

## Changes of the Incidence of falls in Patients with Rheumatoid Arthritis after Orthopaedic Lower Limb Surgery

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### Abstract

**Introduction:** Orthopaedic lower limb surgeries are often performed for joint pain or destruction in rheumatoid arthritis (RA), however, there were few studies for incidences and risk factors of falls after lower limb surgeries in RA. The aim of current study was to examine the incidences of falls and to analyze the risk factors for falls in patients with RA after lower limb surgeries.

**Methods:** Self-reported questionnaires were completed by 141 patients. The incidence of falls in patients who underwent lower limb surgeries (71 cases, 1 surgery) were compared to patients with no history of surgery.

**Results:** The incidence rate of falls in surgery group was significantly fewer when compared to no-surgery group (9.8% vs. 38.6%,  $p < 0.01$ ). Among the patients with history of surgery, DAS 28-CRP (4) and tender joint counts were significantly higher in the fall group than in the no-fall group. After the surgery, the frequency of falls decreased in 30% of the patients. Walking ability improved in 34% of the patients after surgery. Tender joint counts and DAS28-CRP(4) were significant risk factors for falls, on the other hand, the history of lower limb surgery was protective factor against falls (OR 0.04,  $p < 0.01$ ).

**Conclusion:** The walking ability clearly improved after surgery in one third of the patients, which may resulted in decreased incidence of falls. Several patients had high disease activity even after surgery, which may be the reason why the frequency of falls increased in 6% of the patients after surgery.

### Key words:

Fall; Rheumatoid arthritis; Orthopaedic lower limb surgery

### Introduction

Several studies reported that patients with rheumatoid arthritis (RA) have a high risk of falls compared with healthy aged people [1-7]. Muscle weakness, joint pain in the lower extremities, and impairment in walking were reported to be associated with falls in patients with RA [2-4]. Orthopaedic surgeries for lower limb are often performed due to joint pain or destruction. After surgeries, the incidence of falls might decrease because of improvement of walking ability or relief of pain. Furuya et al. reported that 10.1% of 4996 patients with RA experienced at least one fall during 6 months of the questionnaires, and patients who fell at least one time were more likely to have a history of total knee arthroplasty (TKA) or total hip arthroplasty (THA) when compared to patients who did not have experience of fall [2]. Hayashibara et al. reported that 50% of 80 women with RA fell at least once during a year [4]. They also indicated that patients who underwent surgery of the lower limb tended to have a higher risk of falls. Based on these reports, surgery of the lower limb seemed to be a significant risk factor for falls. However, on the other hand, it may be possible that patients who have a higher risk of fall underwent lower limb surgeries. To our knowledge, there were few studies about the

changes of the incidence and risk factors of falls in patients with RA after lower limb surgeries. The aim of current study was to analyze the rate of incidence of falls and to clarify the risk factors of falls in patients with RA in association with lower limb surgeries.

### Patients and Methods

Self-reported questionnaires were performed in 141 patients affected by RA (female 121 and male 20) who regularly visited Yokohama City University Medical Center and Yokohama City University Hospital from July 2010 to March 2013. The study protocol was approved by ethics committee of Yokohama City University and the informed consent was obtained from each patient. The questionnaires included: 1) frequency of falls within past one year; 2) frequency of fractures caused by falls within past one year; 3) walking ability at the time of investigation; and 4) history of orthopaedic lower limb surgeries. Walking ability was classified into four groups: a) able to walk without support; b) able to walk with a cane; c) able to walk along handrail; and d) able to walk with other person's support. For patients who had a history of lower limb surgery, frequency of falls and walking ability before and after surgery were asked using additional questionnaires. Patients who could not walk, or who could not obtain the informed consent to this study were excluded. As taking into account of rehabilitation and recovery time after lower limb surgery,

patients who underwent surgery within six months were also excluded. The incidences of falls in patients who underwent lower limb surgeries (71 cases, 103 surgeries) were compared to patients with no history of lower limb surgery (70 cases). There were no significant differences in age, sex, and body mass index between surgery and non-surgery group (Table 1). As for surgical procedures, TKA was performed in 44 cases, toe plasty in 28 cases, THA was in 14 cases, total ankle arthroplasty was in five cases, ORIF (open reduction and internal fixation) was in five cases, ankle arthrodesis was in four cases, and others in three cases (Table 1). Thirty three patients (46.5%) underwent lower limb surgeries more than once.

	Surgery group (n=71)	Non-surgery group (n=70)	p-value
Age (year)	68.5	69.3	0.55
Sex (female : male)	67 : 4	62 : 8	0.51
BMI* (kg/m2)	21.3	21.9	0.22
Steinbrocker's classifications			
Stage I	0	3	
II	16	25	
III	41	35	
IV	14	7	
Class I	5	4	
II	41	42	
III	18	20	
IV	7	4	
Surgical Procedures			
TKA (Total arthroplasty) knee	44		
Toe plasty	28		
THA (Total hip arthroplasty)	14		
TAA (Total arthroplasty) ankle	5		
ORIF**	5		
Ankle arthrodesis	4		
Synovectomy of knee	2		
Partial osteotomy of navicular bone	1		
Total	103 joints		

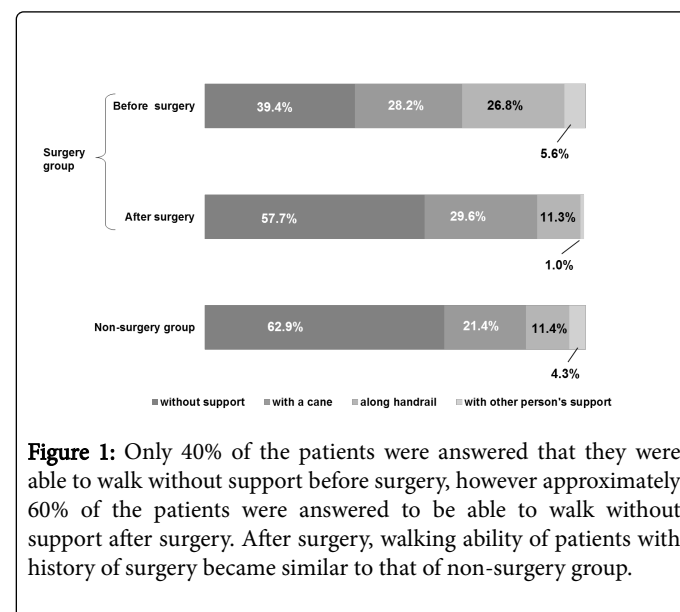
\*Body Mass Index  
\*\*Open Reduction and Internal Fixation

**Table 1:** Patients' characteristics.

Incidences of fall between surgery group and non-surgery group were analyzed using Fisher's exact test. McNemar test was applied to analyze the incidence of fall before and after surgery in surgery group. Risk factors for fall were analyzed using multivariate logistic regression analysis. The Cochran-Armitage test was used to examine the correlation between frequency of fall and disease activity of RA. P-values less than 0.05 were considered to be statistically significant.

## Results

According to questionnaires made in 141 patients, 34 patients (24.1%) had at least one fall within a year; 20 patients (14.2%) had one fall and 14 patients (9.9%) experienced more than one fall. Seven patients (5.0%) reported fractures caused by fall. As for site of fractures, compression fracture of the spine in 3 cases, rib fracture in 2 cases, distal radius fracture in one case, and pubis fracture in one case. With regard to walking ability in surgery group, only 40% of the patients answered that they were able to walk without support before surgery; however, approximately 60% of patients answered to be able to walk without support after surgery. The status of walking ability of patients after surgery became similar to that of non-surgery group. In surgery group, 34% of patients answered that walking ability was clearly improved after surgery, in contrast, 7% of patients answered that walking ability was impaired after surgery (Figure 1).



The incidence rate of falls in patients who underwent lower limb surgeries was significantly lower when compared to patients who had no history of surgery (9.8% and 38.6% respectively,  $p < 0.01$ , Table 2). There was no significant difference in incidence of fracture between surgery and non-surgery group (4.2% and 5.7% respectively,  $p = 0.72$ ). The frequency of falls after surgery was significantly lower than before surgery (9.8% and 32.4% respectively,  $p = 0.01$ , Table 2). The frequency of falls decreased after surgery in 30% of patients, on the other hand, it increased in 6% of patients. There was no correlation between types of surgery and the frequency of falls.

	Surgery group (n=71)	Non-surgery group (n=70)
	Before surgery	After surgery

<b>Fall</b>	23 (32.4%)	7 (9.8%)	27 (38.6%)
	p=0.002		p=0.001
<b>Fracture</b>	7 (9.8%)	3 (4.2%)	4 (5.7%)
	p=0.82		p=0.72

**Table 2:** Comparison of incidence of fall.

In all cases, logistic regression analysis revealed that Disease activity score (DAS)28-CRP(4), tender joint counts, and modified Health Assessment Questionnaire (mHAQ) were significantly higher in fall group (Table 3: DAS28-CRP(4); 3.42 in fall group and 2.41 in no-fall group,  $p<0.01$ , tender joint counts; 2.8 vs. 1.1,  $p<0.01$ , mHAQ; 0.96 vs. 0.43,  $p<0.01$ ). Although swollen joint counts was higher in fall group, there was no significant difference between fall group and non-fall group ( $p=0.08$ ).

Comparison between fall and no-fall group in all patients			
	Fall group	No-fall group	
	(n=37)	(n=104)	p-value
<b>DAS28-CRP(4)</b>	3.42	2.41	<0.01
<b>Tender joint counts</b>	2.8	1.1	<0.01
<b>Swollen joint counts</b>	1.4	0.9	0.08
<b>mHAQ</b>	0.96	0.43	<0.01
Comparison between fall and no-fall group in surgery group			
	Fall group	No-fall group	
	(n=7)	(n=64)	p-value
<b>DAS28-CRP(4)</b>	3.53	2.68	0.02
<b>Tender joint counts</b>	2.6	1.5	0.03
<b>Swollen joint counts</b>	1.4	1.2	0.57
<b>mHAQ</b>	1.08	0.53	0.10

**Table 3:** Univariate analysis of risk factors of fall.

Among the patients with history of surgery, DAS28-CRP (4) was significantly higher in the fall group than in the no-fall group (3.53 and 2.68 respectively,  $p<0.01$ , Table 3). Tender joint counts was also significantly higher in the fall group than in the no-fall group (2.6 vs. 1.5,  $p<0.05$ ).

Multivariate logistic regression analysis showed that tender joint counts (Odds ratio 2.03,  $p<0.05$ ) and DAS28-CRP(4) (Odds ratio 5.71,  $p<0.05$ ) were significant risk factors for falls, on the other hand, the history of lower limb surgery was protective factor against falls (Odds ratio 0.04,  $p<0.01$ , Table 4). Analysis between disease activity and the incidence of fall revealed that the rate of fall was positively correlated with DAS28-CRP (4) (Table 5).

	Odds ratio	95% CI	p-value
<b>Age (years)</b>	1.04	0.95–1.13	0.40
<b>History of lower</b>	0.04	0.0–0.20	<0.01

limb surgery			
<b>DAS28-CRP(4)</b>	5.71	1.05–31.0	0.04
<b>Tender joint counts</b>	2.03	1.01–4.11	0.04
<b>Swollen joint counts</b>	0.67	0.36–1.25	0.21
<b>mHAQ</b>	1.57	0.31–7.86	0.58

**Table 4:** Multivariate logistic regression analysis of risk factors of fall.

Disease activity	Rate of fall
Remission	2/52 (3.9%)
Low	5/18 (27.8%)
Moderate	23/63 (36.5%)
High	7/8 (87.5%)
Cochran-Armitage test $p<0.01$	

**Table 5:** Analysis between disease activity and the incidence of fall.

## Discussion

Several authors reported that RA patients have higher risk for fall when compared with healthy people. Kaz Kaz et al. reported that 54% of 103 patients with RA had a history of a previous fall [1]. They found that RA patients with symptoms/signs localized to the knees and ankles were more likely to be associated with the presence of fall risk factor. Stanmore et al. reported that 36.4% of 535 patients with RA reported falling during 1 year follow-up period from their prospective research [8]. Although according to the report by WHO [9], global frequency of falls increases with age and frailty level, several authors [10-12] reported that there was no significant linear increase in risk with age in RA patients. Yamagiwa et al. [10] reported that no significant linear increase in risk with age, but over age 65 (at least one fall) and age 75 (multiple falls) appeared to have a high risks of fall in RA. Oswald et al. [13] also reported that falls were more frequent in those over age 75 years, although there was no significant linear increase in risk with age. No linear increase of fall with age in RA patients probably reflects active arthritis with younger patients. Our results showed that 24.1% of patients had at least one fall within a year, and approximately 10% of the patients experienced multiple falls. Although the patients' background and cohort of each report are different, and the reported incident rates of fall are in various, many RA patients are thought to be under critical condition regarding fall. For better ambulation in RA patients with severe joint conditions, orthopaedic surgeries play significant roles. There were few studies, however, about the changes of the incidences and risk factors of falls in patients with RA after lower limb surgeries.

As for risk factor of fall in joint status, Stanmore et al. reported more than one-third of the falls were caused by hips, knees, and ankle joints instability [8]. They recently reported that a history of multiple falls in the previous 12 months was the most significant predictive risk factor, additionally, the most significant modifiable risk factor were swollen and tender lower extremity joints, psychotropic medication, and fatigue [9]. It is reasonable that the fall in RA patients tend to occur on the patients with joint pain, instability, and severe joint destruction. On the other hand, Furuya et al. reported that patients

who fell at least one time were more likely to have a history of TKA or THA when compared to patients who did not fall [2]. Hayashibara et al. also reported that patients who underwent surgery of the lower limb tended to have a higher risk of falls [4]. In our cases, the incidence rate of falls in surgery group was significantly lower when compared to non-surgery group. The orthopaedic surgeries for lower limbs are always performed to improve the symptom of the joint or the walking ability. Higher risk of falls after lower limbs surgery may reflect that patients who have higher risk of fall underwent lower limb surgeries, and they still have additional joints with inflammation or destruction.

For walking ability, 34% of the patients answered that walking ability was improved after surgery. 20% of the patients answered that they became to walk without support, and 30% of the patients experienced lower frequency of falls after surgery. Bugdayci et al. reported that assistive devices for ambulation were found to be independent risk factor for falls [14], but patients who are fearful of falling need the use of devices for ambulation. Our results obviously show that orthopaedic surgery for RA is not only to relieve pain or to correct joint deformation, but may also prevent fall and fractures.

For other clinical risk factors, Bugdayci et al. reported that age, visual analogue score for pain, previous falls, use of 2 or more medications were found to be correlated with ability to do heel-toe walking [14]. Bohler et al. analyzed the correlations between disease activity and the risk of falling [15]. They found health assessment questionnaire disability index (HAQ-DI), clinical disease activity indexes (CDAI), visual analogue scale (VAS) pain, patient global assessment of disease activity (PGA), and tender joint count (TJC) were most evident risk factors. In our study, tender joint counts and DAS28-CRP(4) were significant risk factors for falls. Among our patients who underwent lower limb surgery, DAS28-CRP(4) was significantly higher in the fall group than in the no-fall group. Based on our results and recent reports, patients who have high disease activity, or joint pain or swelling in lower limb have higher risk of falls even after surgery.

For the RA patients with relatively short history of disease, better disease control by progressive changes of disease modifying anti-rheumatoid arthritis drugs and introduction of biologics may result in fewer incidence rates of fall and better walking ability in the near future. The physician also have to take care of RA patients with relatively long history of disease with persistent joint pain and swelling, severe joint destruction, and severe walking impairment. Smulders et al. [16] stated that the prevention of falls in patients with RA should receive priority because the occurrence of a fall in the coming year is almost 10 times higher in patients with RA reporting a fall in the previous year. To avoid fall in RA patients, more precise evaluation or better method of prevention regarding fall in each patients will be needed.

The findings in this study are subject to some limitations. First, the small numbers enrolled in this study may possibly affect the results; there are few falls in the surgery group (n=7). It is difficult to discuss the difference between fall and no-fall group in the surgery group. Further investigation with a larger number of patients might be needed to confirm the results of this study. Second, this study is designed as a retrospective observation and the data in this study are based on self-report questionnaires; therefore, the incidence of fall, walking ability, or the incidence of fracture might be misclassified or underestimated.

## Key Message

Based on our results, the rate of falls was decreased in 30% of the patients after lower limb surgery in RA. Also, the walking ability clearly improved after surgery in more than one third of the patients, which may resulted in decreased incidence of falls. Several patients had high disease activity even after surgery, which may be the reason for the frequency of falls was increased in 6% of the patients after surgery. Tender joint counts and DAS28-CRP (4) were found to be significant risk factors, on the other hand, the history of lower limb surgery was protective factor against falls in RA patients.

## Conflict of Interest

Kengo Harigane, Yuichi Mochida, Katsushi Ishii, Naoto Mitsugi, Yutaka Inaba, and Tomoyuki Saito declare that they have no conflict of interest.

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