

ORIGINAL RESEARCH

Medicine Science 2019;8(2):385-9

Rheumatoid arthritis and ankylosing spondylitis with cervical involvement and characteristics**¹Nevsun Pihitli Tas¹, Rabia Aydogan Baykara², Ayhan Kamanli³**¹Elazig Education and Research Hospital, Department of Physical Medicine and Rehabilitation, Turkey²Malatya State Hospital, Department of Physical Medicine and Rehabilitation, Malatya, Turkey³Sakarya University Training and Research Hospital, Division of Rheumatology, Department of Physical Medicine and Rehabilitation, Sakarya, Turkey

Received 01 October 2018; Accepted 19 December 2018

Available online 30.01.2019 with doi:10.5455/medscience.2018.07.8961

Copyright © 2019 by authors and Medicine Science Publishing Inc.

Abstract

Rheumatoid Arthritis and Ankylosing Spondylitis are systemic, inflammatory and chronic diseases. Cervical vertebra involvement is common and may cause disability in patients. The aim of this study; to determine the clinical and radiological features of cervical vertebrae involvement in patients with Rheumatoid Arthritis and Ankylosing Spondylitis and to assess the disability and quality of life of patients with different measurement methods. Forty-two patients with Ankylosing Spondylitis (AS) were diagnosed according to Modified New York criteria and 54 Rheumatoid Arthritis (RA) patients meeting the American College of Rheumatology (ACR) criteria were included. Cervical vertebra joint range of motion and neurological examination of all patients were evaluated. Open odontoid radiographs, lateral cervical graphs in the flexion and extension positions and MRI images were taken. Values such as erythrocyte sedimentation rate (ESR), C-reactive protein (CRP), and Rheumatoid factor (RF) were determined in all patients. Disease activity was assessed in patients with RA using DAS 28 and BASDAI (Bath Ankylosing Spondylitis Disease Activity Index) in AS patients. In the evaluation of quality of life and disability for RA patients, the health assessment questionnaire (HAQ), the Rheumatoid Arthritis Quality of Life Scale (RAQOL), Short Form 36 (SF36), AS patients were interviewed for the Quality of Life Scale-SPA (SPA-QOL), Ankylosing Spondylitis Life Quality Scale (ASQOL), Short Form 36. 48 of the RA patients were female and 8 were male. The average age was 50.7 years Six patients with RA and AS had AAS identified by radiography. Pannus was detected on MRI of 5 patients with RA and 7 patients with AS. 80% of our patients with RA and 71% of our patients with AS who detected pannus formation by MRI were AA joint range was below 3 mm. There was no significant relationship between disease activity criteria and AAS. There was a significant relationship between AAS and age in RA patients ($p < 0.05$). Patients with RA had a worse quality of life. Cervical vertebral involvement can lead to deterioration of the quality of life of patients. For this reason, cervical spine involvement should be specifically investigated following the disease. Plain radiographs can provide reliable and practical measurements in determining cervical involvement MRI can be consulted if needed. Assessment of atlantoaxial joint integrity in patients with minimal cervical symptoms. Early diagnosis and treatment of cervical spine disorders is important.

Keywords: Rheumatoid arthritis, ankylosing spondylitis, cervical vertebrae, cervical MRI, quality of life**Introduction**

Rheumatoid arthritis (RA) is a symmetric, systemic, chronic, and inflammatory disease that shows the primer effect in synovium. The disease can affect all synovial joints, especially affecting the hands, wrists, and feet. [1] The disease can eventually cause pannus formation in the synovium, leading the destruction of cartilage, bone and other adjacent tissues, and eventually joint deformations. [2]

Cervical vertebra lesions in RA patients are reported between 25% and 86%. [3-5] The cause is usually seen as a synovial pannus, which is a characteristic lesion of RA. [6] Collagenase and other proteolytic enzymes secreted from pannus tissue cause destructive synovitis, ligamentous laxity, and bone erosions. This can lead to instability and subluxation. [6] The most common cervical involvement is the Atlanto-Axial Subluxation (AAS). [7]

Anterior subluxation has been reported in 70% of patients with AAS cases, 20% to lateral, 7% to posterior and Rotational subluxation very rarely. Anterior Atlanto-Dental Interval (AADI) is the most common form of cervical involvement (50-70%). [8] The second most common type of cervical involvement is the

*Corresponding Author: Nevsun Pihitli Tas, Elazig Education and Research Hospital, Department of Physical Medicine and Rehabilitation, Turkey
E-mail: nevsunpihitli@gmail.com

superior migration of odontoids. Neurological damage or even death may occur due to direct compression of the brain stem.[9] Subaxial subluxation is seen in 15%. Spinal cord compression, which is less common than AAS, is more severe.[10] Combined anomalies are also very common. [10]

Ankylosing spondylitis (AS) of the axial skeleton is mainly known for certain pathologies (sacroiliac joints and spinal joints) from the spondyloarthropathy group seronegative characterized by a chronic rheumatic disease involvement. In about 75% of AS patients chronic back pain and stiffness are the first symptoms.[11] However, sacroiliac joint involvement in this disease and is not limited to dorsal lumbar vertebral joints but include the cervical spine.

Cervical vertebra involvement usually manifests itself with neck painful detention. Complications of cervical involvement in stubborn neck pain; fractures, subluxation, and discitis should be considered. Early diagnosis and treatment are important because unimportant trauma in AAS cases can lead to serious neurological findings or even death. [12] In addition, AAS and dislocations should be excluded in cases with AS, because in cases with general anesthesia, neck manipulation may be required during intubation and positioning of the patient. [13] For this reason, cervical vertebrae should be routinely evaluated in the follow-up of RA and AS patients.

Plain graphs are very useful for determining the dislocation. The maximal flexion of the neck and the lateral graphs were taken at the extension should be evaluated. The most commonly used radiological measurements to assess the severity of dislocation are; Anterior Atlanto-Dental Interval (AADI), Posterior Atlanto-Dental Interval (PADI), McGregor Line, Ranawat Index and Redlund - Johnell Line. [10] Generally, RA and AS patients are followed by AADI and it is help to decide for surgery. [10]

Magnetic Resonance Imaging (MRI) provides the early detection of pannus formation and changes in synovial tissues with high-resolution power on soft tissues. [14] Bone marrow edema is a marker of subsequent erosive injury. [15]

Studies suggest that contrast MRI is the gold standard. STIR or T2 fat-printed images have been shown to have high sensitivities in evaluating bone marrow edema and bone erosions. [16]

In this study, we aimed to determine the clinical and radiological features of cervical vertebrae in RA and AS patients and to evaluate the disability and quality of life of patients with different measurement methods.

Materials and Methods

This study protocol was made in line with the approval of the local ethics committee of the Faculty of Medicine of Firat University in 2008 / 05.

This study included 54 RA and 42 AS patients enrolled or newly diagnosed in the polyclinic of Rheumatology Department. A detailed physical examination of patients, neurological findings, socio-demographic characteristics, duration of illness, drugs used and morning prisoner were evaluated.

Rheumatoid Arthritis Quality of Life Scale (RAQoL), the Health Assessment Questionnaire (HAQ), Short Form 36 (SF 36), Nottingham Health Profile (NHP) and Disease Activity Score 28 (DAS 28 score) were used for the functional evaluation of patients with RA. BASFI (Bath Ankylosing Spondylitis Functional Index), Ankylosing Spondylitis Life Quality Scale (ASQoL), Bath Ankylosing Spondylitis disease activity index (BASDAI), HAQ-S, NHP were used in the functional evaluations for AS patients.

All patients participating in the study had antero-posterior mouth open and lateral cervical radiographs in flexion and extension (Shimadzu brand radspeed 200 models, Tokyo, Japan) and cervical MRIs were taken. (1.5 Tesla, Signa Excite, GE Healthcare, Milwaukee, USA) the shooting was done in the axial sagittal T1 and T2 image (TR / TE, 660/16, 4800/102 and 700/10, 3340/105, respectively).

Radiological measurements of AADI, PADI, McGregor line, Ranawat index, and Redlund - Johnell line were measured with a caliper sensitive to 0.02 mm to assess the severity of dislocation.

Patients receiving cervical MRI images were recorded with atlanto- axial subluxation, destruction, and erosion in the dens, an enlargement at the distance of the atlantoaxial joint, and synovial hypertrophy with or without contrast material in the odontoid process.

Statistical methods

Data are mean $\pm$ SD, median (range), what (%) was given as. All statistical analysis SPSS (SPSS version 18, Chicago, IL, USA) was performed. Data was evaluated using the Kolmogorov-Smirnov test disperses homogenously. The nonhomogeneous distribution shows ESR, CRP, and RF parameters such as duration of illness were assessed with the Mann-Whitney U test. Indicating homogeneous distribution data were analyzed by Student t-test. Categorically Chi-square test was used to compare the data. Pearson correlation test was used for correlation analysis. A P value of <0.05 was considered significant.

Results

Eight of RA patients (14.8%) were male, 46 (85.2%) were female, their ages were 50.7 ± 10.9 (26 - 75), of the 42 AS patients, 31 (73.8%) were male and 11 (26.2%) female, their ages were 36.3 ± 8.11 (18-60) years.

In patients with RA and AS, height, weight, BMI, and the duration of morning arrest were similar (Table1).

Table 1. Demographic characteristics of patients (mean $\pm$ SD)

	RA N=54	AS N=42
Age	50.7 $\pm$ 10.9	36.3 $\pm$ 8.1
Size (m)	163.8 $\pm$ 7.9	169.2 $\pm$ 10.3
weight(kg)	71.6 $\pm$ 14.04	67.7 $\pm$ 13.6
BMI(kg/m2)	26.5 $\pm$ 4.4	23.6 $\pm$ 4.17
Duration of illness (Year)	9.3 $\pm$ 7.3	6.9 $\pm$ 5.06
Morning stiffness(mn)	60.09 $\pm$ 108.8	8 0.8 $\pm$ 107
BMI: Body mass indeks		

DAS28, RAQOL and HAQ scores in patients with rheumatoid arthritis are given in Table 2.

Table 2. DAS28. RAQ oL. HAQ scores in RA patients (mean±SD)

	RA N=54
DAS 28	3.780±1.56
HAQ	0.900±0.78
RAQ OL	14.98±9.35

DAS28; Disease Activity Score. HAQ. Health Assessment Questionnaire.
RAQ OL: Rheumatoid Arthritis Quality of Life Scale

In patients with Ankylosing spondylitis, the BASDAI score was 4.06 ± 2.97 (0-9.46), BASFI score was 3.63 ± 3.40 (0-9.6), ASQOL was 8.61 ± 7.02 (0-19), HAQ-S stiffness score last week was 45.8 ± 33.2 (0-100) and HAQ-S total score was measured as 0.98 ± 0.86 (0-3).

When the values obtained from measurements of cervical graphs of patients with RA and AS were compared, it was seen that the measurements were similar in RA and AS patients (Table3).

Table 3. Measurements in RA and AS patients(mean±SD)

	RA	AS
AADI flex (mean±SD)	1.52±1.17	1.36±0.97
PADI (mean±SD)	28.8±3.98	30.9±5.13
Ranavat Index(mean±SD)	16.9±3.5	17.9±3.94
Redlund-Johnell Line(mean±SD)	30.2±4.41	31.04±5.74

AADI flex: on flexion graphs Anterior Atlantodental Interval. AADI ext: on extension graphs Anterior Atlantodental Interval padi: posterior atlantodental interval

AADI was measured 3 mm and over in 6 patients with Rheumatoid arthritis and AS

The results of the McGregor line used for evaluating superior migration of odontoids and C1 - C2 measurements on the anterior-posterior radiographs for assessment the lateral subluxation are shown in table 4.

Table 4. Mc Gregor and C1-C2 measurements in RA and AS patients (mean±SD)

	RA	AS
Mcgregor line dens of 1-4 mm past >4.5 mm past	17±31.5	11±26.2
Mcgregor line dens of >4.5 mm past	6±11.1	7±16.7
C1-C2 right >2mm	2±3.7	1±2.4
C1-C2 left >2mm	5±9.3	3±7.1
C1-C2 >2mm bilateral	9±16.7	4±9.5

Cervical MRI images of 32 RA and 27 AS patients were obtained. In 6 patients with Rheumatoid Arthritis, in the dens erosion was detected on MRI. 12 patients had apex destruction, 5 patients had contrast-enhanced synovial hypertrophy.(Table5)

As a result of interrogation with SF - 36 which is a general quality of life criterion; physical function, vitality, and mental health; It was determined that AS patients were higher than in patients with RA and the difference was statistically significant ($p < 0.05$) (Table 6).

As a result of questioning with the Nottingham Health Profile (NHP), there was a significant difference between the groups in the scores of physical activation and social isolation titles of patients with RA and AS. ($p < 0.05$) Scores were found to be higher in patients with RA (Table 7).

Table 5. Some MRI findings of RA and AS patients (n (%))

	RA	AS
The presence of osteophyte formation	24 (75)	20 (64.1)
Degenerative disc disease	13 (40.6)	5 (18.5)
Intervertebral disc herniation	18 (55.2)	16 (59.3)
Spinal stenosis	11 (34.4)	6 (22.2)
Erosion in Dens	6 (18.8)	4 (14.8)
Apex destruction	12 (37.5)	9 (33.3)
Contrast holding synovial hypertrophy	5 (15.6)	7 (25.9)
Contrast keep synovial hypertrophy	9 (28.1)	2 (7.4)
Expansion of the AA joint space	4 (12.5)	3 (11.1)
AA joint space narrowing	2 (6.2)	0 (0)
Cervical axis angulation	1 (3.1)	1 (3.7)

Table 6. SF-36 scores of RA and AS patients (mean±SD)

	RA	AS	P
SFF	37.62±30.62	58.21±26.61	0.001
SF	39.44±65.85	30.3333±43.31	0.440
SVA	48.92±25.54	41.30±23.75	0.139
SGS	44.31±23.58	47.69±23.4	0.487
SV	35.37±17.23	45.45±23.23	0.017
SSF	57.45±24.13	57.78±27.25	0.950
SER	49.37±66.26	38.72±43.40	0.369
SMS	41.98±16.82	54.19±27.88	0.009

Sd: Standard deviation SGS; SF-36 general health SFF; SF-36 physical function SFR; SF-36 physical role restriction SER; SF-36 emotional role restriction SVA; SF-36 body pain SSF; SF-36 social function SMS; SF-36 mental health SV; SF-36 vitality

Table 7. NHP scores of RA and AS patients (mean±SD)

	RA	AS	P
NER	32.79±33.27	29.84±33.92	0.700
NSI	39.08±39.19	14.52 ±29.03	0.001
NU	41.2959±34.78	32.54±32.48	0.234
NY	63.31±43.08	50.3±42.7	0.245
NFA	42.46±29.10	33.88±31.74	0.210
NA	44.29±33.22	48.93±37.37	0.427

NA; Nottingham health profile pain NFA; Nottingham health profile physical activity NY; Nottingham health profile fatigue NU; Nottingham health profile SLEEP NSI; Nottingham health profile social isolation NER: Nottingham health profile emotional reactions

Discussion

In this study we aimed to investigate cervical region with conventional graphs and MR images in patients with RA and AS who applied to our clinic, to evaluate the effects on the functioning and quality of life of patients determined by different pathologies with different scales.

54 RA and 42 AS patients were included in our study. Measurements were used to determine the severity of cervical involvement and the patients were evaluated for their quality of life.

Radiological evaluation was the first and most important step leading us to assess patients AA subluxations. The lateral graphs taken from our patients were evaluated in flexion and extension.

The most commonly used AADI for evaluating AA subluxation was 11.2 % in our patient with RA over than 3 mm. Values were between 3 and 5 mm. They suggested that transverse ligament injury and instability were subluxations in these patients.

PADI is directly related to the risk of neurological damage. PADI, which is more valuable than AAS evaluation, was evaluated as 16.5 mm in one patient.

According to the literature, cervical vertebra lesions in RA patients are between 25% and 86%. Cervical subluxation has been reported in 43% to 86% of RA patients. [5,18]

We evaluated the AAS ratio in patients with AS as 14.8 %. Values between 3 and 5 mm suggest that the subluxation is due to transverse ligament injury and instability.

In a study conducted by Ramos et al. the AAS frequency seen in AS was reported to be 21%. [19]

Lateral subluxation occurs because of damage to the joint capsule and bone erosion and anterior-posterior open mouth is best assessed by X-ray light. Chellapandi et al. [20] RA patients show cervical involvement had the rate of 1.3 % lateral subluxation, Agarwal et al. [21] reported in 2%. In our study, the rate of lateral subluxation which diagnosed by having a joint space greater than 2 mm in the anteroposterior radiographs was found to be 16.7 %. This rate may be related to the fact that our patients have a longer disease duration.

Vertical subluxation is rarely seen in AS in various studies. [19] In our study, the vertical subluxation rate AS patients was 4.8 %. As a result of odontoid compression in the vertical AAS, 9th, 10th, and 12th cranial nerves can be affected and dysphagia and vocalization can occur.

In our study, 14.8 % of patients with RA had a voice depression, and 5.3 % of patients had dysphagia with vertical subluxation and the relation with subluxation was not significant ($p > 0.05$). This suggested to us that the complaints may be due to the different involvement of the RA, such as the cricoarytenoid joint.

Pannus tissue, soft tissue, nerve tissue and bone that can not be detected on conventional radiographs can be evaluated by MRI which can show more clearly. [22] Einig et al. [23] RA with cervical involvement in their studies of 60 patients are a good amount of assessment and a high rate of MRI results with clinical signs of the disease, they reported that correlated.

In our study, we were able to obtain MRI images of 32 RA and 27 AS patients. Limitations of this study were patient's postural disturbances, claustrophobia, prosthetic presence, and patients' refusal to take MRI were the reasons that restricted MRI imaging.

80 % of our patients with RA who detected pannus formation by MRI and 71.5 % of our AS patients had an AA joint area of less than 3 mm. This result suggests that we should determine the risk of subluxation of the MRI before detection by radiography and we should be more careful in following the patient. The inflammation in the ligament causing the subluxation as well as the erosions in AS and RA are also increasing the severity of cervical involvement.

Odontoid erosion or fracture of the posterior subluxation is rare but it is difficult to assess with direct radiography. [17] Erosion was detected with MRI at 14.8 % of AS patients and 18.8 % of patients with RA who received MRI images. In MRI, the relationship between dense erosion presence and AADI measurements was significant. ($p < 0.05$) This suggests that clinical and MRI compatible results can be obtained in the absence of statistical significance in the detection of AAS with conventional radiographs.

Indexes for measuring functional status and quality of life following various diseases have been widely used in recent years.

We assessed the effects of cervical involvement on quality of life and functioning in our patient groups evaluated by radiography and MRI images with various quality of life criteria.

Neve et al. [24] in RA patients were detected in patients with AAS rate of 38.3 % and reported that the subluxation was worse than the HAQ score. Talamo et al. [25] identified radiographic erosions in patients with RA, SF-36, and worse HAQ score.

HAQ scores were higher in patients with RA than patients with AS who had AAS and AA joint space increased. SF 36 physical function, physical role weakness, general health subscale deteriorated ($p < 0.005$) another RA-specific scale.

We found that RAQOL worsening, another specific scale that we used to evaluate functioning in RA, also increased subluxation ($r = 325$. $p > 0.05$).

There was no significant deterioration in the quality of life of patients with RA or AS who had pannus formation on MRI.

There was a significant deterioration in the quality of life of RA patients with cervical involvement. It should also be noted that the long duration of illness and high disease activity, which are risk factors for cervical involvement, contribute to this situation.

BASDAI, HAQ - S changes we evaluated for general outcomes of AS patients and changes in the BASFI scores we evaluated for functioning. No significant effect on the risk of subluxation was found. ($p > 0.05$). This can be attributed to the fact that the overall condition of our cases is good.

Conclusion

In conclusion, RA and AS are the most frequent rheumatic diseases affecting the cervical spine. The development of AAS in RA and AS can cause significant morbidity and mortality. Early diagnosis and regular treatment can prevent the development of AAS. At the same time, cervical involvement causes disability and loss of function in patients, which adversely affects the quality of life. Therefore, evaluation of atlantoaxial joint integrity in patients, cervical spine disorders early diagnosis and treatment is important, although cervical symptoms are minimal. Plain radiographs are also a quick, practical and economical method to follow with practical measurements.

Competing interests

The authors declare that they have no competing interest.

Financial Disclosure

All authors declare no financial support.

Ethical approval

This study protocol was made in line with the approval of the local ethics committee of the Faculty of Medicine of Firat University in 2008 / 05.

Nevsun Pihitli Tas ORCID: 0000-0003-0202-6426

Rabia Aydoğan Baykara ORCID: 0000-0003-0542-266X

Ayhan Kamanlı ORCID: 0000-0001-5299-7250

References

- O'Dell JR. Rheumatoid arthritis: The clinical picture JAMA. 2001;50-648.
- Ergin S. Romatoid artrit ve Sjögren Sendromu. In: Beyazova M, Gökçe-Kutsal Y editörler. Fiziksel Tıp ve Rehabilitasyon 3. Baskı, Ankara: Güneş Kitapevi; 2000;1549-76.
- Kim HJ, Nemani VM, Riew KD et al. Cervical spine disease in rheumatoid arthritis: incidence, manifestations, and therapy. Curr Rheumatol Rep. 2015;17:9.
- Mukerji N, Todd NV. Cervical myelopathy in rheumatoid arthritis. Neurol Res Int. 2011;153-628.
- Nguyen HV, Ludwig SC, Silber J, et al. Rheumatoid arthritis of the cervical spine. Spine J. 2004;4:329-34.
- Zhang T, Pope J. Cervical spine involvement in rheumatoid arthritis over time: results from a meta-analysis. Arthritis Res Ther. 2015;17:148.
- Gillick JL, Wainwright J, Das K. Rheumatoid arthritis and the cervical spine: a review on the role of surgery. Int J Rheumatol. 2015;252-456.
- Boden SD, Dodge LD, Bohlman HH, et al. Rheumatoid arthritis of the cervical spine. JBJS. 1998;9:693-703.
- Pamela L, Laasonen L, Kankaanpää E, et al. Progression of cervical spine changes in patients with early rheumatoid arthritis. J Rheumatol. 1997;24:1280-4.
- Reiter MF, Boden SD. Inflammatory disorders of the cervical spine. Spine. 1998;23:2755-66.
- Haroon N. Ankylosis in ankylosing spondylitis: current concepts. Clin Rheumatol. 2015;34:1003-7.
- Khan MA, Hochberg MC, Silman AJ, et al. Clinical features of ankylosing spondylitis. Rheumatology. Mosby, Philadelphia. 2003;1161-81.
- Slobodin G, Shpigelman A, Dawood H et al. Craniocervical junction involvement in ankylosing spondylitis. Eur Spine J. 2015;24: 2986-90.
- Stiskal MA, Neuhold A, Szolar DH et al. Rheumatoid arthritis of the craniocervical region by MR imaging: detection and characterization. Am J Roentgenol. 1995;165:585-92.
- Collins DN, Barnes CL, Fitzrandolph RL. Cervical spine instability in rheumatoid patients having total hip or knee arthroplasty. Clin Orthop. 1991;272:127-35.
- Jacobsen EA, Riise T. MRI of the cervical spine with flexion and extension used in patients with rheumatoid arthritis. Scand J Rheumatol. 2000;29:249-54.
- Narvaez JA, Narvaez J, Serrallonga M et al. Cervical spine involvement in rheumatoid arthritis: correlation between neurological manifestations and magnetic resonance imaging findings. Rheumatology. 2008;47:1814-9
- Del Grande M, Del Grande F, Carrino J et al. Cervical spine involvement early in the course of rheumatoid arthritis. Semin Arthritis Rheum 2014;43:738-44.
- Ramos-Remus C, Gomez- Vargas A, Guzman-Guzman JL, et al. Frequency of atlantoaxial subluxation and neurologic involvement in patients with ankylosing spondylitis. J Rheumatol. 1995;22:2120-5.
- Chellapandian D, Rajendran Panchapekesa C, Rajan Rukmangatha S. The cervical spine involvement in rheumatoid arthritis and its correlation with disease severity. Indian Rheumatol Assoc. 2004;12:2-5.
- Aggarwal A, Kulshrestha A, Chaturvedi V et al. Cervical spine involvement in rheumatoid arthritis: Prevalence and relationship with overall disease severity. J Assoc Phys India. 1996;44:468-71.
- Kramer J, Jolesz F, Kleefield J. Rheumatoid arthritis of the cervical spine. Rheum Dis Clin North Am. 1991;3:757-71.
- Einig M, Higer HP, Meairs S et al. Magnetic resonance imaging of the craniocervical junction in rheumatoid arthritis: value, limitations, indications. Skeletal Radiol. 1990;19:341-6.
- Neva MH, Hakkinen A, Makinen H et al. High prevalence of asymptomatic cervical spine subluxation in patients with rheumatoid arthritis waiting for orthopedic surgery. Ann Rheum Dis. 2006;65:884-8.
- Talamo J, Frater A, Gallivan S et al. Use of the short form for health status measurement in rheumatoid arthritis. Brit J Rheumatol. 1997;36:463-9.