



Preoperative patient's expectations and clinical outcomes after rheumatoid forefoot deformity reconstruction by joint sacrificing surgery

Sung-Jae Kim, M.D., Ph.D.¹, Young-Woon Gil, M.D.², Il-Hoon Sung, M.D., Ph.D.²

¹Department of Orthopedic Surgery, Dongtan Sacred Heart Hospital, Hallym University College of Medicine, Hwaseong, ²Department of Orthopedic Surgery, Hanyang University College of Medicine, Seoul, Korea

Objective: To study the clinical and radiologic factors related with overall patient satisfaction of joint sacrificing reconstruction on severe rheumatoid forefoot deformity (RFD).

Methods: Forty cases of RFD were retrospectively enrolled. A questionnaire on the factors for patient's expectations and satisfactions of the greater and lesser toes was administered, including repression of relapse in deformity (D), pain reduction (P), improvement in shoe wearing (S), barefoot activity (B), and appearance (A). Overall satisfaction were assessed using the 5-digit-scale. Hallux valgus angle, 1, 2 intermetatarsal angle, and other radiologic parameters were measured. Pearson's correlation and multiple linear regression analyses were used to evaluate the relationships between these factors and overall satisfaction.

Results: Overall satisfaction was 4.0 ± 0.82 . Postoperative radiologic parameters were corrected in adequate range. Visual analog scale (VAS) was reduced from 7.2 ± 2.1 to 2.2 ± 1.8 . For the greater toe, patient's expectations (D, P, S, B, and A) were 4.2, 4.1, 3.0, 2.5, 2.7 and satisfactions were 4.2, 4.0, 3.4, 3.5, 3.3, respectively. For the lesser toes, patient's expectations (D, P, S, B, and A) were 3.9, 4.1, 3.4, 3.0, 2.8, and satisfactions were 3.4, 4.0, 3.4, 3.6, 2.9, respectively. Satisfactions with P and B, and reduction amounts of VAS were significantly correlated with overall satisfaction.

Conclusion: Although forefoot reconstruction with a joint sacrificing procedure is non-physiological, it could be a good surgical option for severe RFD. Each patient's expectations and satisfactions with this procedure could vary. Thus, it seems important to inform patients preoperatively that expectation could be fulfilled well or less.

Keywords: Human forefoot, Rheumatoid arthritis, Surgical treatment, Patient's expectations and satisfaction

INTRODUCTION

Foot discomfort is a major concern for patients with rheumatoid arthritis (RA), and nearly 90% of patients complain of foot pain during the course of disease [1,2]. These discomforts can occur during all periods of RA and have a huge impact on the patient's daily life [3]. Inflammation of the forefoot joints and soft tissue causes forefoot deformity despite proper medical

treatment [1,4], and pathologic features around the metatarsophalangeal joint (MTPJ) and interphalangeal joint (IPJ) of the digits, such as hallux valgus, lesser toe deformity and metatarsalgia, are observed in many RA patients [5]. Forefoot joint damage in RA changes pressure distribution patterns due to changes in the anatomical and biomechanical aspect of the MTPJ and increases peak pressure under the forefoot, leading to increased pain during barefoot walking [6]. There have been many ad-

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Corresponding author: Il-Hoon Sung, <https://orcid.org/0000-0002-4757-5210>

Department of Orthopaedic Surgery, Hanyang University College of Medicine, 222-1 Wangsimni-ro, Seongdong-gu, Seoul 04763, Korea. E-mail: sungih@hanyang.ac.kr

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vances in pharmacotherapy, including disease-modifying anti-rheumatic drugs (DMARDs) and biological agents, but it is not yet known whether the drug can actually prevent the deformation [7]. Even if pharmacological treatment is performed to alleviate symptoms and maintain function of the feet, 5% to 22% of patients eventually get surgical treatment [8-10].

Several surgical techniques have been described for RA forefoot deformity surgery, and they aim to relieve pain, correct deformity, increase footwear options and restore walking function [11]. They vary by type of procedure on the first MTPJ and lesser toes. Joint preserving surgery can be performed only in cases with mild to moderate deformity without significant arthritic changes of the MTPJ [11,12], thus preserving the MT heads which are important weight-bearing structures. However, for RA patients with severe joint destruction, deformity and bone loss, joint sacrificing procedures are required to relieve symptoms. Regardless of surgical technique, patient's preoperative expectations have been shown to strongly relate to their ultimate satisfaction [12]. Discussion with physicians about patient's expectations from surgery is important to prevent or reduce postoperative dissatisfaction. Currently, there does not appear to be any studies on patient's satisfaction with rheumatoid forefoot deformity (RFD) correction. While there are previous studies on hallux valgus deformity alone, there are no studies that have performed joint sacrificing surgery including lesser toe for RFD. So we designed this study to find out how the surgery affects patients expectations and satisfactions. This study aimed to investigate the clinical expectations, satisfactions and radiologic factors related with overall satisfaction.

MATERIALS AND METHODS

A retrospective study of orthopaedic surgery was performed to identify patients who underwent surgical treatment with complete preoperative and minimum 2-year postoperative patient-reported outcome measures. The study was approved by Board of Hanyang University Medical Center (Study number: HYUH 2018-07-015).

Patients who underwent RA forefoot deformity reconstruction, joint sacrificing surgery performed by a single surgeon (I.H.S) at the foot and ankle department at a single institution between January 2000 and April 2016 were enrolled. All the patients were diagnosed as RA, confirmed by rheumatologists according to the American College of Rheumatology RA criteria

and the indications for surgery included metatarsalgia associated with severe RFD. All patients had severe hallux valgus deformity with or without arthritic change on the first MTPJ and severe dislocation of more than three lesser MTPJ along with claw toe deformity (Figure 1). Patients with a history of foot or ankle procedures were excluded. All patients provided written informed consent.

Surgical treatment was conducted using the modified Dwyer procedure, the joint sacrificing technique. The original Dwyer procedure undergoes arthrodesis of the first MTPJ and proximal IPJ of the lateral four toes, proximal phalanx and metatarsal head resection of the 2nd, 3rd, 4th and 5th rays and their respective tendon interposed to provide a tenodesis effect. The modified version is the same as conventional Dwyer procedure except the IPJ of the lateral four toes and proximal phalanx are preserved if possible and manual reduction of the IPJ along with extensor digitorum longus lengthening and extensor digitorum brevis tenotomy is performed concomitantly.

We performed a perioperative assessment on all patients before surgery and consulted with the rheumatology department to ensure that about those matters and also the preoperative disease activity would not affect perioperative patient's status. Surgery was performed when preoperative disease activity did not significantly affect the patient's systemic condition.

Research on expectations and satisfactions was conducted through a questionnaire. The questionnaire asked patients about



Figure 1. Preoperative radiographs of a patient with severe rheumatoid forefoot deformity. HVA, 1-2 IMA are 56.25°, 22.73° (A). Postoperative radiographs of a patient after modified Dwyer procedure. HVA, 1-2 IMA are 27.5°, 23.25° (B). HVA: hallux valgus angle, IMA: intermetatarsal angle.

their preoperative and postoperative concerns and interests, and selected the five most frequently identified items, which patients commonly ask to surgeon before surgery. Questionnaires were administered at preoperative and postoperative outpatient visits or by telephone. A questionnaire of preoperative patient's expectations and postoperative satisfactions for greater toe and lesser toes were given, based on a 5-digit-scale (5: very high, 4: high, 3: average, 2: low, 1: very low) of common factors for patient's expectations and satisfactions of forefoot surgery, including repres-

sion of relapse in deformity (D), pain reduction (P), improvement in shoe wearing (S), barefoot activity (B) and appearance (A). Overall satisfaction, which also based on a 5-digit-scale (5: very high, 4: high, 3: average, 2: low, 1: very low) and pain were assessed using the visual analog scale (VAS).

Radiologic evaluation was performed using the standing anterior-posterior and lateral view of the foot. For evaluation of forefoot deformity, the hallux valgus angle (HVA) and 1, 2 intermetatarsal angle (IMA) were measured preoperatively and postoperatively. During routine outpatient visits, the degree of fusion of the first MTPJ, maintenance of metatarsal parabola and other anatomical alignment are measured.

Frequency analysis was performed on preoperative patient's expectations, postoperative satisfactions. To compare changes in of VAS scores and radiologic parameters of HVA and IMA, preoperative and postoperative values were compared using paired t-tests. Pearson's correlation analysis and multiple linear regression analysis were used to evaluate the relationships between clinical and radiologic factors, including VAS, IMA, HVA, items about satisfaction, preoperative Disease Activity Score 28-erythrocyte sedimentation rate (DAS-28-ESR) score and overall satisfaction. Preoperative the DAS-28-ESR score based on 28 joints (DAS-28) is calculated from four components: number of tender joints, number of swollen joints, VAS score of the patient's global health, and ESR. DAS-28-ESR score was measured to validate RA disease activity.

Statistical analysis was performed using the SPSS Statistics software (version 24.0; IBM Corp., Armonk, NY, USA). Statistical significance was set at $p < 0.05$.

RESULTS

Thirty-five patients (40 feet) were retrospectively reviewed. One patient was male, and 34 patients were female. The mean

Table 1. Demographic data, radiologic measurements and clinical outcomes of patients

	All cases (n=40)
Age (yr)	55.1±8.2
Sex (male/female)	1/39
BMI (kg/m ²)	22.2±2.7
Preoperative	
HVA (°)	47.7±9.7
IMA (°)	16.3±4.5
VAS	7.3±2.1
DAS-28	4.56±1.53
Postoperative	
HVA (°)	14.0±4.2
IMA (°)	9.7±3.6
VAS	2.2±1.8
Overall satisfaction	4.0±0.8
ΔHVA (°)	37.47±10.51
ΔIMA (°)	5.67±3.24
ΔVAS	5.80±1.94

Values are presented as mean±standard deviation or number only. BMI: body mass index, VAS: visual analog scale, HVA: hallux valgus angle, IMA: 1, 2 intermetatarsal angle, ΔHVA: difference between preoperative HVA and postoperative HVA, ΔIMA: difference between preoperative IMA and postoperative IMA, ΔVAS: difference between preoperative VAS and postoperative VAS, DAS-28: Disease Activity Score 28-erythrocyte sedimentation rate score.

Table 2. Five-digit-scale of patient's expectation and satisfaction for rheumatoid forefoot surgery

Item	Greater toe		Lesser toes	
	Expectation	Satisfaction	Expectation	Satisfaction
Repression of relapse in deformity	4.2 (3 to 5)	4.2 (2 to 5)	3.9 (2 to 5)	3.4 (2 to 5)
Progression reduction in pain	4.1 (2 to 5)	4.0 (1 to 5)	4.1 (2 to 5)	4.0 (2 to 5)
Improvement in shoe wearing	3.0 (1 to 5)	3.4 (2 to 5)	3.4 (1 to 5)	3.4 (1 to 5)
Improvement in barefoot activity	2.5 (1 to 5)	3.5 (2 to 5)	3.0 (1 to 5)	3.6 (1 to 5)
Improvement in appearance	2.7 (1 to 5)	3.3 (2 to 5)	2.8 (1 to 5)	2.9 (1 to 5)

5-digit-scale: 5, very high; 4, high; 3, average; 2, low; 1, very low.

age of patients at the time of surgery was 55.1 years (30~72 years), and the mean follow-up period was 9.2 years (2.8 to 20.5 years) (Table 1). Postoperatively, there were no neurologic complications, vascular injury, breakage of instrument or fixation failure. For the greater toe, average patient's expectations (D, P, S, B, and A) were 4.2, 4.1, 3.0, 2.5, 2.7, respectively and satisfactions were 4.2, 4.0, 3.4, 3.5, 3.3, respectively. For the lesser toes, patient's expectations (D, P, S, B and A) were 3.9, 4.1, 3.4, 3.0, 2.8, respectively and satisfactions were 3.4, 4.0, 3.4, 3.6, 2.9, respectively (Table 2). D and P were the highest patient's expectations, followed by S, B and A in descending order. P and D had the highest satisfaction, followed by B, S and A in descending order. The number of cases in each of the 5-digit-scale for each patient's expectations and satisfactions for items were counted (Table 3).

The mean overall satisfaction score postoperatively was 3.95 (2 to 5), that meaning most patients scored average to high for the questionnaire. The number of cases in each of the 5-digit-scale were counted (Table 4). The mean reduction of overall VAS was 5.1 (7.3 to 2.2; $p < 0.001$) (Table 1). Radiologic results showed a significant decrease of HVA after surgery, 47.7 ± 9.7 (30 to 70) to 14.0 ± 4.2 (6 to 21; $p < 0.001$), and IMA, 16.3 ± 4.5 (10 to 25) to 9.7 ± 3.6 (4 to 17; $p < 0.001$) (Table 1). During routine outpatient visits, 1st MTPJ were all united in the greater toe, and 2nd to 5th MTP joints all were resected properly without any significant remnants in the lesser toes. In two cases, postoperative wound dehiscence occurred, which was treated with periodic wound dressings in outpatient. Within two weeks, their wounds were healed clearly without further surgical intervention. No other

complications were showed.

The mean DAS-28-ESR score was 4.56 (3.09 to 6.09) (Table 1). The average time from RA diagnosis to surgery was 13 years and 9 months. In medications taken for RA before surgery, 28 patients were taking NSAIDs, 30 patients were taking DMARDs, and 18 patients were taking corticosteroid.

In the Pearson correlation analysis, All clinical factors and radiologic factors except preoperative DAS-28-ESR score were positively correlated with overall postoperative satisfaction to moderate and low degrees. Satisfactions with P ($p = 0.002$) and B ($p = 0.023$) for the greater toe, P ($p = 0.035$) and B ($p = 0.002$) for the lesser toes, and the difference between preoperative and postoperative VAS (Δ VAS) ($p = 0.003$) were significantly related to overall satisfaction (Table 5).

Factors correlating significantly with overall satisfaction, were satisfactions with P and B in both the greater and lesser toes, and reduction amounts of VAS scores following surgery. Additionally, we performed multiple linear analyses to identify the independent factors associated with overall satisfaction. Satisfaction with P for the greater toe was significantly associated to overall satisfaction ($p = 0.042$; Table 6).

DISCUSSION

It is overt that the foot, in particular the forefoot, is a major part in the surgery of inflammatory joint disease. Synovitis of the MTPJ of foot is often the common findings of RA and results in forefoot pain. It is often the initial symptom of RA. It is reported that within the first three years of RA, approximately

Table 3. Frequency analysis of patient's expectation and satisfaction

Item	No. of expectation/satisfaction for greater toe					No. of expectation/satisfaction for lesser toe				
	Very high (5)	High (4)	Average (3)	Low (2)	Very low (1)	Very high (5)	High (4)	Average (3)	Low (2)	Very low (1)
Questionnaire D	24/23	0/1	16/15	0/1	0/0	14/11	9/10	15/8	2/6	0/5
Questionnaire P	20/22	11/2	3/12	6/3	0/1	22/20	3/1	13/18	2/1	0/0
Questionnaire S	15/11	2/3	2/17	10/9	11/0	7/7	10/9	14/19	8/4	1/1
Questionnaire B	3/9	11/5	2/22	11/4	13/0	7/13	5/1	12/24	12/2	4/0
Questionnaire A	7/7	3/3	10/23	10/7	10/0	2/2	2/0	25/29	9/8	2/1

D: repression of relapse in deformity, P: reduction in pain, S: shoe wearing, B: barefoot activity, A: appearance.

Table 4. Frequency analysis of overall satisfaction

Overall satisfaction (grade)	Very high (5)	High (4)	Average (3)	Low (2)	Very low (1)
No. of cases	11	17	11	1	0

Table 5. Pearson correlation analysis between clinical factors (VAS, IMA, HVA and items for satisfaction) and overall satisfaction

	Pearson coefficient	p-value
Repression of relapse in deformity in greater toe	0.021	0.897
Progression reduction in pain in greater toe	0.420	0.002
Improvement in shoe wearing in greater toe	0.246	0.127
Improvement in barefoot activity in greater toe	0.359	0.023
Improvement in appearance in greater toe	0.280	0.080
Repression of relapse in deformity in lesser toes	0.224	0.164
Progression reduction in pain in lesser toes	0.334	0.035
Improvement in shoe wearing in lesser toes	0.251	0.118
Improvement in barefoot activity in lesser toes	0.478	0.002
Improvement in appearance in lesser toes	0.256	0.110
Δ HVA	0.072	0.659
Δ IMA	0.003	0.984
Δ VAS	0.459	0.003
Preoperative DAS-28	-0.092	0.286

HVA: hallux valgus angle, IMA: 1, 2 intermetatarsal angle, VAS: visual analog scale, Δ HVA: difference between preoperative HVA and postoperative HVA, Δ IMA: difference between preoperative IMA and postoperative IMA, Δ VAS: difference between preoperative VAS and postoperative VAS, DAS-28: Disease Activity Score 28-erythrocyte sedimentation rate score. Statistically significant ($p < 0.05$).

Table 6. Multilinear regression analysis between clinical factors and overall satisfaction

	Unstandardized coefficients		Standardized coefficients		p-value
	B	SE	β	t	
Constant	2.061	0.621		3.320	0.003
Progression reduction in pain in greater toe	0.238	0.113	0.347	2.113	0.042
Improvement in barefoot activity in greater toe	-0.070	0.215	-0.082	-0.325	0.747
Progression reduction in pain in lesser toes	-0.059	0.135	-0.075	-0.436	0.666
Improvement in barefoot activity in lesser toes	0.191	0.149	0.235	1.279	0.210
Δ VAS	0.076	0.056	0.230	1.357	0.184

VAS: visual analog scale, Δ VAS: difference between preoperative VAS and postoperative VAS. Statistically significant ($p < 0.05$).

65% of the patients have MTPJ involvement [1,13,14]. Furthermore, It is estimated, with disease progression, two thirds of patients have MTPJ pain of hallux, and subluxation or dislocation of lesser MTP joints. Pain, deformity, and dysfunction of the forefoot, not responding to conservative treatment, eventually causes these patients to undergo surgical treatment [8,9].

It is well known that there is a difference between the patient's expectations undergoing surgery and the surgical goals of surgeons in the orthopedic field [15-17]. Before surgery, physicians should discuss the patient expected results of the surgery with the patient and understand the patient's expectations as accurately as possible. If patients and surgeons have similar expectations or explain the difference between postoperative satisfactions and preoperative patient's expectations, patient satisfaction may be higher than if they have different expectations or not

explain. A previous study on preoperative patient's expectations in hallux valgus patients without RA, and they reported that the patients most expected improvement in foot function, followed by relief of pain at the bunion site, comfortable shoe wearing, and decreased pain at the lesser toes [18].

In our study, patients had a mean DAS-28-ESR score of 4.58, indicating that they had, on average, moderate RA activity. There are several studies about relationship between disease activity and surgical treatment in patients with RA. However, most of these study have been conducted in patients who have undergone large joint surgery or artificial joint replacement surgery. On the contrary, our procedure was a small joint surgery and did not constitute an artificial joint replacement. There are no study about high RA disease activity have been associated with postoperative complications or infections in foot and ankle

surgery. We believed that patient's symptoms were the result of deformity of the forefoot caused by the chronic course of the disease rather than an inflammatory response. So we did not use the preoperative DAS-28-ESR score as a criteria for making a surgical decision [19].

We analyzed the correlation between preoperative DAS-28-ESR score and patients overall satisfaction and found no significant correlation. We believe that this would be resulted from their symptoms were the result of deformity of the forefoot caused by the chronic course of the disease rather than an inflammatory response.

For the great toe, repression of relapse in deformity was the patients' most expected factor of RA forefoot deformity surgery, followed by pain, comfortable shoe wearing, barefoot activity and appearance. For lesser toes, pain was the most expected factor, and followed by repression of relapse in deformity, comfortable shoe wearing, barefoot activity and appearance (Table 2). This showed that the factors that patient's most expected improvement for both the greater toe and lesser toes were pain and repression of relapse in deformity.

Traditionally, joint sacrificing procedures such as 1st MTPJ fusion or resection arthroplasty in 1st MTPJ and resection arthroplasty of the lesser toes are performed for patients with severe RFD. However, with recent advances in RA drug medication, many surgeons have conducted joint preserving surgeries in patients with minimal erosion of the MTP joint and have reported satisfactory results [20]. In the greater toe, 50% to 95% good correction with osteotomy has been reported in rheumatoid hallux valgus [12,21]. In the lesser toes, the Weil or other metatarsal head preserving osteotomies may have the advantage of preserving the plantar attachment and MTPJ function to bear weight [22]. Niki et al. [11] evaluated a combination of joint preserving procedure for rheumatoid forefoot deformities in 30 patients. They reported no cases of nonunion, deformity recurrence, or callosity. However, joint preserving procedures could not be performed to correct severe deformities as in our study.

In contrast, in the greater toe, many procedures are performed for severe rheumatoid forefoot deformities, such as resection arthroplasty or arthrodesis as joint sacrificing procedures. Torikai et al. [23] found that significant improvement in the HVA could not only be achieved through resection but also with arthrodesis. In addition, Horita et al. [24] reported that arthrodesis of the MTP joint should be indicated for severe hallux valgus with an HVA $>50^\circ$. In the lesser toes, resection arthroplasty

has been commonly used in patients with RA and is essentially unchanged from the original description by Hoffman in 1911. Dai et al. [25] reported that resection arthroplasty of the lesser metatarsals, combined with arthrodesis of the first MTP joint, achieved significant improvements in pain relief, deformity correction, and footwear comfort. In our study, the joint sacrificing, Modified Dwyer procedures were conducted for all patients with severe rheumatoid forefoot deformities and overall satisfaction showed improved clinical and radiological results.

In the Pearson correlation analysis, statistically significant clinical factors were satisfactions of P and B for the greater toe, P and B for the lesser toes, and Δ VAS. Above these, satisfaction of P for the greater toe significantly affected overall satisfaction in multiple linear regression analysis. We believe that all items about satisfaction were positively correlated with overall postoperative satisfaction to a moderate or low degree. Although postoperative overall satisfaction is influenced by a variety of factors, there are factors correlated significantly with overall satisfaction. Satisfactions with P and B in both the greater and lesser toes, and reduction in VAS scores following surgery is significantly correlated.

Clinical factors, particularly satisfactions with S and A for the greater and lesser toes, were not significantly related to overall satisfaction. We believe that the reason was the joint sacrificing procedure have disadvantages in aspect of S and A for the greater and lesser toes.

Piqué-Vidal and Vila [26] studied severity of hallux valgus deformities according to angular measurements in 301 radiographs. In this study, preoperative radiologic parameters of all patients showed almost severe deformities. And postoperative radiologic parameters of all patients were mostly corrected within acceptable range. Nonunion, malunion, or other complications on radiologic examinations may affect clinical outcomes. However, in this study, 1st MTP joints were all united in the greater toe, and 2nd-5th MTP joints all were resected without any significant remnants in the lesser toe, and no complications were found. So we believe that those consistent good results in each patient could not make any significant differences in overall satisfaction.

The limitations of this study are as follows. First, this was a retrospective study. Second, the number of patients who underwent the surgery as rather small. However, RA generally has a low prevalence of approximately 1%, and it is difficult to recruit severe RA patients who underwent surgery by the joint sacri-

ficing surgery with long term follow-up. Nevertheless, this is a long term study about the joint sacrificing procedure. This study analyzes not only the patient's expectations of preoperative patients but also satisfactions after surgery. Our results show that joint sacrificing procedure in RA is one of the surgical methods that can be tailored to acceptable patient satisfaction. These results will be useful for orthopedic surgeons and rheumatologists when discussing surgical treatment with patients for severe RFD.

CONCLUSION

Although forefoot reconstruction with a joint sacrificing procedure is non-physiological, it could be a good surgical option for severe RFD. Because clinical outcomes and patients overall satisfaction have shown to be improved in most cases. When comparing patients' expectations and postoperative satisfactions with the joint sacrificing procedure, both the greater and lesser toes showed better satisfaction on items, 'reduction in pain' and 'barefoot activity' than on other items, 'shoe wearing' and 'appearance'.

Since many clinical factors could affect the overall satisfaction and patient's expectations of individual patient were diverse, it seems to be important to inform patients preoperatively with a detailed explanation of what could and could not be improved much after surgery.

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CONFLICT OF INTEREST

No potential conflict of interest relevant to this article was reported.

AUTHOR CONTRIBUTIONS

Conceptualization: I.H.S. Data curation: S.J.K., Y.W.G. Methodology: I.H.S. Supervision: I.H.S. Writing – original draft:

S.J.K., Y.W.G. Writing – review & editing: I.H.S., S.J.K., Y.W.G.

ORCID

Sung-Jae Kim, <https://orcid.org/0000-0003-4785-8154>

Young-Woon Gil, <https://orcid.org/0000-0002-2067-2336>

Il-Hoon Sung, <https://orcid.org/0000-0002-4757-5210>

REFERENCES

1. Michelson J, Easley M, Wigley FM, Hellmann D. Foot and ankle problems in rheumatoid arthritis. *Foot Ankle Int* 1994;15:608-13.
2. Kim HA, Park SY, Shin K. Implications of persistent pain in patients with rheumatoid arthritis despite remission status: data from the KO-BIO registry. *J Rheum Dis* 2022;29:215-22.
3. Wickman AM, Pinzur MS, Kadanoff R, Juknelis D. Health-related quality of life for patients with rheumatoid arthritis foot involvement. *Foot Ankle Int* 2004;25:19-26.
4. Mann RA, Horton GA. Management of the foot and ankle in rheumatoid arthritis. *Rheum Dis Clin North Am* 1996;22:457-76.
5. Louwerens JW, Schrier JC. Rheumatoid forefoot deformity: pathophysiology, evaluation and operative treatment options. *Int Orthop* 2013;37:1719-29.
6. van der Leeden M, Steultjens M, Dekker JH, Prins AP, Dekker J. Forefoot joint damage, pain and disability in rheumatoid arthritis patients with foot complaints: the role of plantar pressure and gait characteristics. *Rheumatology (Oxford)* 2006;45:465-9.
7. Loveday DT, Jackson GE, Geary NP. The rheumatoid foot and ankle: current evidence. *Foot Ankle Surg* 2012;18:94-102.
8. Coughlin MJ. Rheumatoid forefoot reconstruction. A long-term follow-up study. *J Bone Joint Surg Am* 2000;82:322-41.
9. Borman P, Ayhan F, Tuncay F, Sahin M. Foot problems in a group of patients with rheumatoid arthritis: an unmet need for foot care. *Open Rheumatol J* 2012;6:290-5.
10. Jung HG, Kim TH. Clinical approach of common foot and ankle disorders. *J Korean Rheum Assoc* 2010;17:348-59.
11. Niki H, Hirano T, Okada H, Beppu M. Combination joint-preserving surgery for forefoot deformity in patients with rheumatoid arthritis. *J Bone Joint Surg Br* 2010;92:380-6.
12. Barouk LS, Barouk P. Joint-preserving surgery in rheumatoid forefoot: preliminary study with more-than-two-year follow-up. *Foot Ankle Clin* 2007;12:435-54, vi.
13. van der Leeden M, Steultjens MP, Ursum J, Dahmen R, Roorda LD, Schaardenburg DV, et al. Prevalence and course of forefoot impairments and walking disability in the first eight years of rheumatoid arthritis. *Arthritis Rheum* 2008;59:1596-602.
14. Matricali GA, Boonen A, Verduyck J, Taelman V, Verschueren P, Sileghem A, et al. The presence of forefoot problems and the role of surgery in patients with rheumatoid arthritis. *Ann Rheum Dis* 2006;65:1254-5.
15. Wright JG, Rudicel S, Feinstein AR. Ask patients what they want. Evaluation of individual complaints before total hip replacement. *J*

- Bone Joint Surg Br 1994;76:229-34.
16. Lieberman JR, Dorey F, Shekelle P, Schumacher L, Thomas BJ, Kilgus DJ, et al. Differences between patients' and physicians' evaluations of outcome after total hip arthroplasty. *J Bone Joint Surg Am* 1996;78:835-8.
 17. Moran M, Khan A, Sochart DH, Andrew G. Expect the best, prepare for the worst: surgeon and patient expectation of the outcome of primary total hip and knee replacement. *Ann R Coll Surg Engl* 2003;85:204-6.
 18. Tai CC, Ridgeway S, Ramachandran M, Ng VA, Devic N, Singh D. Patient expectations for hallux valgus surgery. *J Orthop Surg (Hong Kong)* 2008;16:91-5.
 19. Bongartz T, Halligan CS, Osmon DR, Reinalda MS, Bamlet WR, Crowson CS, et al. Incidence and risk factors of prosthetic joint infection after total hip or knee replacement in patients with rheumatoid arthritis. *Arthritis Rheum* 2008;59:1713-20.
 20. Lee JW, Ahn JH, Kim MS, Kim SC. Operative treatment of hallux valgus. *J Korean Foot Ankle Soc* 2014;18:48-55.
 21. Ahn J, Jeong BO. Relationship between foot width reduction and clinical outcomes after chevron osteotomy for hallux valgus deformity. *Clin Orthop Surg* 2023;15:159-65.
 22. Sung IH, Sung YK, Huh DR, Kim SJ. A comparative study on the results of the modified Ludloff osteotomy for hallux valgus deformities with minimal erosion of the metatarsophalangeal joints in rheumatoid patients versus non-rheumatoid patients. *Mod Rheumatol* 2015;25:694-700.
 23. Torikai E, Kageyama Y, Suzuki M, Ichikawa T, Nagano A. Comparison between resection arthroplasty alone and resection arthroplasty with arthrodesis of the first MTP joint for rheumatoid forefoot deformities. *Mod Rheumatol* 2008;18:486-91.
 24. Horita M, Nishida K, Hashizume K, Nasu Y, Saiga K, Nakahara R, et al. Outcomes of resection and joint-preserving arthroplasty for forefoot deformities for rheumatoid arthritis. *Foot Ankle Int* 2018;39:292-9.
 25. Dai H, Zhai WT, Wang LC, Xu YL, Ding S, Xie J, et al. [Clinical result of forefoot correction by the first ray stabilization combined with resection of the lesser metatarsal head procedure for patient with rheumatoid arthritis]. *China J Orthop Traumatol* 2012;25:821-4. Chinese.
 26. Piqué-Vidal C, Vila J. A geometric analysis of hallux valgus: correlation with clinical assessment of severity. *J Foot Ankle Res* 2009;2:15.