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ORIGINAL ARTICLE

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Total ankle arthroplasty for deformity of the foot in patients with rheumatoid arthritis using the TNK ankle system: clinical results of 21 cases

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Abstract We report the results of total ankle arthroplasty (TAA) of 21 ankle joints performed on 19 patients with rheumatoid arthritis (RA) using the Japanese TNK ankle system. The clinical evaluation for an average follow-up period of 33.8 months was based on the ankle analysis system. The total score, pain score, range of motion, and walking ability significantly improved postoperatively compared with the preoperative period. These parameters also showed significantly different values between the preoperative and the follow-up periods. However, the range of motion significantly improved postoperatively. In the evaluation of TAA using the TNK ankle system, a radiolucent line of about 1 mm was detected, but there was no dislocation or sinking of the tibial and talar prostheses. There were no severe complications except for two cases with a delayed wound healing and one with a deep infection. These results suggest that if the talocrural joint only was destroyed and the neighboring joints (subtalar or talonavicular) had fibrous fusion, or the patient had relatively fewer activities in daily life or was an elderly person, TAA using the TNK ankle system was effective for the treatment of painful and disabling ankle joints in patients with RA in the middle of the follow-up period.

Key words Ankle joint arthroplasty · Follow-up study · Rheumatoid arthritis (RA) · TNK ankle system

Introduction

Both total ankle arthroplasty (TAA) and ankle arthrodesis have been used in cases of severe deformity of the foot in patients with rheumatoid arthritis (RA). We reported that ankle arthrodesis using an intramedullary nail with fins proved to be a good treatment for severe deformity of the foot, because nonunion was not detected and the clinical results were satisfactory.[1] However, TAA does not always show good results. There has been a high failure rate, disappointing results after a long period, and a high incidence of complications, including loosening and sinking, or migration, of the prosthesis.[2,3] The advantages of TAA compared with ankle arthrodesis are the absence of mechanical stress on the neighboring joints, and the achievement of joint motion with relief of pain. These are the main differences between TAA and ankle arthrodesis.

Several types of ankle prosthesis, e.g., the spherical type[4,5] and the cylindrical type,[6–9] were developed between 1970 and 1980, after Buchholz et al.[6] and Lord and Marotte[10] reported several types of TAA. In the 1990s, the cylindrical-type TNK ankle system (Kyocera, Kyoto, Japan) with a ceramic component[11] was developed. This system consisted of a beaded coating of hydroxylapatite on the surface of the tibial and talar prostheses to enhance the affinity between the bone and the prosthesis. In the primary fixation, a screw was generally used to connect the tibial prosthesis and the bone rather than cement (Fig. 1).

Here, we report the clinical results of TAA of 21 ankle joints using the TNK ankle system. This is used for painful or disabling ankle joints in RA patients. The average follow-up period was 33.8 months.

Patients and methods

From August 1998 to December 2002, 19 patients (18 women and one man) with RA underwent TAA using the TNK ankle system; two patients underwent bilateral TAA. The average age at the operation was 57.9 years, with a range of 42–71 years, and the average follow-up period was 33.8 ± 9.6 months, with a range of 1 year and 6 months to 4 years and 2 months (Table 1). Follow-up was possible in all 19 cases. The following indications for surgery were appar-

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Table 1. Patient profiles at the time of surgery

Patient	Age (years)	Stage	Class	Follow-up (months)	Side	Hybrid[a]	Neighboring joints	Complications	Radiolucent line (≥1 mm)	Sinking	Total scores		
											Pre	Post	Follow-up[b]
1	67	3	3	50	R	−	No change	None	None	None	38	64	−
2	54	3	3	49	R	−	Osteoarthritis	None	None	None	43	63	59
3	49	4	2	48	R	−	No change	None	Tibia, talus	None	61	81	81
4	47	4	3	45	R	+	No change	None	Tibia	None	43	67	73
5	47	4	3	45	L	+	No change	None	Tibia	None	43	67	73
6	57	4	3	38	L	+	No change	Delayed wound healing	Deep infection	None	45	73	−
7	50	4	3	38	L	−	No change	None	Tibia, talus	None	49	74	80
8	70	4	3	36	L	+	No change	None	None	None	49	78	76
9	71	4	3	36	R	−	No change	None	None	None	50	74	73
10	71	3	3	36	L	−	No change	None	None	None	50	74	73
11	55	3	2	33	R	+	No change	None	Tibia	None	56	81	76
12	59	4	2	33	L	+	No change	None	None	None	61	86	77
13	56	3	2	28	L	+	No change	None	Tibia, talus	None	64	77	78
14	64	3	2	28	R	+	No change	None	Tibia	None	65	77	65
15	42	3	3	28	L	+	No change	None	Tibia	None	42	72	67
16	62	4	3	28	R	+	No change	None	None	None	49	74	76
17	65	4	3	26	L	+	Osteoarthritis	Delayed wound healing	None	None	47	84	91
18	62	4	3	25	L	+	No change	None	Tibia, talus	None	60	84	77
19	48	4	3	23	L	+	No change	None	Tibia	None	60	77	81
20	57	4	2	19	L	+	No change	None	None	None	55	74	76
21	63	3	2	18	L	+	No change	None	Tibia	None	63	83	70

[a] Plus means that the tibial component was noncemented and the talar component was cemented. Minus means that the tibial and talar components were cemented

[b] Minus means data not followed-up. Patient No. 1 died before the end of the follow-up period. Patient No. 6 developed a deep infection, and the prostheses was removed during the follow-up period

ent in all patients: no severe foot deformity; possible fusion of the subtalar joint; varus or valgus deformities within 15°; ankle arthrodesis on the other foot; no severe osteoporosis; no aseptic necrosis of the talus; a relatively low activity of daily life (walking ability less than 30 min or an elderly patient).

Postoperative treatment

After the operation, the patients were fitted with a below-the-knee cast which they were required to wear for 3 weeks. They were allowed to bear their own weight after 4 weeks, i.e., 1 week after removal of the cast. The casts were applied to provide stability and to avoid delayed wound healing.

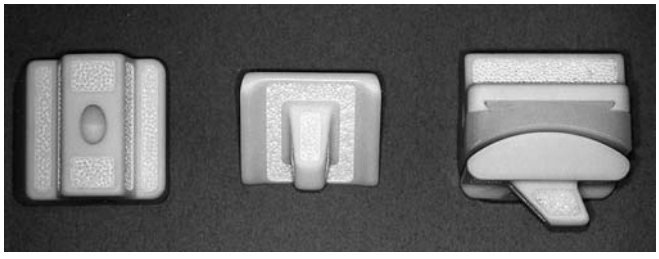

Fig. 1. Photographs of the TNK ankle system. This system is composed of a ceramic tibial prostheses with high-density polyethylene, and a ceramic talar prostheses. Three sizes, small, medium, and large, are prepared. A ceramic prosthesis with a medial facet joint was inserted from the anterior side

Clinical assessment and statistical analysis

Clinical assessments were performed using the 100-point rating system proposed by Evanski and Waugh.[12] This method allots 40 points for pain, 50 for function, and 10 for range of motion, with 6 points for flexion and 4 for extension.

The Wilcoxon signed-ranks test was used to compare the total scores of each parameter among the three periods (preoperative, postoperative, and follow-up). P values less than 0.05 were considered to indicate a significant difference.

Results

The perioperative treatment and assessment of the arthroplasty were as follows: average operation time 2.0 ± 0.2 h, range 1 hour and 50 min to 2 h and 37 min; hybrid type prosthesis (talus component cemented, tibial component not cemented) used in 15 out of 21 cases, while in the other cases both components were cemented; weight bearing resumed 4 weeks after the operation for both types of prosthesis. Figures 2 and 3 show radiographs of patients with RA pre- and postoperatively, and in the follow-up period after TAA.

The complications encountered in this study are listed in Table 1. These included two cases of delayed wound healing and one case of deep infection. A radiograph assessment showed radiolucent lines in the tibial component in 11 out of 21 cases. Sinking of the talar component was not detected in any of the 21 cases.

Fig. 2. Case 1 was a 50-year-old woman with RA. Radiographs taken **a** preoperatively and **b** 3 years after surgery. The talocrural joint space has disappeared, and the subtalar joint shows almost complete ankylosis. The patient had developed severe pain in her left ankle joint, and her walking ability was less than 30 min with a cane. She had already been treated by ankle desis in the right ankle joint and multiple joint arthroplasties, namely bilateral total hip arthroplasties and total knee arthroplasties. The patient's radiographic findings and daily activity level were considered to be good indications for TAA. Her total score improved from 49 points before surgery to 80 points 3 years and 2 months after surgery

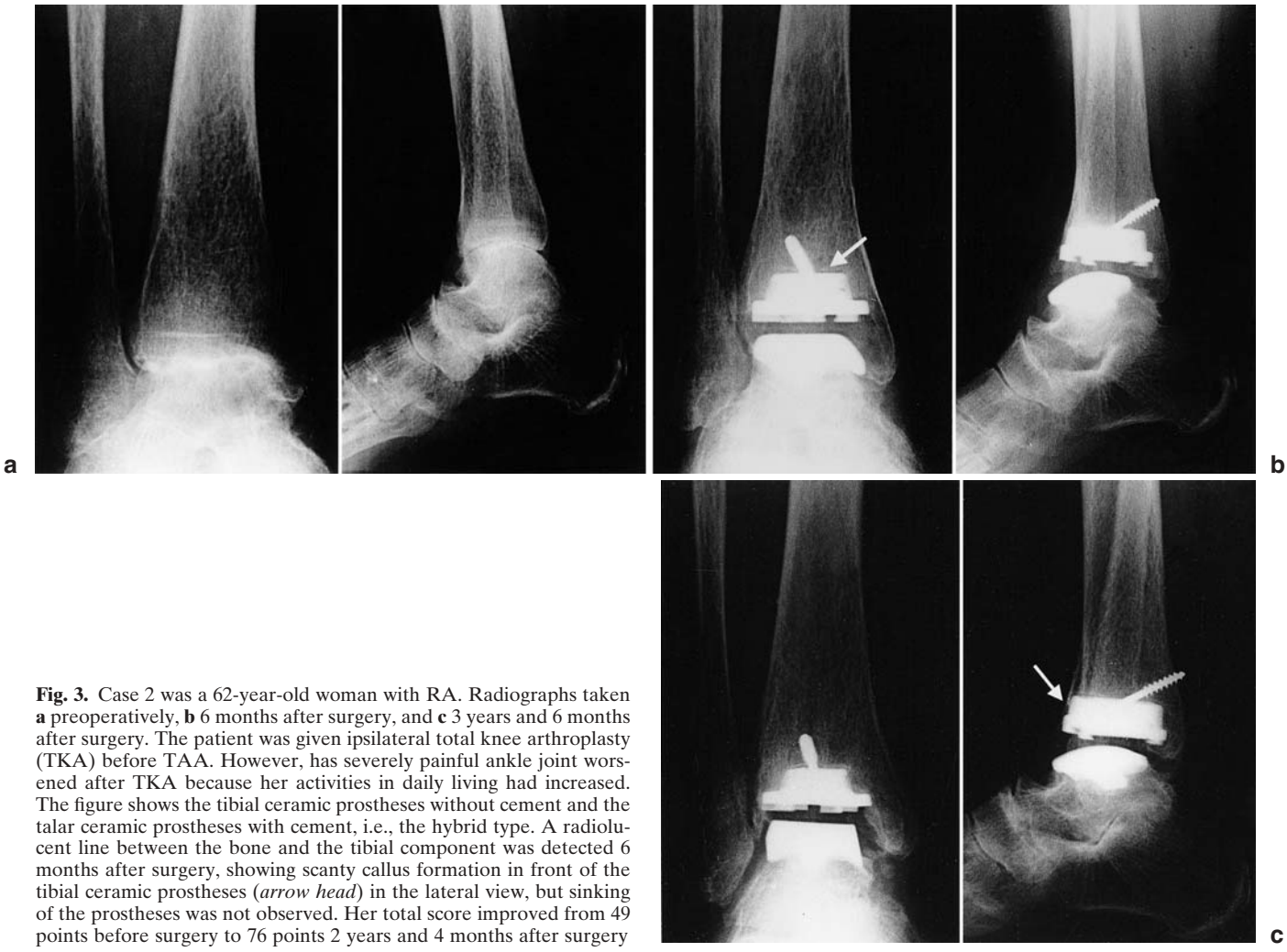

Fig. 3. Case 2 was a 62-year-old woman with RA. Radiographs taken **a** preoperatively, **b** 6 months after surgery, and **c** 3 years and 6 months after surgery. The patient was given ipsilateral total knee arthroplasty (TKA) before TAA. However, has severely painful ankle joint worsened after TKA because her activities in daily living had increased. The figure shows the tibial ceramic prostheses without cement and the talar ceramic prostheses with cement, i.e., the hybrid type. A radiolucent line between the bone and the tibial component was detected 6 months after surgery, showing scanty callus formation in front of the tibial ceramic prostheses (*arrow head*) in the lateral view, but sinking of the prostheses was not observed. Her total score improved from 49 points before surgery to 76 points 2 years and 4 months after surgery

In the clinical assessments (Fig. 4), total scores improved significantly in all 21 cases from an average of 52.0 ± 8.4 points before surgery, to 75.4 ± 6.5 points after surgery, and 74.1 ± 8.2 points after the average follow-up period of 33.8 months. Pain scores improved significantly from 21.3 ± 4.8 points before surgery, to 35.3 ± 3.1 points after surgery, and 35.4 ± 2.7 points in the follow-up period. The mean score for function also increased from 27.3 ± 5.7 points before surgery, to 35.7 ± 4.0 points after surgery, and 35.0 ± 7.0 points in the follow-up period. Walking ability increased from 6.2 ± 2.7 points before surgery, to 9.2 ± 2.0 points after surgery, and 9.7 ± 3.2 points in the follow-up period. These four parameters improved between the pre- and postoperative periods, and between the preoperative and the follow-up periods.

In terms of motion, scores improved from 3.2 ± 0.8 points before surgery, to 4.8 ± 1.4 points after surgery, and 3.4 ± 2.0 points in the follow-up period. However, motion only improved significantly between the pre- and postoperative periods. This means that motion may gradually decrease depending on the daily activities of the patients.

Discussion

The advantages of TAA over ankle arthrodesis in the treatment of painful or disabling ankle joints in RA patients are controversial. McGuire et al.,[13] Lachiewicz et al.,[14] and Growth and Fitch[15] agree that TAA is effective for the treatment of painful and disabling ankle joints in RA patients. McGuire et al. concluded that TAA is effective in increasing the daily activities of RA patients, but is not effective for young patients with posttraumatic arthrosis.[13] However, Hamblen,[2] Newton,[4] and Kitaoka and Patzer[16] do not agree with the use of TAA for the treatment of RA patients. Kitaoka and Patzer[16] reported that 57 cases out of 160 arthroplasties failed after a mean time of 9 years follow-up. This also demonstrates the importance of a long follow-up period.

Several complications have been reported after TAA, such as loosening and sinking of the tibial and talar prostheses after a long period and infection. Mechanical loosening causes bone resorption, which may be accelerated by the presence of cement fragments. It would be logical to perform cementless fixation of the prosthesis, because resec-

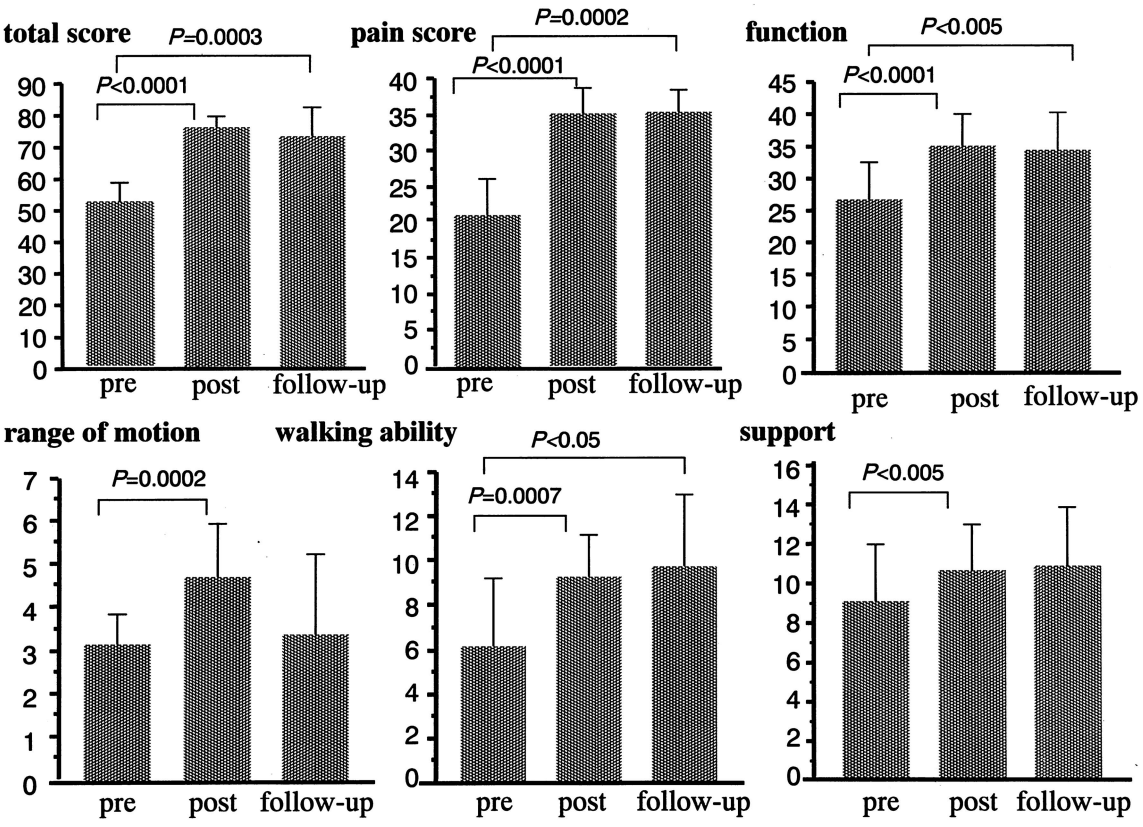

Fig. 4. Clinical results of the ankle rating system preoperatively, postoperatively, and in the follow-up periods. The total, pain, function scores, and walking ability had significantly improved when the pre- and postoperative periods were compared, and when the preoperative and follow-up periods were compared. However, the range of motion improved significantly only between the pre- and postoperative periods

tion of the bone surface is minimal and bone necrosis of the talus body is much less than with a cemented prosthesis. Furthermore, a metal-back prosthesis with cement results in osteolysis of the bone,[17] micromovement, and loosening of the prosthesis. In a comparison of cemented cases and uncemented cases for the treatment of osteoarthritis, RA, and hemophilic arthritis,[18] loosening and sinking in the prosthesis were observed in 28 out of 33 cases (85%) in the cemented group, of which 23 were metal and 5 were ceramic prosthesis, and in only 7 out of 30 cases (23%) in the noncemented ceramic group. Wood et al.[19] compared cemented and noncemented prostheses in RA patients and reported that cementless prostheses showed satisfactory outcomes both clinically and radiographically in a 5-year follow-up period.

After investigating the indications for TAA, Lachiewicz and co-workers[14] and Herberts et al.[20] concluded that arthroplasty is likely to be successful in carefully selected RA patients with severe arthritis of the ankle that is unresponsive to conservative treatment. We have also concluded the indications for TAA are possible fusion of the subtalar joint, varus or valgus deformity within 15°, the absence of severe osteoporosis or aseptic necrosis of the talus, and a relatively low level of activity in daily life (walking ability less than 30 min or an elderly patient).

On radiographic analysis, a radiolucent line was obseved in 11 out of 21 cases (52.4%) in our study, and in 11 out of 17 cases (64.7%) for an average of 39 months in Ranawat's study. In cases of uncemented ceramic prostheses, a sclerotic or radiolucent line was detected 2 or 3 months postoperatively. However, in patients with a good prognosis, this clear zone did not spread postoperatively, and callus formation covering the ceramic prostheses was observed about 6 months postoperatively. The callus formation helped to fix the prostheses firmly, even though ceramic is a bioinert substance.

A considerable number of complications, e.g., deep and superficial infection, and delayed wound healing, have been reported after TAA. In our results, deep infection of the prostheses was observed in one case, and delayed wound healing was observed in 2 out of the 21 cases (about 10%). In arthrodesis, the incidence of infection caused by a pin was reported to be 40% by Moran et al.,[21] 33% by Cracchiolo et al.,[22] and 36% by Smith and Wood.[23] Delayed wound healing was reported in 2 out of 26 cases in the study by Smith and Wood,[23] and in 8 out of 30 cases in our previous study. Thus, the incidence of infection and delayed wound healing after TAA is not always higher than that after arthrodesis. These results suggest that TAA using the TNK ankle system is effective for the treatment of

painful and disabling ankle joints in carefully selected RA patients.

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