High Disease Activity Influences the Presence of Vertebral Fractures in Rheumatoid Arthritis

Hideo Sakane
Gunma University Graduate School of Medicine School of Medicine: Gunma Daigaku Daigakuin Igakukei Kenkyuka Igakubu
Koichi Okamura (kokamura@gunma-u.ac.jp)
Gunma University https://orcid.org/0000-0003-4523-7514
Yoichi Iizuka
Gunma Daigaku
Akira Honda
Gunma University: Gunma Daigaku
Eiji Takasawa
Gunma Daigaku
Tokue Mieda
Gunma Daigaku
Sho Ishiwata
Gunma Daigaku
Syunsuke Ito
Gunma Daigaku
Kazuhiro Inomata
Gunma Daigaku
Yukio Yonemoto
Inoue Hospital: Inoue Byoin
Takahito Suto
Gunma University: Gunma Daigaku
Tetsuya Kaneko
Fukaya Red Cross Hospital: Fukaya Sekijuji Byoin
Hirotaka Chikuda
Gunma University Graduate School of Medicine School of Medicine: Gunma Daigaku Daigakuin Igakukei Kenkyuka Igakubu

---

Research article

Keywords: disease activity score, prevalent vertebral fracture, rheumatoid arthritis

Posted Date: October 26th, 2021

DOI: https://doi.org/10.21203/rs.3.rs-942051/v1

Abstract

Background: To investigate the prevalence and risk factors for vertebral fractures in patients with rheumatoid arthritis (RA) during an era of tight management.

Methods: We retrospectively reviewed 426 RA patients who had visited our outpatient RA clinic between July 2017 and June 2020. Among them, we included 107 patients (19 males and 88 females) who had undergone lateral X-ray of the thoracolumbar spine and dual-energy X-ray absorption spectroscopy for the assessment of osteoporosis. We assessed the disease activity score for 28 joints (DAS28), the history of medication for RA and osteoporosis, the number and location of vertebral fractures, and the bone mineral density (BMD). Two board-certified specialists determined osteoporotic vertebral fractures on a lateral X-ray of the thoracolumbar spine.

Results: The mean age, average disease duration, and average DAS28 of the analyzed patients were 67.9 years, 14.9 years, and 2.8, respectively. Vertebral fractures were found in 33 patients (30.8%). In this population, 84.8% of patients with vertebral fractures and 59.5% of those without vertebral fractures were treated for osteoporosis with active vitamin D3, bisphosphonate, and/or denosumab. RA patients with vertebral fractures had significantly higher DAS28 values, a higher rate of patients with a history of glucocorticoid use, and lower BMD in comparison to those than without vertebral fractures ($p = 0.009$, $p = 0.004$, and $p = 0.01$, respectively). Logistic regression analysis showed DAS28 ($p = 0.038$) and BMD ($p = 0.004$) were independent factors associated with the presence of vertebral fractures. The ordered logistic regression analysis also showed DAS28 ($p = 0.043$) and BMD ($p = 0.024$) were independent factors that explained the number of vertebral fractures.

Conclusions: Vertebral fractures were frequently observed in RA patients, even when patients were treated the recommended anti-osteoporotic agents. A high disease activity score and low BMD were associated with the presence and number of vertebral fractures in patients with RA.

Background

Patients with rheumatoid arthritis (RA) are more likely to have osteoporosis than the general population and are considered to be at increased risk of fracture (1–5). The effects of inflammatory cytokines and osteoclast activation, which is associated with the disease itself and the effects of steroids used for treatment have been reported as risk factors for osteoporosis (1, 2, 5, 6). However, in recent years, the arrival of biologic agents has dramatically changed the treatment strategy for RA, and has reduced the risk of fracture in RA patients (5, 7).

Vertebral fractures (VFs) are associated with a reduced functional status (8–15), and the presence of existing VFs are risk factors for a new VF and other fragile fractures (16, 17). Therefore, it is important to assess the risk of VF, especially in RA patients with a high risk of fractures. Despite the era of tight control for RA, the risk of VF in RA patients remains inconclusive. Therefore, it is clinically meaningful to

investigate the factors that influence VFs. The aim of the present study was to investigate the prevalence and risk factors for VFs in patients with RA.

Materials And Methods

Patient

We retrospectively reviewed 426 RA patients who were treated at an outpatient RA clinic in Gunma University Hospital between July 2017 and June 2020. All patients met the American College of Rheumatology RA classification criteria in 1987 (18). Among them, we included 107 patients who had undergone lateral X-ray of the thoracolumbar spine and dual-energy X-ray absorption spectroscopy (DEXA) for the assessment of osteoporosis. We did not include patients with a history of thoracolumbar surgery (Fig. 1). At the time of the survey, the patients had no subjective spinal symptoms. The research protocol was approved by the Institutional Review Board of Gunma University Hospital, and written informed consent for participation was obtained from all patients.

Clinical parameters

Clinical data were collected from medical records including age, sex, body mass index (BMI), RA disease duration, anti-cyclic citrullinated peptide antibody, rheumatoid factor, and treatment history. Disease activity-related parameters, C-reactive protein, erythrocyte sedimentation rate, tender joint count, swollen joint count, and the visual analog scale of patient's global assessment were also collected. The disease activity score for 28 joints (DAS28) was calculated. The Health Assessment Questionnaire-Disability Index was also assessed to evaluate dysfunction in RA patients. In addition, the use of medication for RA and osteoporosis for ≥ 3 months during the follow-up period was recorded.

Measurement of bone mineral density

The BMD of the femoral neck was measured by DEXA using the Discovery A System (Hologic, Inc., Waltham, MA, USA). T-scores were calculated based on normative data for Asian women.

Evaluation of VFs

The evaluation of VFs from T4 to L5 was performed using lateral X-ray of the thoracolumbar spine using a semi-quantitative method (19). Vertebral deformities were classified into grades 0 (normal), 1 (mild), 2 (moderate), and 3 (severe) according to the decrease in vertebra height (grade 1, 20–25% decrease; grade 2, 25–40% decrease; and grade 3, ≥ 40% decrease. Grade 1 and above was classified as VF in this study. The number of VFs was categorized as 0, 1, 2, or ≥ 3, according to a previous report (17).

Statistical analysis

Statistical analyses for univariate analysis and logistic regression analysis were performed using SPSS Statistics software program (version 25, IBM Corp., Armonk, NY, USA). The Mann-Whitney U test was used to compare continuous data, and the chi-squared test or Fisher's exact test was used for categorical

variables. A logistic regression analysis was performed to identify risk factors for pre-existing VF in RA patients and to calculate odds ratio (OR) with 95% confidence interval (CI) for VF. An ordered logistic regression analysis was also performed to investigate risk factors for the categorized number of prevalent VFs in RA patients using the STATA/SE software program (version 15, StataCorp, College Station, TX, USA). *P* values of < 0.05 were considered statistically significant.

Results

The demographics and clinical characteristics of the RA patients in the study population are shown in Table 1. Of 107 RA patients, 19 were male and 88 were female. The mean age was 67.9 years. The average disease duration was 14.9 years and the average DAS28 was 2.9. At the time of the survey, 74 patients (69%) were receiving medication for osteoporosis. A total of 95 VFs were identified in 33 patients (30.8%). The VFs showed a bimodal distribution with peaks at the middle thoracic spine and thoracolumbar junction (Fig. 2). Of 33 patients with VF, 28 (85%) had been treated for osteoporosis. Among those receiving anti-osteoporosis agents, 41% (30/74) had VFs. The prevalence of VFs was similar among patients treated with different anti-osteoporosis agents (active vitamin D3, 41%; bisphosphonate, 42%; denosumab, 46%).

As shown in Table 2, in patients with VFs, the DAS28 was significantly higher ($p = 0.009$) and the BMD was significantly lower ($p = 0.001$) comparison to patients without VFs. Additionally, the prevalence of a history of corticosteroid use was significantly higher in patients with VFs than in patients without VFs ($p = 0.004$).

A logistic regression analysis was performed to identify risk factors for existing VFs in RA patients. RA patient with or without VF was defined as a dependent variable. When age, sex, BMI, history of corticosteroid use, history of biologic use, DAS28 and BMD were used as independent variables, DAS28 (OR: 1.814, $p = 0.038$, 95% CI: 1.032–3.187) and BMD (OR: 0.297, $p = 0.004$, 95% CI: 0.131–0.676) were defined as independent risk factors for existing VFs in RA (Table 3). The higher the DAS28, the higher the prevalence of VFs (Fig. 3A).

Next, the risk factors for the number of VFs were investigated by an ordered logistic regression analysis. The categorized number of prevalent VFs was defined as the dependent variable, while age, sex, BMI, history of corticosteroid use, history of biologic use, DAS28, and BMD were used as independent variables. As a result, DAS28 ($p = 0.043$) and BMD ($p = 0.024$) were identified as independent risk factors for the number of VFs (Table 4). Figure 3B shows the number of VFs in each disease activity group.

Discussion

Our study had three main findings. First, VFs were detected as a morbidity in 30.8% of patients. Second, VFs were frequently observed, even when patients received the recommended anti-osteoporotic agents.

Finally, a high DAS28 and low BMD were independent risk factors associated with the presence and number of existing VFs.

The prevalence of VF in patients with RA has been reported to be 20.2–45.5%, although the background of those reports differed from this study (20–23). In our study, VFs were frequently observed, even with the therapeutic agents recommended in the treatment guidelines: activated vitamin D3, bisphosphonate, and denosumab (24). The distribution of the sites of VF was similar to previous reports (6, 20, 22).

In this study, the disease activity of RA was determined as a risk factor for existing VFs in RA patients. Previous reports have shown the relationship between VFs and high disease activity (10, 25). In the management of VFs in RA patients, it might be important not only to treat osteoporosis but also to manage disease activity.

The use of corticosteroids was also reported to affect VFs (6, 8, 9, 11, 20, 22, 26). However, in our study, the use of corticosteroids was not identified as an independent predictor of VF. One of the reasons might be the low dosage of corticosteroids used in this study. Since methotrexate and biologics were administered reduce RA activity, the dosage of corticosteroid was 3.9 mg/day.

Anti-rheumatic biological drugs have been reported to prevent bone loss in RA patients (5, 7, 27), and tumor necrosis factor inhibitors were associated with reduced incidence of VF (28). On the other hand, other reports demonstrated that biologic agents did not contribute to increased bone density or reduce the risk of fracture (29, 30). In this study, we found no association between the use of biologics and VF. Besides, since our study was a cross-sectional in nature, we could not determine whether VF occurred before or after the use of biological agents. Longitudinal studies should be performed in performed in the future.

The present study was associated with some limitations. First, this was a retrospective study conducted at one hospital. The age and duration of RA were similar to the previous reports, and the effects of these factors may have been limited (6, 12, 20). Second, the study population was relatively small. However, we conducted multivariate analyses and the results for the prevalence of VFs were comparable to past studies with larger cohorts (10, 25). Therefore, the results of this study considered to be acceptable. Third, since this was a cross-sectional study, changes in disease activity and the therapeutic period were not taken into account. However, we analyzed the history of past drug use. Longitudinal research is needed to investigate the effects of disease activity and drug use on VFs more accurately.

Conclusions

VFs were frequently observed, even with the recommended anti-osteoporotic agents in RA patients. The presence and number of prevalent VFs in RA patients were associated with high disease activity as well as low BMD.

Abbreviations

BMD: bone mineral density; BMI: body mass index, CI: confidence interval, DAS28: disease activity score for 28 joints; DEXA: dual-energy X-ray absorption spectroscopy; OR: odds ratio; RA: rheumatoid arthritis; VF: vertebral fracture

Declarations

Funding

There has been no significant financial support for this work that could have influenced its outcome. The authors acknowledge the financial support provided by a UCB Japan Grant (UCBJ Grant) for the English proofreading and article processing charge of the journal.

Availability of data and materials

All data generated or analyzed during this study are included in this published article.

Authors' contributions

HS and KO made substantial contributions to the design of the study, acquisition, analysis, interpretation of data and writing of the manuscript. YI participated in the design of the study, acquiring data, helped to draft the manuscript and contributed to revising the manuscript critically. AH, ET, TM, SI and KI participated in acquiring data and critically contributing to revising the manuscript. TS, TK and YY contributed to revising the manuscript critically. HC critically contributed to revising the manuscript enhancing its intellectual content and approving the final content of the manuscript. All authors read and approved the final manuscript.

Ethics approval and consent to participate

Ethical approval was obtained from the institutional review board of the Gunma University Hospital. Patients provided written informed consent before taking part in this study.

Competing interests

The authors declare that they have no competing interests.

Competing interests

The authors declare no conflicts of interest in association with the present study.

Acknowledgments

None.

References

1. Haugeberg G, Uhlig T, Falch JA, Halse JI, Kvien TK. Bone mineral density and frequency of osteoporosis in female patients with rheumatoid arthritis: results from 394 patients in the Oslo County Rheumatoid Arthritis register. Arthritis and Rheumatism. 2000 ;43(3):522-30.
2. van Staa TP, Geusens P, Bijlsma JW, Leufkens HG, Cooper C. Clinical assessment of the long-term risk of fracture in patients with rheumatoid arthritis. Arthritis and Rheumatism. 2006 ;54(10):3104-12.
3. Wright NC, Lisse JR, Walitt BT, Eaton CB, Chen Z; Women's Health Initiative Investigators. Arthritis increases the risk for fractures–results from the Women's Health Initiative. The Journal of rheumatology. 2011 ;38(8):1680-8.
4. Xue AL, Wu SY, Jiang L, Feng AM, Guo HF, Zhao P. Bone fracture risk in patients with rheumatoid arthritis: A meta-analysis. Medicine (Baltimore). 2017 ;96(36):e6983.
5. Fardellone P, Salawati E, Le Monnier L, Goëb V. Bone Loss, Osteoporosis, and Fractures in Patients with Rheumatoid Arthritis: A Review. Journal of Clinical Medicine. 2020 ;9(10):3361.
6. Ørstavik RE, Haugeberg G, Mowinckel P, Høiseth A, Uhlig T, Falch JA, et al. Vertebral deformities in rheumatoid arthritis: a comparison with population-based controls. Archives of Internal Medicine. 2004 ;164(4):420-5.
7. Zerbini CAF, Clark P, Mendez-Sanchez L, Pereira RMR, Messina OD, Uña CR, et al. Biologic therapies and bone loss in rheumatoid arthritis. Osteoporos International. 2017 ;28(2):429-446.
8. Nampei A, Hashimoto J, Koyanagi J, Ono T, Hashimoto H, Tsumaki N, et al. Characteristics of fracture and related factors in patients with rheumatoid arthritis. Modern Rheumatology. 2008;18(2):170-6.
9. Furuya T, Kotake S, Inoue E, Nanke Y, Yago T, Hara M, et al. Risk factors associated with incident fractures in Japanese men with rheumatoid arthritis: a prospective observational cohort study. Journal of Bone Mineral Metabolism. 2008 ;26(5):499-505.
10. Dirven L, van den Broek M, van Groenendael JH, de Beus WM, Kerstens PJ, Huizinga TW, et al. Prevalence of vertebral fractures in a disease activity steered cohort of patients with early active rheumatoid arthritis. BMC Musculoskeletal Disorders. 2012 ;13:125.
11. Ishida O, Furuya T, Inoue E, Ochi K, Ikari K, Taniguchi A, et al. Risk factors for established vertebral fractures in Japanese patients with rheumatoid arthritis: Results from a large prospective observational cohort study. Modern Rheumatology. 2015 ;25(3):373-8.
12. Omata Y, Hagiwara F, Nishino J, Matsudaira K, Kadono Y, Juji T, et al. Vertebral fractures affect functional status in postmenopausal rheumatoid arthritis patients. Journal of Bone Mineral Metabolism. 2014 ;32(6):725-31.
13. Cho SK, Lee JH, Han M, Lee S, Kim JY, Ryu JA, et al. The influence of vertebral fracture on the functional disability of patients with rheumatoid arthritis. Journal of Korean Medical Science. 2014 ;29(6):859-63.
14. Phuan-Udom R, Lektrakul N, Katchamart W. The association between 10-year fracture risk by FRAX and osteoporotic fractures with disease activity in patients with rheumatoid arthritis. Clinical Rheumatology. 2018 ;37(10):2603-2610.

15. Horii C, Asai Y, Iidaka T, Muraki S, Oka H, Tsutsui S, et al. Differences in prevalence and associated factors between mild and severe vertebral fractures in Japanese men and women: the third survey of the ROAD study. Journal of Bone Mineral Metabolism. 2019 ;37(5):844-853.
16. Lindsay R, Silverman SL, Cooper C, Hanley DA, Barton I, Broy SB, et al. Risk of new vertebral fracture in the year following a fracture. JAMA. 2001 ;285(3):320-3.
17. Delmas PD, Genant HK, Crans GG, Stock JL, Wong M, Siris E, et al. Severity of prevalent vertebral fractures and the risk of subsequent vertebral and nonvertebral fractures: results from the MORE trial. Bone. 2003 ;33(4):522-32.
18. Arnett FC, Edworthy SM, Bloch DA, McShane DJ, Fries JF, Cooper NS, et al. The American Rheumatism Association 1987 revised criteria for the classification of rheumatoid arthritis. Arthritis and Rheumatism. 1988 ;31(3):315-24.
19. Genant HK, Wu CY, van Kuijk C, Nevitt MC. Vertebral fracture assessment using a semiquantitative technique. Journal of Bone and Mineral Research. 1993 ;8(9):1137-48.
20. Ørstavik RE, Haugeberg G, Uhlig T, Falch JA, Halse JI, Høiseth A, et al. Vertebral deformities in 229 female patients with rheumatoid arthritis: associations with clinical variables and bone mineral density. Arthritis and Rheumatism. 2003 ;49(3):355-60.
21. El Maghraoui A, Rezqi A, Mounach A, Achemlal L, Bezza A, Ghozlani I. Prevalence and risk factors of vertebral fractures in women with rheumatoid arthritis using vertebral fracture assessment. Rheumatology (Oxford). 2010 ;49(7):1303-10.
22. Tong JJ, Xu SQ, Zong HX, Pan MJ, Teng YZ, Xu JH. Prevalence and risk factors associated with vertebral osteoporotic fractures in patients with rheumatoid arthritis. Clinical Rheumatology. 2020 ;39(2):357-364.
23. Okano T, Inui K, Tada M, Sugioka Y, Mamoto K, Wakitani S, et al. High frequency of vertebral fracture and low bone quality in patients with rheumatoid arthritis-Results from TOMORROW study. Modern Rheumatology. 2017 ;27(3):398-404.
24. Japan Osteoporosis Society (2021,July, 10), 2015 Guideline for the treatment of osteoporosis (Japanese), http://www.josteo.com/ja/guideline/doc/15_1.pdf
25. Mohammad A, Lohan D, Bergin D, Mooney S, Newell J, O'Donnell M, et al. The prevalence of vertebral fracture on vertebral fracture assessment imaging in a large cohort of patients with rheumatoid arthritis. Rheumatology (Oxford). 2014;53(5):821-7.
26. Kim D, Cho SK, Park B, Jang EJ, Bae SC, Sung YK. Glucocorticoids Are Associated with an Increased Risk for Vertebral Fracture in Patients with Rheumatoid Arthritis. Journal of Rheumatology. 2018 ;45(5):612-620.
27. Chen JF, Hsu CY, Yu SF, Ko CH, Chiu WC, Lai HM, et al. The impact of long-term biologics/target therapy on bone mineral density in rheumatoid arthritis: a propensity score-matched analysis. Rheumatology (Oxford). 2020 ;59(9):2471-2480.
28. Ozen G, Pedro S, Wolfe F, Michaud K. Medications associated with fracture risk in patients with rheumatoid arthritis. Annals of Rheumatic Diseases. 2019 ;78(8):1041-1047.

29. Lee JS, Lim DH, Oh JS, Kim YG, Lee CK, Yoo B, et al. Effect of TNF inhibitors on bone mineral density in rheumatoid arthritis patients receiving bisphosphonate: a retrospective cohort study. Rheumatology International. 2020 ;40(3):481-487.
30. Di Munno O, Ferro F. The effect of biologic agents on bone homeostasis in chronic inflammatory rheumatic diseases. Clinical and Experimental Rheumatology. 2019 ;37(3):502-507.

Tables

Table 1

Characteristics of the RA patients in the study population

Parameter	
Age (years), mean ± SD	67.9 ± 10.9
Female, n (%)	88 (82.2)
BMI (kg/m²), mean ± SD	23.3 ± 3.9
Disease duration (years), mean ± SD	14.9 ± 11.2
RF positivity, %	69.3
ACPA positivity, %	77.6
Steinbrocker class (1/2/3/4)	17/65/24/1
Steinbrocker stage (□/□/□/□)	14/21/39/33
Tender joint count, 28 joints	1.6 ± 3.0
Swollen joint count, 28 joints	1.0 ± 2.8
Global assessment score	22.7 ± 24.7
CRP (mg/dl)	0.4 ± 0.5
ESR (mm/h)	24.6 ± 22.0
DAS28	2.8 ± 1.2
MTX use, n (%)	85 (79.4)
History of corticosteroid use, n (%)	66 (61.7)
Current users, n	47
Daily dose for current users (mg/day), mean ± SD	3.9 ± 2.3
Long users (≥ 12months), n	59
History of biologic agent use, n (%)	61 (57.0)
TNF inhibitor, n	46
Tocilizumab, n	26
Abatacept, n	17
Anti-osteoporotic drug use, n (%)	74 (69.2)

BMD, bone mineral density; BMI, body mass index; RA, rheumatoid arthritis; CRP, C-reactive protein; ESR, erythrocyte sedimentation rate; DAS28, disease activity score in 28 joints; MTX, methotrexate; TNF, tumor necrosis factor; HAQ-DI, Health Assessment Questionnaire-Disability Index

Parameter	
Activate vitamin D3, n	54
Bisphosphonate, n	41
Denosumab, n	22
Prevalence of vertebral fracture, n (%)	33 (30.8)
Number of vertebral fracture	
1, n	15
2, n	10
≥3, n	8
BMD (T-score at femoral neck)	-2.0 ± 1.0
HAQ-DI	0.8 ± 0.8

BMD, bone mineral density; BMI, body mass index; RA, rheumatoid arthritis; CRP, C-reactive protein; ESR, erythrocyte sedimentation rate; DAS28, disease activity score in 28 joints; MTX, methotrexate; TNF, tumor necrosis factor; HAQ-DI, Health Assessment Questionnaire-Disability Index

Table 2

Demographic and clinical parameters of RA patients with or without vertebral fracture

	without vertebral fracture (n = 74)	**with vertebral fracture (n = 33)**	**p value**
Age, years	67.0 ± 1.4	70.2 ± 1.5	0.254
Female, n (%)	61 (82.4)	27 (81.8)	0.939
BMI, kg/m²	23.2 ± 10.7	19.6 ± 10.1	0.791
Disease duration of RA, years	13.8 ± 1.2	17.1 ± 2.2	0.248
Tender joint count, 28 joints	1.1 ± 1.8	2.7 ± 4.6	0.155
Swollen joint count, 28 joints	0.8 ± 2.8	1.3 ± 2.6	0.351
Global assessment score	19.2 ± 20.7	31.0 ± 31.2	0.19
CRP, mg/dl	0.31 ± 0.54	0.45 ± 0.57	0.198
ESR, mm/h	21.6 ± 18.9	30.7 ± 26.7	0.11
DAS28	2.6 ± 0.1	3.4 ± 0.3	0.009
HAQ-DI	0.6 ± 0.7	1.2 ± 1.0	0.111
History of corticosteroid use, n (%)	39 (52.7)	27 (81.8)	0.004
History of biologic agent use, n (%)	38 (51.4)	23 (69.7)	0.077
BMD (T-score at femoral neck)	-1.7 ± 0.1	-2.5 ± 0.2	0.001

BMD, bone mineral density; BMI, body mass index; RA, rheumatoid arthritis; CRP, C-reactive protein; ESR, erythrocyte sedimentation rate; DAS28, disease activity score in 28 joints; HAQ-DI, Health Assessment Questionnaire-Disability Index.

Table 3

Logistic regression analysis for the risk factors for existing prevalent vertebral fractures in RA patients

	OR	95% CI	P
Age	0.984	0.925–1.046	0.606
Female	3.334	0.658–16.886	0.146
BMI	0.995	0.848–1.168	0.954
History of corticosteroid use	1.425	0.372–5.460	0.605
History of biologic agent use	1.485	0.427–5.159	0.534
DAS28	1.814	1.032–3.187	0.038
BMD (T-score at femoral neck)	0.297	0.131–0.676	0.004

BMD, bone mineral density; BMI, body mass index; RA, rheumatoid arthritis; OR, Odds ratio; 95% CI, 95% confidence interval; DAS28, disease activity score in 28 joints

Table 4

The ordered regression analysis for the risk factors for the number of prevalent vertebral fractures in RA patients

	OR	95% CI	p
Age	1.012	0.958–1.069	0.668
Female	3.024	0.640- 14.288	0.163
BMI	0.972	0.845–1.119	0.695
History of corticosteroid use	1.812	0.525–6.250	0.347
History of biologic agent use	1.501	0.489–4.605	0.478
DAS28	1.683	1.017–2.784	0.043
BMD (T-score at femoral neck)	0.472	0.245- -0.906	0.024

BMD, bone mineral density; BMI, body mass index; RA, rheumatoid arthritis; 95% CI, 95% confidence interval; DAS28, disease activity score in 28 joints

Figures

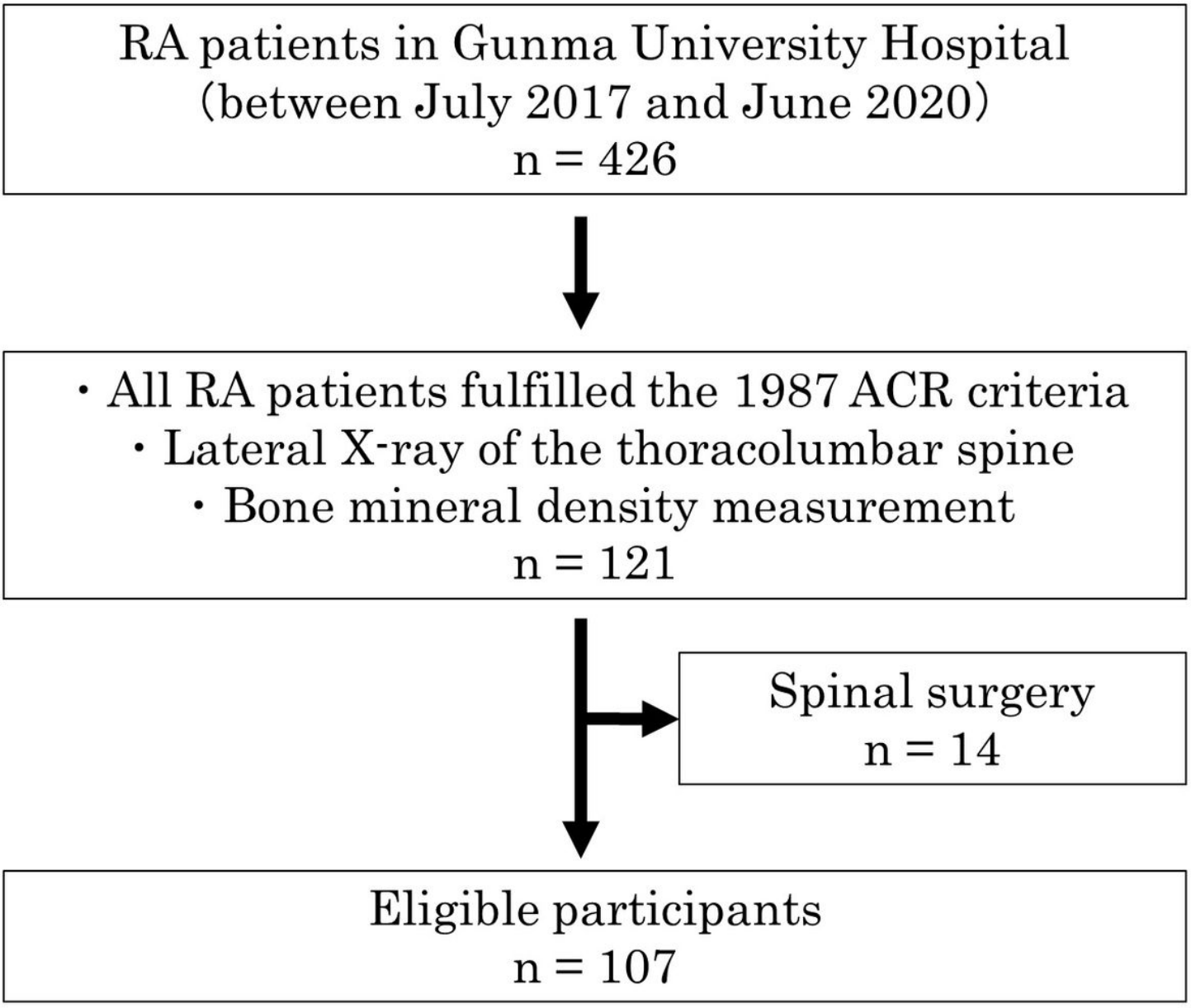

Figure 1

Flow diagram of the present study. ACR, American Rheumatism Association; RA, rheumatoid arthritis.

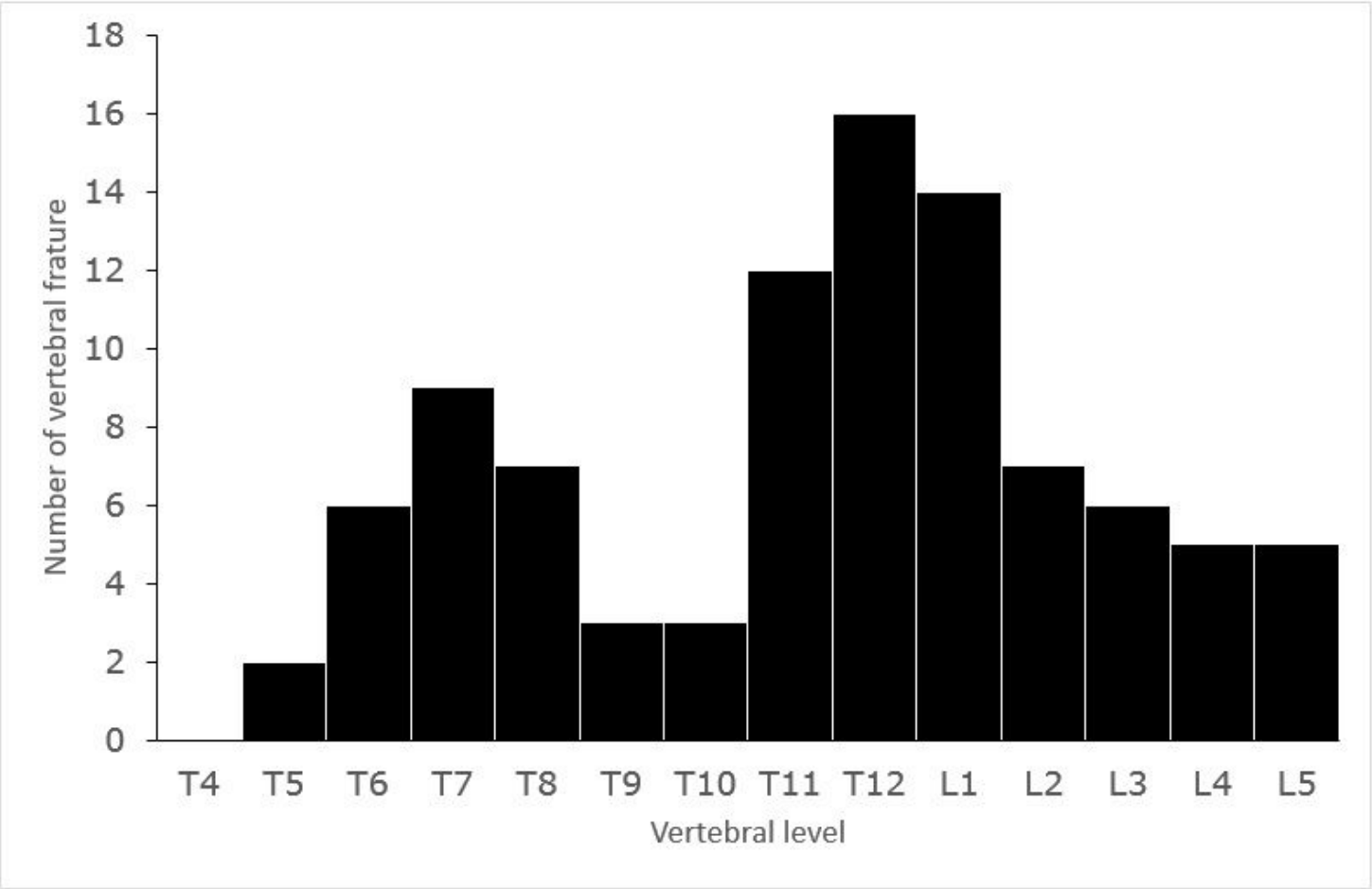

Figure 2

Number of vertebral fractures in patients with RA.

Figure.3A

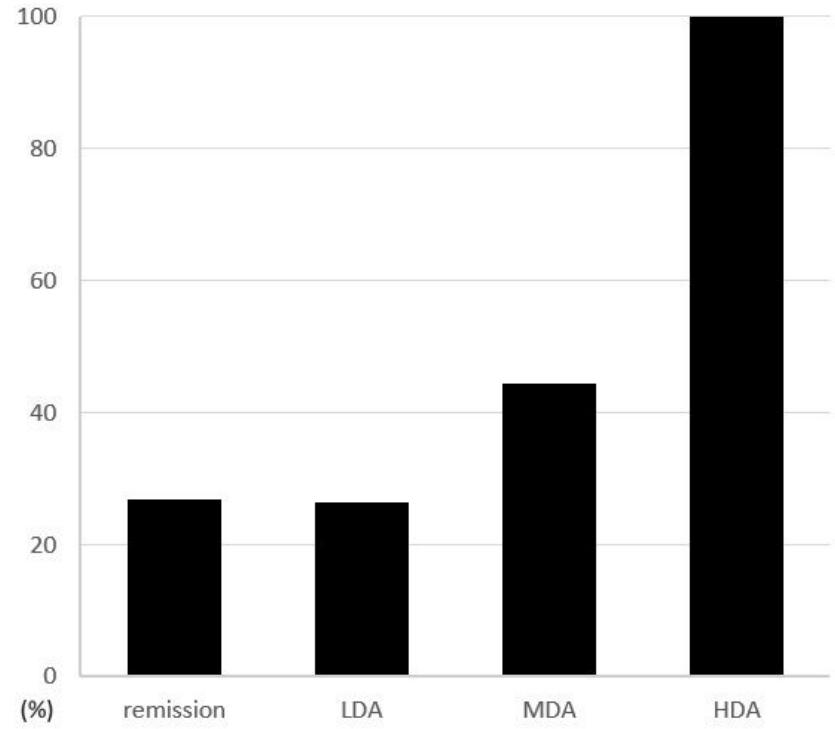

Figure.3B

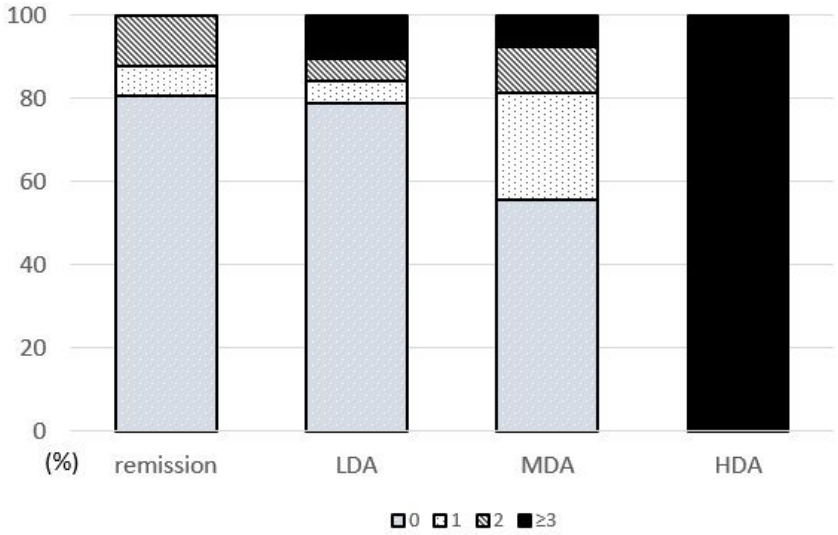

Figure 3

3A Prevalence of vertebral fractures according to DAS28. LDA, low disease activity; MDA, moderate disease activity; HAD, high disease activity. 3B Number of vertebral fractures in participants according to DAS28.