The Relationship between Radial Bone Properties and Disease Activity and Physical Function in Individuals with Rheumatoid Arthritis

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ABSTRACT

Purpose: People with rheumatoid arthritis (RA) are at increased risk for osteoporosis. This study explored the relationships between compartment-specific (cortical and trabecular) bone properties in the distal radius, a common site for osteoporotic fracture, and RA-related pain, upper-limb disease activity, and hand function in adults diagnosed within the previous 8 years. **Methods:** Cortical and trabecular bone properties (mass, density, and apparent trabecular structure) were assessed at the 4% site of the radius in 21 adults with RA using peripheral quantitative computed tomography (pQCT). Clinical measures included upper-limb active joint count; self-reported pain (AIMS-2 Arthritis Pain scale) and physical function (AIMS-2 Hand and Finger Function scale); and grip strength (modified sphygmomanometer). Associations were characterized using correlations (Pearson correlation coefficients or Spearman's rho). **Results:** Cortical and trabecular bone mass and trabecular bone density were negatively associated with the number of active joints ($r = -0.47$, -0.54 , and -0.47 , respectively). Cortical bone density and mass were associated with grip strength ($r = 0.61$ and 0.51 , respectively). Cortical and trabecular bone density and cortical bone mass were negatively associated with scores on the Hand and Finger Function scale ($r = -0.49$, -0.45 and -0.56 , respectively). **Conclusions:** Although the patterns differed slightly for cortical and trabecular bone, better bone health in both compartments was associated with fewer active joints and lower self-reported hand disability in adults with RA.

Key Words: bone and bones; hand strength; inflammation; arthritis, rheumatoid; wrist; tomography scanners, X-ray computed.

RÉSUMÉ

Objectif : Les personnes qui sont atteintes de polyarthrite rhumatoïde (PR) courent un plus grand risque de souffrir aussi d'ostéoporose. Cette étude se penche sur la relation entre les propriétés des compartiments osseux (cortical et trabéculaire) du radius inférieur, qui est un site fréquent de fracture attribuable à l'ostéoporose, à la douleur associée à la PR, à l'activité de la maladie sur les membres supérieurs et à la fonction des mains chez les adultes diagnostiqués au cours des derniers huit ans. **Méthode :** Les propriétés des os corticaux et trabéculaires (masse, densité et structure trabéculaire apparente) ont été évaluées à l'emplacement situé à 4% du radius chez 21 adultes avec PR, à l'aide d'une tomographie quantitative par ordinateur (pQCT). Les mesures cliniques recueillies sont le décompte de l'activité de l'articulation du membre actif, la douleur déclarée par le sujet (échelle AIMS-2 de douleur provoquée par l'arthrite), la fonction physique (échelle AIMS-2 de fonction des mains et des doigts); et la force de préhension (avec sphygmomanomètre modifié). Des associations ont été caractérisées à l'aide de corrélations (coefficient de corrélation de Pearson ou de Spearman). **Résultats :** La masse osseuse corticale et trabéculaire et la densité de l'os trabéculaire ont été associées négativement au nombre d'articulations actives ($r = -0,47$, $-0,54$ et $-0,47$, respectivement). La densité et la masse de l'os cortical ont été associées à la force de préhension de la main et des doigts ($r = 0,61$ et $0,51$, respectivement). Les densités osseuses corticale et trabéculaire ont été associées négativement au pointage obtenu sur l'échelle de fonction des mains et des doigts ($r = -0,49$, $-0,45$ et $-0,56$, respectivement). **Conclusions :** Bien que les modèles diffèrent légèrement pour l'os cortical et l'os trabéculaire, une meilleure santé osseuse des deux compartiments a pu être associée avec moins d'articulations actives et avec une moins grande incapacité des mains signalée par les adultes avec PR.

Rheumatoid arthritis (RA), which affects 1% of the Canadian population, is a chronic and painful systemic inflammatory disease that, in the absence of effective treatment, leads to progressive synovial joint damage, disability, deterioration in quality of life, and shortened

life expectancy.¹ The RA inflammatory process, disease sequelae, and medical management introduce a variety of factors that elevate the risk of osteoporosis.²⁻⁴ In a cohort of 47,034 American men and women diagnosed with RA, fracture incidence rates at the wrist, humerus,

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pelvis, and hip were 1.5 times those of 235,170 age and sex-matched adults with no RA diagnosis, regardless of age, sex, or anatomic site.⁵ In addition to elevating the risk of fracture, poor bone health in people with RA results in additional difficulty with hardware fixation in cases where fractures and/or damaged joints require surgical management.^{6,7} Thus, monitoring and preserving bone health in individuals with RA deserves more clinical attention.

Bone loss is measured to quantify changes that predict fracture risk.⁸ Major determinants of bone loss in people with RA are disease activity, age, sex (with women—particularly following menopause—at higher risk), reduced mobility, medication, and disease duration.^{4,9,10} A study of 74 postmenopausal women with RA found that elevated pro-inflammatory markers (C reactive protein [CRP], erythrocyte sedimentation rate, and interleukin [IL]-6) were associated with an increase in bone loss.¹¹ A population-based study demonstrated an association between elevated pro-inflammatory markers (IL-2, IL-6, CRP, and tumour necrosis factor- α) and osteoporotic fracture.¹² The influence of the inflammatory process on bone may explain why longitudinal studies have reported rapid bone loss within the first year of disease onset, when the influences of age, reduced mobility, and the duration of both disease and medication use are less pronounced.^{4,9,10} The ends of the long bones, which are in close proximity to the inflamed synovial joints in the limbs of individuals with active RA, have a progressively thinning shell of cortical bone reinforced by a porous network of trabecular bone.¹³ The greater porosity of the trabecular network results in a larger surface area for bone remodelling in response to circulating triggers.¹³ Bone loss associated with RA could potentially be observed earlier in trabecular bone than in cortical bone.

Exercise designed to increase mechanical loading of bones through weight bearing and muscle activity appears to have site-specific effects on the skeleton, more evident in cortical bone than in trabecular bone compartments in people with low-activity RA.^{14,15} For example, long-term high-intensity exercise and dynamic strength training have been shown to slow systemic bone loss (measured as areal bone mineral density [aBMD], i.e., grams of bone mineral per cm²) at the hip, composed of 75% cortical bone at the femoral neck, but not at the spine, composed of > 66% trabecular bone.^{16–18} One dynamic exercise trial showed delayed bone loss in the weight-bearing joints of the feet, but not in the non-weight-bearing joints of the hands and wrists.¹⁹ In a systematic review evaluating the effect of dynamic exercise in adults with RA, only 6 of the 17 included trials reported bone outcomes, and all six were conducted by the same two research groups.¹⁵ While the effect of dynamic exercise on bone in individuals with RA remains unclear,¹⁵ the observations to date appear consistent with the site-specific preferential effect on cortical bone re-

ported for postmenopausal women exposed to exercise or higher physical activity levels.²⁰

The methods used to measure bone affect our ability to understand the mechanisms for the progression or slowing of bone loss in RA. Clinically, bone loss associated with RA is estimated by scoring the extent of peri-articular bone erosions on conventional X-ray;^{4,21} however, only advanced bone erosions can be detected using this method. Researchers have used digital X-ray radiogrammetry (DXR) to assess aBMD in the hands of individuals with early RA, and these measures have been compared to conventional X-rays of the hand taken 5 and 10 years later.²² Progression of bone erosions detectable on conventional X-rays at 5 and 10 years was significantly greater in individuals with aBMD loss in the hand at 1 year.²² Concurrently, Güler-Yüksel and colleagues have used DXR to assess aBMD of the hand, observing the same temporal relationship between hand aBMD loss and the progression of bone erosions.²³ These researchers have also assessed aBMD of the spine and hip and have found that bone loss in the hand both preceded and exceeded that in the spine and hip.²³ Two-dimensional imaging methods available clinically, such as DXR, provide estimates of total bone density (aBMD) based on the area and mass of mineral in the region of interest.¹³ However, one study validated a novel DXR-based method of assessing cortical and trabecular compartments of the metacarpal bones separately, using peripheral quantitative computed tomography (pQCT) measures of volumetric bone mineral density (vBMD, mg/cm³) at the distal radius.²⁴

The quantity of bone mineral (in mass and volumetric density) and its spatial distribution in the cortical and trabecular compartments of the peripheral skeleton can be analyzed using pQCT.¹³ Distal radius bone properties estimated using pQCT, including trabecular vBMD and the average size of marrow pores in the trabecular network, are associated with osteoporosis and fracture in postmenopausal women.^{25,26} Given that the wrist joint is a common site for osteoporotic fracture and joint replacement in individuals with RA,^{5,6} and that bone loss in the hands precedes that at other skeletal sites,²³ assessing the distal radius using pQCT may provide important insight into RA's compartment-specific effects on cortical and trabecular bone health. We therefore conducted a case series to collect preliminary data on the relationship between cortical and trabecular bone properties measured at the distal radius using pQCT, and pain and upper-limb joint activity and physical function in individuals diagnosed with RA involving the wrist within the previous 8 years. We hypothesized that at the 4% site of the radius in people with RA trabecular bone properties are associated with disease activity (pain, upper-limb active joint count), and that cortical bone properties and total bone strength are associated with upper-limb physical function.

Figure 1 The commercial software (Stratec XCT 5.21) output for bone density at the 4% site of the distal radius imaged using peripheral quantitative computed tomography.

METHODS

Our cross-sectional, non-experimental case-series study was approved by our institution's Research Ethics Board. One physiotherapist (NJM) completed the clinical assessments, and acquired and analyzed the pQCT images for all participants.

Participants

Adults diagnosed with RA by a rheumatologist within the previous 8 years were recruited between April and September 2000 through advertisements posted in a university-based tertiary-care rheumatology clinic, and a privately owned direct-access physiotherapy clinic with a special interest in hand therapy services. Self-reported demographic data (age, height, weight, menopausal status [for women], time since RA diagnosis, history of wrist involvement, medications, stiffness, fatigue) were collected. A 10 cm visual analogue scale (VAS) was used to quantify joint stiffness and fatigue related to RA in the past week (0 = joint stiffness / fatigue is no problem; 10 = joint stiffness / fatigue is a major problem). Body mass index (BMI) was calculated as the ratio of weight to height squared (kg/m^2).

Clinical outcomes

Upper-limb active joint count was recorded on a body diagram and summed (maximum = 40). Participants with an active wrist joint in the forearm to be imaged were noted as having current RA involvement. Pain due to RA in the past month was assessed using the Arthritis Pain scale of the Arthritis Impact Measurement Scales—version 2 (AIMS-2; 0 = no pain, 10 = severe pain).²⁷ To assess performance-based upper-limb physical function, grip strength was measured using a modified sphyg-

momonometer (over 20 mmHg to a maximum of 300);²⁸ the average of three trials was recorded for the forearm that was imaged. To quantify self-reported upper-limb physical function in the past month, the Hand and Finger Function and Arm Function scales of the AIMS-2 (0 = best function, 10 = worst function) were completed.²⁷ These outcomes have established psychometric properties in this patient group.²⁹

Bone outcome measures

A transaxial image of the non-dominant distal radius (4% the length of the ulna) was acquired using pQCT (XCT 960, Stratec Medizintechnik, Pforzheim, Germany) for all except one participant, whose dominant distal radius was imaged because a previous fracture of the non-dominant shoulder prevented positioning of that forearm in the scanner. The voxel size of the image was $0.59 \text{ mm} \times 0.59 \text{ mm} \times 2.5 \text{ mm}$; the scan time was 5 minutes. Volumetric bone mineral density (vBMD, mg/cm^3) and bone mineral content (BMC, mg) were determined for the cortical and trabecular bone compartments, as illustrated in Figure 1, using commercial software (Stratec XCT5.21; contmode/peelmode/separation mode = 2/5/3). The bone strength index (BSI, mg^2/cm^4), which demonstrates a strong relationship with radial bone strength in compression loading,³⁰ was calculated as the product of squared total vBMD and total bone cross-sectional area. The reproducibility, expressed as the standard error of the measurement (see Figure 1), determined for duplicate images acquired in 25 individuals 7.7 (5.1) days apart for total, cortical, and trabecular vBMD, was 11.95, 29.49, and $10.48 \text{ mg}/\text{cm}^3$, respectively, for this operator.³¹

Figure 2 Original peripheral quantitative computed tomography (pQCT) image and images post-processed using custom software. (A) Original pQCT image acquired at the 4% site; (B) Image of the segmented radius; (C) Binary image of the trabecular bone compartment from which mean hole size (mm^2) is derived.]

A second transaxial image with a voxel size of $0.33 \text{ mm} \times 0.33 \text{ mm} \times 2.5 \text{ mm}$ was acquired at the same radial site using the same scanner. The time required for the second scan was 5 minutes. The same investigator analyzed these images using custom software to quantify the average hole size of the marrow pores (Ha, mm^2), representing trabecular spacing, as described previously³² and as illustrated in Figure 2. The SEM for Ha is 0.55 mm^2 .³¹

Data were analyzed using the Statistical Package for the Social Sciences (SPSS) for Windows, version 16 (SPSS Inc., Chicago, IL). Descriptive statistics for each variable were determined. Associations between the variables were explored using the Pearson correlation and Spearman's rho (for data that were not normally distributed) to identify and exclude bone variables that were very highly correlated with another ($r \geq 0.90$). The remaining associations were examined to test the hypothesis that trabecular vBMD, BMC, and Ha are associated with upper-limb active joint count and AIMS-2 Arthritis Pain scale score, whereas cortical vBMD, BMC, and BSI are associated with grip strength and scores on the AIMS-2 Hand and Finger Function and Arm Function scales. For hypothesis testing, associations were considered of interest where $r \geq 0.45$ (this is considered a large effect size),³³ statistical significance was achieved ($p < 0.05$, given our sample size), and $>20\%$ of the variance is shared by the two measures being compared.

RESULTS

Thirty-five potential participants responded to the poster advertisements. Of these, 3 declined to participate (too far to come for assessment [$n = 1$]; no reasons provided [$n = 2$]), 6 had been diagnosed more than 8 years previously, 4 did not attend the scheduled appointment, and 1 was excluded due to incomplete data collection. Written informed consent was obtained from 21 adults (6 men) before assessment during a single visit at the

Table 1 Medication Use and Comorbidities Reported by 21 Adults with Rheumatoid Arthritis

Characteristics	No.
Current Medication	
DMARDs	
Methotrexate	3
Hydroxychloroquine	1
Methotrexate + Hydroxychloroquine	9
Hydroxychloroquine + Gold	1
Hydroxychloroquine + Sulfasalazine	1
Corticosteroid	8
NSAIDs	12
Bisphosphonate	3
Hormone Replacement Therapy	3
Didrocal	2
Comorbidities	
Other rheumatic disease	5
Cardiovascular disease	6
Endocrine disease	2
Respiratory	2
Depression	1
Cancer	1

DMARD = disease modifying anti-rheumatic drugs; NSAIDs = nonsteroidal anti-inflammatory drugs.

Rheumatology Clinic. The mean (SD) age and BMI of the participants were 55.9 (12.4) years and $28.2 (6.4) \text{ kg/m}^2$, respectively. The median (inter-quartile range) for time since initial diagnosis (disease duration) was 3 (0.8–4.2) years, varying from 0.18 to 8 years. On the assessment day, 9 participants had RA involvement in the wrist that was imaged. Table 1 summarizes the current medications and comorbidities reported by participants. Mean (SD) joint stiffness and fatigue due to RA over the past week were 3.6 (3.1) and 3.1 (2.9) out of 10, respectively.

Table 2 summarizes the measures of pain, upper-limb joint count, upper-limb physical function, and pQCT-based measures of radial bone properties at the 4% site in all 21 participants with RA. The associations between bone variables are reported in Table 3. Because BSI and cortical bone BMC were highly correlated, only BSI was included in the subsequent analyses.

Age, BMI, time since diagnosis, joint stiffness, and fatigue were not associated with any radial bone properties ($r \leq -0.38$; data not shown). Joint stiffness and fatigue were correlated with arthritis pain ($r = 0.90$ and 0.48 , respectively). Joint stiffness was also correlated with Hand and Finger Function scale score ($r = 0.59$). Table 4 shows the associations between pQCT-based measures of radial bone properties at the 4% site and clinical measures of pain and upper-limb active joint count and physical

Table 2 Descriptive Data for 21 Adults with Rheumatoid Arthritis

Assessment findings	Mean (SD) or median (IQR)	Minimum, maximum
AIMS-2 Arthritis Pain scale score, /10	4.4 (3.1)	0.5, 10
Upper-limb active joint count*	4 (1.75–8.2)	0, 16
Grip strength, /20 mmHg†	166.4 (55.7)	88, 280
AIMS-2 Hand and Finger Function scale score, /10	2.1 (2.3)	0, 7.5
AIMS-2 Arm Function scale score, /10*	1 (0–3)	0, 6.5
Bone strength index, mg ² /cm ⁴	4567.8 (2170.5)	1748.0, 9207.2
Bone mineral density, mg/cm ³		
Cortical bone compartment	630.4 (174.8)	319.3, 1005.1
Trabecular bone compartment	191.1 (43.2)	117.7, 269.8
Bone mineral content, mg/mm		
Cortical bone compartment	78.0 (21.6)	42.9, 128.4
Trabecular bone compartment*	30.3 (17.2–39.3)	14.2, 77.6
Average hole size, mm ² *‡	1.4 (1.2–1.6)	0.9, 4.0

*Data not normally distributed.

† $n = 17$; a ceiling effect was observed for 4 men; grip strength exceeded the upper limit of the modified sphygmomanometer (300/20 mmHg).

‡ $n = 15$; the higher resolution image could not be analyzed for 6 participants (4 men).

AIMS-2: Arthritis Impact Measurement Scales—version 2.

Table 3 Associations between Peripheral Quantitative Computed Tomography-Based Measures of Radial Bone Properties in 21 Adults with Rheumatoid Arthritis

	Cortical vBMD	Cortical BMC	Trabecular vBMD	Trabecular BMC*	Ha*†
BSI	0.80	0.92‡	0.66	0.54	–0.40
Cortical vBMD		0.66	0.25	0.27	–0.09
Cortical BMC			0.62	0.42	–0.21
Trabecular vBMD				0.56	–0.86
Trabecular BMC*					–0.37

Note: Pearson correlation coefficients reported for all variables except where data were not normally distributed.

*Spearman rho correlation reported for non-normally distributed data.

† $n = 15$ (the higher resolution image could not be analyzed for 6 participants (4 men)).

‡ $r \geq 0.90$.

BSI = bone strength index—resistance to compression loading; vBMD = volumetric bone mineral density; BMC = bone mineral content; Ha = average hole size in trabecular network.

function. Associations between bone properties and score on the AIMS-2 Arm scale were not explored because of the lack of variance in level of arm disability reported by our participants (see Table 2). Pain due to RA in the past month was not associated with radial bone properties. As the number of active joints in the upper limb increased, BMC decreased in both bone compartments and trabecular vBMD decreased. As hand disability increased and grip strength decreased, vBMD decreased in both bone compartments and cortical BMC decreased.

DISCUSSION

In our case series of 21 adults diagnosed with RA within the previous 8 years, trabecular bone mineral density and content were inversely associated with the

number of active joints. This finding may be interpreted as supporting the hypothesis that the extent of joint inflammation is related to bone properties in the trabecular bone compartment, which is more metabolically active than the cortical bone compartment. Furthermore, cortical bone compartment properties demonstrated the anticipated associations with grip strength and self-reported hand disability. However, cortical BMC was associated with the number of active joints in the upper limb and trabecular vBMD with hand disability.

In our study we were unable to distinguish between bone loss associated with disease activity and that associated with reduced physical function of the upper limb. On average, participants reported low levels of stiffness and fatigue, and minimal to moderate disability in the

Table 4 Associations between Peripheral Quantitative Computed Tomography-Based Measures of Radial Bone Properties at the 4% Site and Measures of Pain, Upper-Limb Active Joint Count, and Hand Function in 21 Adults with Rheumatoid Arthritis

Clinical measures	Radial Bone Properties				
	Cortical vBMD	Cortical BMC	Trabecular vBMD	Trabecular BMC*	Ha*†
Arthritis Pain scale	−0.09	−0.33	−0.33	−0.29	−0.01
Active joint count*	−0.38	−0.47‡	−0.47‡	−0.54‡	0.29
Grip strength§	0.61‡	0.51‡	0.25	0.36	−0.14¶
Hand and Finger Function scale	−0.49‡	−0.56‡	−0.45‡	0.35	0.24

Note: Pearson correlation reported for all variables except where data were not normally distributed.

*Spearman rho correlation reported for non-normally distributed data.

† $n = 15$ (the higher resolution image could not be analyzed for 6 participants (4 men).

‡ $r \geq 0.45$ (explains >20% of the variance).

§ $n = 17$ (a ceiling effect was observed for 4 men).

¶ $n = 14$.

vBMD = volumetric bone mineral density; BMC = bone mineral content; Ha = average hole size in trabecular network.

Table 5 Peripheral Quantitative Computed Tomography-Based Measures of Radial Bone Density and Mass at the 4% Site in Adults Participating in the Current Study, Women with a Fracture of the Contralateral Distal Radius, and Adults with Mild RA

Radial bone properties	Current study ($n = 21$ adults)	Women with a contralateral forearm fracture ($n = 22$) ²⁵	Adults with mild RA ($n = 24$) ²⁴
Cortical vBMD, mg/cm ³	630.4 (174.8)	582.5 (108.0)	432.5 (659.3)
Trabecular vBMD, mg/cm ³	191.1 (43.2)	129.1 (40.8)	121.4 (28.4)
Cortical BMC, mg/mm	78.0 (21.6)	151.0 (24.0)	NR
Trabecular BMC, mg/mm	30.3 (17.2–39.3)*	54.9 (21.8)	NR

*Not normally distributed; median (IQR) is reported.

vBMD = volumetric bone mineral density; BMC = bone mineral content; RA = rheumatoid arthritis; NR = not reported.

upper limbs (see Table 2). The small size and homogeneity of our sample prevented comparison of bone properties for participants in the lowest and highest tertiles for active joint count and physical function. On the other hand, it may be that the interaction between joint inflammation and physical function in people with RA precludes the preferential effect of physical activity levels on cortical bone previously reported for post-menopausal women.²⁰

The mean values for bone mass observed in the current study are lower than mean values reported for a group of 22 women with a fracture of the contralateral distal radius, recruited from the same geographic region and assessed using the same scanner.²⁵ However, as summarized in Table 5, mean values for bone density in the current study were higher than values observed for the group of women with a wrist fracture,²⁵ and for a group of 24 participants with mild RA.²⁴ Lower bone mass in combination with higher bone density indicates that the bone is smaller in size but well mineralized for participants in the current study. MacIntyre and colleagues found that in women with wrist fractures, Ha was significantly larger than in women without a distal radius

fracture matched for low vBMD at the radius.²⁵ Ha for our group of individuals with RA was considerably smaller (median = 1.36 mm²; see Table 2) than that observed by MacIntyre and colleagues, both for the women with a distal radius fracture (mean = 4.9 mm²) and for vBMD-matched controls without fracture (mean = 2.9 mm²).²⁵ These comparisons suggest that participants in our study are at low risk for fracture at this time.

No association was observed between apparent structure of the trabecular network and disease activity (see Table 4). The image resolution used in our study was not sufficient to visualize trabeculae, which are 100–300 μ m thick;¹³ instead we focused on the average marrow pore size (with spacing between trabeculae varying from 700 to 2000 μ m),¹³ which more easily resolved in pQCT images despite the 2.5 mm image slice thickness. The resolution available and the long scan time (note that images for six of our participants were excluded from analysis because of motion artefact) may explain why no associations were observed for the indices of apparent trabecular structure. Our ability to resolve trabecular bone architecture and cortical shell geometry at the distal radius is further limited by the partial volume effect

associated with CT imaging.¹³ When an image voxel contains a mixture of bone and soft tissue the CT number reported for that voxel reflects the relative contribution of each component; this partial volume effect produces a blurring of bone boundaries. We propose that further investigations using newer pQCT scanners with greater scan speeds and higher resolution are warranted for more accurate assessment of the spatial distribution of bone and compartment-specific bone loss, and/or adaptations associated with RA.

LIMITATIONS

Our findings must be interpreted in the context of several limitations. These observations cannot be generalized to people with less well controlled and more severe RA. Ceiling effects on our measure of grip strength were noted for four men, thus data for only two men were included in our analyses of the associations between grip strength and bone properties. This small sample prevented us from determining the influence of sex differences on these relationships. Although previous studies have shown that the elevated fracture incidence in people with RA was independent of sex, further studies are needed to compare patterns of bone loss in men and women with RA. Further, our study had no control group for comparison, and the sample size was insufficient to determine the effect of medication and comorbidities on the relationships observed. The cross-sectional design does not provide insight into the temporal relationship between bone properties and clinical measures of disease activity and physical function. Finally, because the timeline for bone to complete one remodelling cycle is approximately 3 months, an assessment of clinical and bone outcomes at one time point is difficult to interpret with respect to skeletal adaptations.¹³

CONCLUSION

Our study investigated how cortical and trabecular bone properties in the distal radius of people with RA relate with clinical measures of disease activity and physical function in the upper limbs. The properties of the cortical and trabecular bone compartments at the 4% site of the radius demonstrated the expected associations with measures of physical function and disease activity, respectively, but cortical BMC also correlated with upper-limb active joint count, and trabecular vBMD also correlated with self-reported hand disability. Our understanding of RA-associated bone loss and fracture risk at the distal radius would be enhanced by the conduct of a randomized controlled trial to investigate sex-specific differences in changes within the cortical and trabecular bone compartments over time (control group), compared with changes in response to exercises targeting the hand/wrist (intervention group) in men and women, stratified by RA activity. Our preliminary results suggest that it is feasible to use pQCT to measure radial bone properties in people with RA.

KEY MESSAGES

What is already known on this topic

The RA inflammatory process produces adverse effects on bone, both systemically and at the articular sites local to affected joints, resulting in secondary osteoporosis and a substantially increased incidence of fractures. Site-specific slowing of bone loss in response to long-term high-intensity exercise and dynamic strength training has been shown (i.e., loss slowed at the hip and feet, but not at the spine). No studies have reported the relationship between physical function or exercise and bone loss in the cortical and trabecular bone compartments at the distal radius in people with RA.

What this study adds

Bone compartments at the distal radius in people with RA may be uniquely affected by disease activity and physical function. The pQCT is suitable for investigating sex-specific effects of disease activity and targeted exercise interventions on RA bone loss at the wrist.

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