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Outcomes of Salvage Arthrodesis and Arthroplasty for Failed Osteochondral Allograft Transplantation of the Ankle

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Abstract

Background: Osteochondral allograft (OCA) transplantation is a useful treatment for posttraumatic ankle arthritis in young patients, but failure rates are high and reoperations are not uncommon. The aim of this study was to evaluate the outcomes of failed ankle OCA transplantation converted to ankle arthrodesis (AA) or total ankle arthroplasty (TAA).

Methods: We evaluated 24 patients who underwent salvage procedures (13 AA and 11 TAA) after primary failed ankle OCA transplantation. Reoperations were assessed. Failure of the salvage procedure was defined as an additional surgery that required a revision AA/TAA or amputation. Evaluation among nonfailing ankles included the American Academy of Orthopaedic Surgeons Foot and Ankle Module (AAOS-FAM), pain, and satisfaction.

Results: In the salvage AA cohort, 3 patients were classified as failures (2 revision AA and 1 amputation). The 10 nonfailing patients had a mean follow-up of 7.4 years. Eighty-eight percent were satisfied with the procedure, but 63% reported continued problems with their ankle (eg, pain, swelling, stiffness). Mean pain level was 1.9 and AAOS-FAM core score was 83±13. In the salvage TAA cohort, 2 patients were classified as failures (both revision TAA). The 9 nonfailing patients had a mean follow-up of 3.8 years. Fifty percent were satisfied with the procedure, but 40% reported continued problems with their ankle. The mean pain level was 1.3, and the median AAOS-FAM core score was 82±26.

Conclusion: Revision and reoperation rates for salvage procedures following failed OCA transplantation of the ankle are higher compared to published data for primary AA and TAA procedures. However, we believe OCA transplantation can serve as an interim procedure for younger patients with advanced ankle joint disease who may not be ideal candidates for primary AA or TAA at the time of initial presentation.

Level of Evidence: Level IV, case series.

Keywords: ankle, cartilage repair, failed osteochondral allograft transplantation, salvage procedures, arthrodesis, arthroplasty

Introduction

Osteochondral allograft (OCA) transplantation of the ankle is a biological joint restoration technique performed for chondral or osteochondral defects as well as for advanced osteoarthritis (OA). Recent literature shows that clinical outcomes are favorable but failure rates are high and reoperations are not uncommon.[1,2,6,13,16,18,27,33] When a primary ankle allograft fails, a salvage operation must be performed that may be challenging in the setting of the prior allograft surgery. In these cases, salvage procedures are limited to revision OCA, arthrodesis, or arthroplasty. Revision OCA of the ankle appears to have similar clinical outcomes as primary OCA transplantations, with high failure rates (~30%) and promising survivorship of 65% at 10 years.[10] No clinical outcome data is available for ankle arthrodesis (AA) or total ankle arthroplasty (TAA) as a salvage procedure after primary failed ankle OCA. Performed as primary procedures, these

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operations have lower failure and revision rates in comparison to OCA transplantations.[20,22] With clearly reduced postoperative function, progression of arthritic changes in the remaining foot joint after arthrodesis, and increased rates of aseptic implant loosening after arthroplasty in patients who engage in sports, young and active patients often refuse these procedures.[4,5,8,15,25,28,30,32]

Although the majority of the literature regarding revision ankle procedures focuses on salvage arthrodesis after primary failed ankle arthroplasty, the aim of this study was to evaluate the outcomes of salvage procedures after failed ankle OCA transplantation which were converted to AA and TAA.

Methods

Our institutional review board–approved database was used to identify 148 patients undergoing primary OCA transplantation of the ankle between 2001 and 2013. All patients gave informed consent to participate in the OCA database. Indications for the OCA transplantation included traumatic arthritis, avascular necrosis, and osteochondral lesion of the talus (OLT), among others. Of the 148 ankles, 30 (20.3%) experienced a failure of the OCA and were converted to a salvage procedure, including 17 AA (11.5%) and 13 TAA (8.8%). Decision to pursue AA or TAA was left up to the operative surgeon and patient. Twenty-four patients who had a minimum follow-up of 1 year following the salvage procedure were included, resulting in a final study population of 13 AA and 11 TAA.

In the AA cohort, the mean age at the time of the salvage procedure was 51±12 (range, 34-69) years, the mean body mass index (BMI) was 27.4 (range, 19.2-35.8), 10 of the 13 patients were female, and the mean time from primary OCA transplantation to arthrodesis was 3.4±1.9 (range, 0.9-6.7) years. At the time of the primary OCA transplantation, 11 patients received a bipolar allograft and 2 patients received a partial talus allograft that comprised 40% and 65% of their talar domes, respectively (Figure 1). Of the 13 patients, the majority (10) had their salvage procedure at outside institutions. For the 3 patients who were operated at our hospital, a combination of cannulated screws and bone graft was used for the ankle fusion.

In the TAA cohort, the mean age was 57±7 (range, 43-66) years, the mean BMI was 26 (range, 24-31), 6 of the 11 patients were female, and the mean time from primary OCA transplantation to arthroplasty was 6.1±3.5 (range, 1.4-13.2) years. All patients received a bipolar allograft at the time of the primary OCA transplantation (Figure 2). All but 1 patient had their salvage TAA at an outside institution. The patient that was operated at our hospital received a third-generation ankle replacement system (Salto-Talaris, Integra, Plainsboro, NJ). All TAAs were performed using the technique that was recommended by the manufacturer.

Figure 1. Radiographs of a 69-year-old man who underwent salvage ankle arthrodesis after failed bipolar osteochondral allograft transplantation for traumatic arthritis. (A) Preoperative anteroposterior and (B) lateral radiographs showing failure of the osteochondral allograft. (C) Postoperative (5 years) anteroposterior and (D) lateral radiographs of same ankle.

For follow-up evaluation, all patients were contacted via mail and/or telephone to inquire about their satisfaction, function, level of pain using the numeric rating scale (NRS), and need for further surgeries. Failure of the salvage AA/TAA procedure was defined as an additional surgery that required a revision AA/TAA or an amputation. We included the Foot and Ankle module (AAOS-FAM) outcome score developed by the American Academy of Orthopaedic Surgeons (AAOS)[17] into our follow-up questionnaire. The AAOS-FAM patient reported assessment outcome tool consisted of 5 subscales: pain (9 questions), function (6 questions), stiffness and swelling (2 questions), giving way (3 questions), and shoe comfort (5 questions). In our study, we only used the Core Scale, which excluded the shoe comfort scale. The final standardized score ranged from 0 to 100 points, with the lower the score, the greater the disability. Based on a general reference population of the United

Figure 2. Radiographs of a 62-year-old man who underwent salvage ankle arthroplasty after failed bipolar osteochondral allograft transplantation for traumatic arthritis. (A) Preoperative anteroposterior and (B) lateral radiographs showing failure of the osteochondral allograft. (C) Postoperative (1 year) anteroposterior and (D) lateral radiographs of same ankle.

States, the AAOS normative scores were calculated from the standardized values using the online-available worksheet provided by the AAOS (www.aaos.org/research/outcomes/Foot_AnkleScoring.xls). If a patient scored above 50 points, he or she was above the general, healthy population's average score (and vice versa).

Statistical Analysis

All descriptive analyses were performed using SPSS version 13.0 (SPSS Inc, Chicago, IL). Means and frequencies were calculated to summarize patient characteristics (age, sex, and BMI), operative details (time from primary OCA to salvage procedures, type of primary allograft), and data regarding number and type of further surgeries following the salvage AA/TAA. Survivorship of the salvage AA/TAA was calculated using the Kaplan-Meier method. Among the nonfailed patients whose AA or TAA remained in situ at the latest follow-up, means, medians, and frequencies were used to summarize follow-up data (NRS for pain, satisfaction, and AAOS-FAM core and normative scores).

Results

Salvage Ankle Arthrodesis Cohort

In the salvage AA cohort, 5 of the 13 patients required further surgery, including 3 patients who were classified as failures (Table 1 and 2). Failure of the AA was defined as an additional surgery that required a revision AA (2 patients) or an amputation (1 patient). The mean time to failure was 2.3 (range, 0.5-5.2) years. Survivorship of the AA was 84.6% at 5 years (Figure 3). Because the majority of patients were operated on at outside institutions, we were not able to assess the reason for failure. Of the 3 patients who had the salvage AA at our institution, none had failed at the latest follow-up. The mean follow-up of the 10 nonfailed AA cases was 7.4 (range, 4.1-13.2) years. Of the 7 patients who answered the question regarding their level of pain (on the NRS) at latest follow-up, 4 patients reported no pain (NRS 0), 1 patient reported mild pain (NRS 1), 1 patient reported moderate pain (NRS 5), and 1 patient reported severe pain (NRS 7). The mean level of pain was 1.9 on the NRS. Of the 8 patients who answered the questions regarding their satisfaction and ongoing ankle problems, 7 patients were satisfied with the procedure (responding satisfied or extremely satisfied) and 5 still had problems with their ankle (ie, pain and/or swelling). Of the 7 patients who answered the question, all would undergo the salvage AA again. Among the 8 patients who completed the AAOS-FAM questionnaire at latest follow-up, the mean standardized Core Score was 83 ± 13 (range, 64-100) and the mean normative score was 42 ± 11 (range, 27-56).

Salvage Total Ankle Arthroplasty Cohort

Among the 11 patients who received a salvage TAA after primary failed OCA transplantation, further surgery was required in 3 cases. Failure of the TAA was defined as an additional surgery that required a revision TAA, which occurred in 2 cases (Tables 3 and 4). The mean time to failure was 5 (range, 3.9-6.0) years. Survivorship of the salvage TAA was 83.3% at 5 years (Figure 3). Because all but 1 patient was operated on at outside institutions, we were not able to assess the reason for failure. The patient who had the salvage TAA at our institution had not failed at latest follow-up. The mean follow-up of the 9 nonfailed TAA patients was 3.8 (range, 1.2-6.8) years. Of the 3 patients who answered the question regarding their level of pain (on the NRS) at the time of the latest follow-up, 2 patients reported

Table 1. Demographic, Operative, and Outcome Data of the Salvage AA Cohort.[a]

Patient	Sex	Age	Side	Primary OCA Graft	Time From Primary OCA to AA, y	Latest Follow-up, y	Salvage AA Failure Type	Standardized AAOS-FAM Core Score	NRS Pain	Problems With Ankle	Satisfaction	Further Surgeries (No.)
1	Female	35.7	Right	Partial talus	6.7	4.4	–	70.2	N/A	No	Somewhat dissatisfied	No
2	Female	43.5	Right	Bipolar	3.7	9.8	–	72.6	0	Yes (swelling)	Satisfied	No
3	Female	61.6	Right	Bipolar	5.9	**5.2**[b]	Revision AA	–	–	–	–	Yes (4)
4	Female	69.1	Left	Bipolar	2.2	**0.5**[b]	Revision AA	–	–	–	–	Yes (1)
5	Female	49.7	Right	Bipolar	4.7	4.1	–	N/A	N/A	N/A	N/A	No
6	Male	39.4	Left	Bipolar	1.9	5.3	–	89.8	1	Yes (swelling)	Extremely satisfied	No
7	Female	66.6	Right	Bipolar	6.4	5.2	–	85.9	0	Yes (not specified)	Satisfied	Yes (1)
8	Male	69.3	Right	Bipolar	1.9	8.5	–	100.0	0	No	Extremely satisfied	No
9	Female	54.3	Left	Bipolar	4.7	9.0	–	98.4	0	No	Extremely satisfied	No
10	Female	42.7	Right	Partial talus	0.9	9.8	–	64.1	5	Yes (pain, swelling)	Extremely satisfied	Yes (1)
11	Female	44.0	Left	Bipolar	2.1	5.1	–	81.4	N/A	N/A	N/A	No
12	Male	33.9	Left	Bipolar	1.9	**1.1**[b]	BKA	–	–	–	–	Yes (1)
13	Female	54.6	Left	Bipolar	1.7	13.2	–	N/A	7	Yes (pain)	Satisfied	No

Abbreviations: AA, ankle arthrodesis; AAOS-FAM, American Academy of Orthopaedic Surgeons-Foot and Ankle Module; BKA, below-knee amputation; N/A, not available; NRS, numeric rating scale; OCA, osteochondral allograft.

[a]Failed ankle arthrodesis cases are highlighted in gray.

[b]Time to failure.

Table 2. Reoperations Following Salvage Ankle Arthrodesis.

Procedure[a]	No.
Hardware removal	2
Diagnostic scope	1
Bone graft	1
Osteotomy	1
Ankle arthrodesis failure	3
Revision arthrodesis	2
Amputation	1

[a]Some patients had more than 1 reoperation.

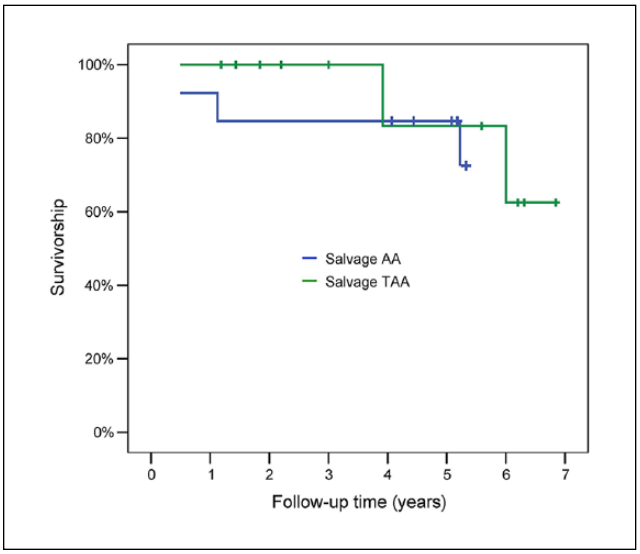

Figure 3. Five-year survivorship of the salvage AA and TAA was 84.6% and 83.3%, respectively.

no pain (NRS 0) and 1 patient reported moderate pain (NRS 4). Of the 5 patients who answered the questions regarding their ongoing ankle problems, 2 still had problems (ie, pain, swelling, stiffness, loss of range of motion). Only 2 patients answered the questions regarding their satisfaction and if they would have the surgery again. One patient was extremely satisfied with the procedure and the other patient was somewhat dissatisfied. Both of the patients would undergo the salvage TAA again. For the 3 patients who filled out the AAOS-FAM questionnaire, the median standardized Core Score was 96 (range, 52-98) and the median normative score was 52 (range, 17-54).

Discussion

The treatment of posttraumatic and end-stage osteoarthritis of the ankle, which often affects young and highly active patients, is difficult and challenging for orthopedic surgeons. Arthrodesis is commonly performed in these cases, which can achieve successful pain relief and good clinical outcomes, with patient satisfaction rates up to 92%.[5,15] Even though the clearly reduced postoperative function (in particular range of motion) can be compensated by the midfoot and subtalar joints, convincing young and very active patients to have this procedure is often difficult.[4,5,15,28,30] An AA can be shown to lead to an acceleration and progression of arthritic changes in the adjacent foot joints.[8,30] Because of modern implant designs and decreasing complication rates, satisfactory clinical outcomes and 10-year survival rates up to 90%, TAA of the ankle joint has gained popularity in recent years.[11,29] With the downside of increased rates of aseptic implant loosening in highly active patients who participate in sports, sacrificing healthy bone with the procedure, most likely require further surgeries because of implant wearing and significant increase of subjective satisfaction scores in patients older than 60 years, TAA still may not be the optimal treatment option for young and active patients.[21,25,32] The third alternative for the treatment of severe ankle osteoarthritis and large osteochondral lesions of the ankle is an OCA transplantation. Compared with AA and TAA, OCA procedures are less common and the available data regarding clinical outcomes is limited. The available literature shows favorable clinical outcomes but failure rates of OCA procedures are high and reoperations are often required.[6,16,18,27,33]

If a primary ankle OCA fails, salvage procedures must be performed, which are limited to revision OCA, AA, or TAA. The available outcome data regarding these 3 procedures is rare. In a previous study, revision OCA of the ankle appears to have similar clinical outcomes to primary OCA transplantation, with almost equal failure rates (~30%). Additionally, revision OCA has an encouraging survival rate of 65% at 10 years.[10] In the present study, we report outcomes of AA and TAA as salvage procedures after primary failed ankle OCA. The comparison of our data with the existing literature is difficult because no outcome data are available for these procedures. Therefore, we are comparing our results to primary AA and TAA.

In the largest systematic literature review to date, Mafulli et al[23] analyzed outcomes of 21 studies published between 1988 and 2017, comparing primary AA and TAA procedures with a minimum follow-up of 6 months. The authors showed a significantly higher overall revision rate for TAA (20.5%; 218 of 1064 patients) in comparison to AA (10.3%; 48 of 465 patients). Regarding the postoperative functional outcomes, only the TAA group showed a statistically significant improvement in the AOFAS scale between preoperative values (33±4.8 points) and final follow-up values (62±5.5 points). TAA showed better pain relief compared with patients undergoing AA. Kim et al[19] performed another meta-analysis of 10 studies published between 2007 and 2015 that directly compared AA and TAA outcomes that had a minimum follow-up period of 6 months and did not use first-generation implants. The

Table 3. Demographic, Operative, and Outcome Data of the Salvage TAA Cohort.[a]

Patient	Sex	Age	Side	Primary OCA Graft	Time From Primary OCA to TAA, y	Latest Follow-up, y	Salvage TAA Failure Type	Standardized AAOS-FAM Score	NRS Pain	Problems With Ankle	Satisfaction	Further Surgeries (No.)
1	Female	54.5	Right	Bipolar	1.4	**6.0**[b]	Revision TAA	–	–	–	–	Yes (3)
2	Female	54.1	Right	Bipolar	7.8	5.6	–	52.1	N/A	N/A	N/A	No
3	Male	52.3	Left	Bipolar	1.5	**3.9**[b]	Revision TAA	–	–	–	–	Yes (1)
4	Male	49.5	Left	Bipolar	2.9	1.2	–	N/A	N/A	N/A	N/A	No
5	Male	58.8	Left	Bipolar	3.2	3.0	–	N/A	N/A	N/A	N/A	No
6	Male	64.1	Right	Bipolar	5.2	1.4	–	N/A	N/A	N/A	N/A	No
7	Female	56.1	Left	Bipolar	8.2	6.8	–	N/A	N/A	No	N/A	No
8	Female	61.1	Right	Bipolar	13.2	1.8	–	N/A	N/A	No	N/A	No
9	Female	43.2	Right	Bipolar	6.3	6.3	–	98.2	0	Yes (Pain, Loss of ROM, Instability)	N/A	Yes (3)
10	Male	62.2	Left	Bipolar	9.8	2.2	–	95.6	0	No	Extremely satisfied	No
11	Female	66.1	Right	Bipolar	7.1	6.2	–	N/A	4	Yes (Pain, Swelling, Loss of ROM)	Somewhat dissatisfied	No

Abbreviations: TAA, total ankle arthroplasty; AAOS-FAM, American Academy of Orthopaedic Surgeons-Foot and Ankle Module; N/A, not available; NRS, numeric rating scale; OCA, osteochondral allograft; ROM, range of motion;.

[a]Failed total ankle arthroplasty cases are highlighted in gray.

[b]Time to failure.

Table 4. Reoperations Following Salvage Total Ankle Arthroplasty.

Procedure[a]	No.
Diagnostic scope	3
Bone graft	1
Incision and drainage	1
Total ankle arthroplasty failure	2
Revision arthroplasty	2

[a]Some patients had more than 1 reoperation.

authors also revealed a significantly higher reoperation rate for TAA compared with AA as well as a higher major complication rate (wound problems, perioperative fractures, and nerve injuries). No significant differences was noted in infection rates, amputations, and adjacent joint arthritis as well as in the clinical outcome scores and satisfaction rates. In another recent systematic literature review, Lawton et al[22] compared outcomes after AA and TAA using studies that directly compared AA and TAA published between 2006 and 2016 that included only modern third-generation implants. Like the 2 previous reviews, the authors also showed a higher revision reoperation rate for TAA (7.9%) compared with AA (5.4%). The overall complication rate was higher for AA (26.9%) compared with TAA (19.7%), as well as the nonrevision reoperation rate (12.9% for AA compared to 9.5% for TAA). The authors concluded that the decision which treatment is used should be made on an individual case-by-case basis.

In contrast to primary AA and TAA procedures, in our study we found a slightly higher failure rate in the salvage AA group compared to the TAA group. Compared to the recent literature that we summarized above, the failure rate of AA after failed OCA transplantation (3 of 13 ankles, 23.1%) was higher than the failure rate of AA performed as a primary procedure. Similarly, the failure rate of TAA after failed OCA transplantation (2 of 11 ankles, 18.2%) was higher than the failure rate of modern third-generation TAA performed as a primary procedure.

How to choose between salvage procedure, AA or TAA, is patient and surgeon specific. Of the salvage procedures performed at our institution, the decision to pursue AA or TAA was largely similar to that with primary cases. Patient age, activity level, BMI, and comorbidities were considered. Also, as with primary procedures, but likely more frequent in the salvage cases, bone quality, bone erosion, bone cysts, ankle deformity, and retained hardware were taken into consideration. It stands to reason that the more challenging cases with more deformity and more bone destruction were salvaged with AA. This complexity might account for the slightly higher failure rate in the salvage AA group compared to the TAA group.

Little is known about revision ankle procedures in general. The majority of the literature focuses on revision arthrodesis after primary nonunion and salvage arthrodesis after primary failed TAA. Although studies show successful results after primary AA with fusion rates up to 100%, the results after revision AA shows lower union rates, poorer satisfaction rates, and extended time to union.[3,7,9,24] O'Connor et al[26] reported on a case series of 82 patients who required a revision AA after primary nonunion with an average follow-up of 16.5 months. The authors showed a nonunion rate of 23% and a 3-fold increase in the risk of persistent nonunion with increased numbers of revision attempts. This shows the general problem of revision ankle procedures. Multiple procedures lead to higher technical difficulties and subsequent poorer outcomes. This is also shown in the outcomes of salvage AA after failed TAA and revision ankle arthroplasty.[12,14,31]

Our study has 2 main limitations. First, we have a small number of patients in each group and not all patients answered all follow-up questions. Ankle OCA transplantations, as well as their revision and salvage operations, are extremely rare, and a lack of outcome data exist regarding these procedures. This small case series shows that an OCA transplantation of the ankle could delay further procedures in correctly selected patients and that undergoing an ankle OCA transplantation might not burn any bridges for later revision to AA and to TAA, which are concerns of many ankle surgeons today. Second, no radiographic follow-up was available. Most of our patients were nonlocal or underwent the salvage procedure at an outside institution, which made them unavailable for follow-up examinations in person.

Conclusion

The revision and reoperation rates for salvage procedures following failed OCA transplantation of the ankle were higher compared to published data for primary procedures. In our cohort, the vast majority of patients received bipolar OCA allografts because of severe osteoarthritis or large osteochondral defects at a young age. These patients are rare and, in general, difficult to treat. Although the results of salvage procedures after an OCA failure were inferior to primary procedures, OCA transplantation may serve as an interim procedure for younger patients with advanced ankle joint disease who may not be ideal candidates for primary TAA or AA at the time of initial presentation. Larger studies with longer follow-up durations are needed to make definitive conclusions, especially regarding clinical failure and patient-reported outcomes.

Declaration of Conflicting Interests

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