese Society for Surgery of the Foot; SAFE-Q, self-administered foot evaluation questionnaire.

Discussion

This study showed that surgical treatment for end-stage ankle OA resulted in satisfactory clinical outcomes in patients aged ≥ 75 years; improvements in scores were observed in patients undergoing both TAA and AA. Furthermore, the improvements were comparable to those observed in patients aged < 75 years. Thus, the results of our study suggest that surgical treatment of end-stage ankle OA can be a viable treatment option, even in elderly patients.

We showed that the JSSF hindfoot scale score and all SAFE-Q subscale scores improved significantly for TAA patients in the older age group with a mean age of 78 years. Specifically, the improvement in the SAFE-Q subscale scores ranged from 13 to 38 points. Non-surgical treatment is the first-line treatment for ankle OA; however, insufficient data support its efficacy (23). Moreover, elderly patients, such as those aged > 75 years, tend to undergo non-surgical management because of their limited physical functioning and concern for postoperative complications (7). The minimal clinically important differences in the SAFE-Q scores for TAA patients were not determined. However, the recorded improvements in the scores found in this study were comparable to those of previous reports (24–26) and were clinically significant.

This study showed that the recorded improvements in the outcomes of the older age group were comparable to those of the younger age group for TAA patients. Our results were in line with those of Tenenbaum et al. (14) in which patients aged > 70 years and those aged 50–60 years demonstrated equivalent improvement in the American Orthopedic Foot and Ankle Society (AOFAS) ankle/hindfoot scale and visual analog scale (VAS) pain scores. Demetracopoulos et al. (15) also found that most of the clinical outcomes in patients aged > 70 years were comparable to those aged ≤ 70 years, although the AOFAS function and SF-36 vitality subscale scores were lower in older patients than in younger patients. Other studies used a younger cut-off age of 50–65 years (8–13) and reported no difference in clinical outcomes depending on age. Thus, the results of our study suggest that TAA could be a treatment of choice even in patients aged ≥ 75 years. Furthermore, there was no difference in intraoperative and postoperative complications between the groups, which was a concern for the elderly.

Similar to TAA, all clinical outcomes improved postoperatively in AA patients in the older age group, with a mean age of 79 years. Only a few studies have reported postoperative results for AA in geriatric patients (16, 17). Strasser et al. (17) found that the postoperative foot and ankle ability measurement scores were 82 points in 22 patients with a mean age of 75 years. However, the authors (17) did not obtain the preoperative scores. Additionally, Yang et al. (16) assessed 41 patients (mean age, 71 years) who had arthroscopic AA and observed significant improvement in the AOFAS ankle/hindfoot scale and VAS pain scores. Although direct comparison would be difficult because of the different evaluation measures used, our results were consistent with those of previous studies (16, 17).

Post-AA, improvements in clinical scores were comparable between patients aged < 75 years and those aged ≥ 75 years. Previous studies have shown that age at surgery was not associated with clinical outcomes (27–29). However, the patients in these studies were relatively young, with a mean age of 57–63 years. Therefore, the results of our study suggest that even older patients can expect a similar level of

clinical improvement after undergoing AA. In contrast, Berlet et al. (30) reported that patients aged ≥ 60 years had a higher risk of nonunion after foot and ankle arthrodesis. However, we could not determine the effect of age on bone union because of the small study population. Furthermore, there was no difference in intraoperative and postoperative complications between the groups or within the TAA group.

This study has several limitations. First, the older age group may have consisted of selected patients with good health status; therefore, surgeons would have logically expected good postoperative outcomes. This limitation could be biased toward better results in the older age group. Second, several covariates that may affect the clinical outcomes, including comorbidities, mental status, and physical activity level, were not included in the multivariate analysis because of the retrospective nature of this study. Although our study can provide clinically meaningful information to patients and surgeons, further prospective studies are necessary to draw definitive conclusions on the association between age and clinical outcomes. Third, the follow-up period was relatively short, with a mean period of 18-26 months. However, considering both short-term results and long-term outcomes is important for elderly patients who may have a shorter life expectancy than younger patients. Fourth, despite collecting patient data from eight hospitals, the study population was relatively small, especially for comparing the incidence of revision surgery between the age groups.

Conclusions

The JSSF scale and all SAFE-Q subscale scores improved postoperatively in patients with end-stage ankle OA aged ≥ 75 years. Furthermore, the recorded improvements in the scores were comparable to those in patients aged < 75 years. Therefore, surgical treatment of end-stage ankle OA, using either TAA or AA, can be a viable treatment option, even in elderly patients. Elderly patients should not be excluded from surgical management because of their age.

List Of Abbreviations

OA, osteoarthritis

TAA, total ankle arthroplasty

AA, ankle arthrodesis

BMI, body mass index

JSSF, Japanese Society for Surgery of the Foot

SAFE-Q, Self-Administered Foot Evaluation Questionnaire

AOFAS, American Orthopedic Foot and Ankle Society

VAS, visual analog scale

Declarations

Ethics approval and consent to participate

This multicenter, retrospective study was approved by the Ethics Committee of St. Luke's International Hospital (17-R164) and the participating hospitals and was conducted following the Declaration of Helsinki. Since this was a retrospective study, each hospital provided opt-out consent with no written consent.

Consent for publication

Availability of data and materials

Competing interests

The authors declare that they have no competing interests.

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Authors' contributions

KA participated in the conception and design of the study, acquisition of data, analysis, and interpretation of the data, drafting the article, and critical revision of the article for important intellectual content. SY participated in the conception and design of the study, acquisition of data, analysis, and interpretation of the data. AT participated in the acquisition of data. TK participated in the acquisition of data. HS participated in the acquisition of data. YK participated in the analysis and interpretation of the data. YS participated in the analysis and interpretation of the data. TY participated in the acquisition of data. NK participated in the acquisition of data. KN participated in the acquisition of data. NK participated in the conception and design of the study, acquisition of data. All authors read and approved the final manuscript

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