

Acceptance and Image Quality of High-Resolution Peripheral Quantitative Computed Tomography of the Metacarpophalangeal Joints in Rheumatoid Arthritis.

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Abstract

Objective:

To investigate the acceptance of the high-resolution peripheral quantitative computed tomography (HR-pQCT) in rheumatoid arthritis (RA). The second objective was to investigate the motion artefacts of the metacarpophalangeal (MCP) joints with two different custom-made positioning devices.

Methods:

Fifty patients with established RA had their MCP joints scanned by HR-pQCT with two different custom-made positioning devices and examined by conventional X-ray. Afterwards, the patients answered a questionnaire of imaging experience. The comparability of the erosion measures was investigated between the two different custom-made positioning devices by Bland-Altman plot, and intrareader repeatability by intraclass correlation coefficient. The motion artefacts were graded for each acquisition, and intrareader repeatability was investigated by Cohen's kappa coefficient.

Results:

Forty percent of the patients preferred HR-pQCT imaging, only 6% preferred conventional X-ray. Seventy-four percent found it difficult to keep their fingers steady during the scan. Fifty percent of the patients reported the inflatable immobilization device helped to keep their fingers steady while only 6% reported that it impaired their ability to do so. However, this difference was not reflected in the visual grading, as motion artefacts were sparse, and no clinically relevant difference could be observed. The intrareader repeatability and comparability for the erosion measures were excellent.

Conclusion:

The high acceptance among patients adds to the feasibility of HR-pQCT imaging of MCP joints in patients with RA. The inflatable immobilization device did not reduce motion-induced image degradation, as the overall visual grading for motion artefacts was low for imaging of the MCP joints in both acquisitions.

Introduction

High-resolution peripheral quantitative computed tomography (HR-pQCT) is a promising imaging modality for monitoring of rheumatoid arthritis (RA) [1,2]. However, HR-pQCT imaging time for the MCP joints alone yields an acquisition time of nine minutes, which are far longer than the current gold-standard conventional X-ray. Immobilizing the hand during the acquisition might discomfort the patients, resulting in poor acceptance and adherence. Presently, the patient acceptance of HR-pQCT imaging has not been investigated.

HR-pQCT uses the same principles as traditional computed tomography, which has an inherent contrast between bone and soft tissue; this makes it ideal for the detection of bone damage *in vivo* [3]. Furthermore, the HR-pQCT scanner has a very low radiation dose of roughly 0.025 mSv for the wrist and metacarpophalangeal (MCP) joints [4]. The long imaging time may, however, induce motion-induced image degradation. A previous study, have shown that HR-pQCT imaging of the radius had to be repeated for 67% of the patients due to motion artefacts [5]. The acquisition time for the radius is only three minutes. Therefore, the nine minutes acquisition time, for the

MCP joints, might exacerbate the motion artefacts. However, motion-induced image degradation and the number of repeated acquisitions are rarely reported for the MCP joints [6–9].

The objective of this study was two-fold. Firstly, the acceptance of HR-pQCT imaging in patients with established RA was investigated using a patient-reported experience measure questionnaire [10]. Secondly, we investigated the comparability and repeatability of motion artefacts and erosion measures of the 2nd and 3rd MCP joint for two different custom-made hand positioning devices.

Methods

Study design and population

Patients with rheumatoid arthritis, according to the ACR/EULAR (2010) classification criteria [11], were recruited from the outpatient clinic at the Department of Rheumatology, Aarhus University Hospital. Inclusion criteria were the ability to give consent, age ≥ 18 years and disease duration ≥ 5 years. Exclusion criteria were fracture or luxation of the MCP joints in both hands, evidence of active malignant disease, hypocalcemia, impaired renal function (Estimated glomerular filtration rate <35 ml/min), untreated hypo- or hyperthyroidism or pregnancy.

A full medical history was obtained, and a clinical examination was performed for all individuals. Specifically, demographic and clinical data were obtained, including age, gender, disease duration, number of tender and swollen joints, C-reactive protein, as well as anti-citrullinated protein antibodies and immunoglobulin M rheumatoid factor.

Conventional radiography

All patients had their hands, wrist and feet examined with radiographs using the standard dorsopalmar projection, the image was generated at a focus distance of 100-115 cm, 50-55 kV and 2-12 mAs. If radiographs had been performed within the last three months or were scheduled in the three months following inclusion, this was recorded as the baseline. The radiographs were evaluated with the Sharp/van-der-Heijde method [12].

HR-pQCT acquisition procedure

An image acquisition protocol endorsed by the Study group for xtrEme-Computed Tomography in Rheumatoid Arthritis (SPECTRA) was used [13]. The 2nd and 3rd MCP joint were imaged using first-generation XtremeCT (Scanco Medical, Brüttiselen, Switzerland). A 2.7-cm-long volume of interest was scanned with a spatial resolution of $82 \mu\text{m}^3$, an X-ray tube voltage of 59.4 kVp, a current of 900 μA , and an integration time of 100 ms. The scan was performed within a region of 80 slices (6.56 mm) distal and 250 slices (20.5 mm) proximal to the distal end of the third metacarpal head. The dominant hand was scanned except in cases with prior fracture or luxation in the MCP joints.

The patients were scanned with two methods of standardized positioning of the hand using custom-made positioning devices. *Splint without the inflatable immobilization device*: The hand and forearm were positioned parallel to the long axis of a rigid splint and strapped down to the rigid splint at the MCP joints and the distal and proximal part of the forearm. The splint-supported hand and forearm were then positioned within a cylindrical

holder manufactured by Scanco Medical AG, Switzerland. The cylindrical holder was placed inside the HR-pQCT unit for scan acquisition (Figure 1A-B). *Splint with the inflatable immobilization device*: The hand was immobilized using a rigid splint as described above. However, an inflatable immobilization device (Multipad Bendy, Pearltec AG, Zurich, Switzerland) was then positioned over the fingers and inflated to immobilize the fingers (Figure 1C-D).

Twenty-five patients were scanned first without the inflatable immobilization device and subsequently with the inflatable immobilization device. The other 25 patients were scanned first with the inflatable immobilization device and subsequently without the inflatable immobilization device in order to minimize bias. Each image was anonymized before analysis in random order using the Osirix software (Version 9.0.1; Pixmeo, Bernex, Switzerland) and a 27-inch cinema screen iMac.

Patient-Reported Experience Measure

A questionnaire was developed, in conjunction with RA patients at our department, to investigate the patient-reported experience measure [10]. The questionnaire investigated the acceptance of HR-pQCT imaging, with and without the inflatable immobilization device (Table 2). The patients were asked to fill out the questionnaire after the conventional radiographs and both HR-pQCT acquisitions.

Visual grading of motion artefacts for HR-pQCT Images

For each anonymized acquisition, the motion-induced image degradation was graded for the distal, middle, and proximal 110-slices stack of the 330-slices stack. The grading of motion-induced image degradation was based on a grading scale proposed by the scanner manufacturer for the 110-slices stack of radius and tibia acquisitions, where the presence and extent of horizontal streaking, disruption of cortical contiguity and trabecular smearing is used for grading [14]. Five different grades were defined from grade 1 (no visible motion artefacts) to grade 5 (severe motion artefacts). A visual grade ≤ 3 has been shown to be adequate for the reproducibility of standard morphological parameters such as bone mineral density and microstructure in the radius [15].

HR-pQCT erosion measures

The metacarpal head and proximal phalanx of the 2nd and 3rd metacarpophalangeal joints were assessed for erosions by a single trained reader (RKJ). Erosions were defined according to the SPECTRA collaboration: 1) a definite break in the cortical bone; 2) the cortical break must extend over at least two consecutive slices; 3) the cortical break must be detectable in two perpendicular planes; 4) the cortical interruption must have a loss of underlying trabecular bone, and 5) the cortical interruption must be nonlinear in shape to differentiate from vascular channels penetrating the cortices [16]. For all erosions, the maximum width, depth and length were measured. Width and depth were measured in the axial plane. The length was measured in the coronal plane for erosions located in either the radial or ulnar quadrant. Conversely, the length was measured in the sagittal plane for erosions located in the palmar or dorsal quadrant.

Intrareader repeatability

Ten images from the acquisitions without the inflatable immobilization device and ten images from the acquisition with the inflatable immobilization device were chosen at random and reevaluated by a single trained reader (RKJ) one week later, to determine intrareader repeatability of the visual grading for motion artefacts and the erosion measures.

Ethical considerations

The Ethics Committee of Medical Research in Central Denmark Region (J. no. 1-10-72-437-17) and The Danish Data Protection Agency (J.nr: 2012-58-006) approved the study. Written informed consent was obtained from the patients.

Statistics

Data were analyzed using STATA 12 (StataCorp LP, College Station, TX, USA). Normal distribution of the data was investigated with Q-Q plots and histograms. Normally distributed data were presented as arithmetic mean (95% CI) and statistical significance tested using students t-test. Non-normally distributed data were presented as median (25th to 75th percentile), and statistical significance was tested using the Mann-Whitney U test.

The number of erosions and the average maximum width, depth, and length of the erosions were measured, and the statistical significance was investigated between acquisitions with and without the inflatable immobilization device. The measures of erosion were compared between the acquisitions with and without the inflatable immobilization device using Bland-Altman Plots[17]. The intrareader repeatability of maximum width, depth, length, and the number of erosions was investigated by the intraclass correlation coefficient (ICC) for both custom-made positioning devices. For visual grading of motion artefacts, the intrareader repeatability was investigated with Cohen's kappa coefficient (κ) for every 110-slices of the 330-slices image stacks.

Correlation between the patient-reported experience and either disease duration, age, BMI, sex, Sharp/van der Heijde score, erosion number and size were investigated using Spearman's rank correlation coefficient in order to identify whether disease severity influenced the patients' experience of having their hand imaged by HR-pQCT. The results were considered significant at $p < 0.05$.

Results

Patient characteristics

Patients demographics and clinical characteristics are shown in Table 1.

Patient-Reported Experience Measure

The patient-reported experience is presented in Table 2. Forty-nine of the 50 (98%) patients reported that the HR-pQCT imaging time was acceptable. No patients found the imaging time to be unacceptable or reported that they

would not want to be examined with the HR-pQCT on another occasion. Twenty of the 50 (40%) patients reported that they would rather be examined with the HR-pQCT compared to conventional X-ray, compared to only 3 of the 50 (6%) patients who preferred to be examined with conventional X-ray (Table 2).

Thirty of the 50 (60%) patients agreed or strongly agreed with the statement "Imaging with the inflatable cushion helped me keep my fingers still.", while only three of the 50 (6%) patients disagreed or strongly disagreed. Twenty-one of the 50 (42%) patients agreed or strongly agreed with the statement "Imaging with the inflatable cushion was more comfortable." while only nine of the 50 (18%) patients disagreed or strongly disagreed (Table 2). A single patient experienced pain during the imaging. The pain was caused by the patient's forearm having a larger diameter than the cast, which resulted in uncomfortable pressure; this was not related to the inflatable immobilization device.

The majority of patients who were imaged first with the inflatable immobilization device answered that they disagreed with the statement "It was challenging to keep my arm at rest", while the majority of patients who were imaged first without the inflatable immobilization device answered that they strongly disagreed with the statement ($p = 0.014$). We observed the same for question nine "It was challenging to keep my fingers at rest during the imaging." ($p < 0.001$). We found no significant correlation between the patient-reported experiences and Sharp/van der Heijde, the number of swollen and tender joints, HAQ, disease duration or activity score.

Comparability

The overall visual grading for motion artefacts was low; none of the patients had repeat scans. The highest visual grade was 3 in the proximal and middle part of the 330-slices stack, while one patient had grade 4 in the distal part of the 330-slices stack. The median (IQR) visual grade was 1(1 to 1) in the proximal, middle and distal part of the 330-slices stack, this was seen in both acquisitions. The calculated average visual grading for motion artefacts, however, was significantly higher with the inflatable immobilization device compared to the acquisitions without the inflatable immobilization device (1(1 to 1.33) versus 1(1 to 1), $p = 0.038$). We did not observe significant differences in the erosion measures between the two methods of standardized positioning of the hand (Table 3). The Bland-Altman plots for the erosion measure are shown in Figure 3.

Repeatability

Intrareader agreement for visual grading of motion artefacts was investigated for every 110-slices of the 330-slices stacks in both acquisitions with and without the inflatable hand immobilization (Table 3) All discrepancies were within one grade-level.

The ICC for the average width, depth, and length of erosions was excellent in both acquisitions (> 0.90). There was no sizeable difference in ICC between the acquisitions without the inflatable immobilization device and acquisitions with the inflatable immobilization device with regard to the number and average width, depth, or length of erosions (Table 3).

Discussion

This is the first study investigating the patient-reported experience of HR-pQCT imaging in patients with inflammatory arthritis. The study indicates that patients with established RA have great acceptance of HR-pQCT imaging, independent of the erosive damage, disease duration, or disease activity score. The repeatability and comparability of visual grading of motion artefacts and erosion measures were excellent for both custom-made positioning devices.

Patient-Reported Experiences

Measures of patient-reported experiences are becoming more and more common when assessing treatment outcomes in patients with all kinds of disorders. However, patient-reported experiences are rarely considered, even though improving patients experiences has been shown to increase outcome scores [10]. In the present study, our patient-reported experiences with HR-pQCT imaging were generally encouraging, only a few patients would rather be imaged using conventional X-ray. This indicates that the imaging modality has high acceptance and will likely have high patient adherence in clinical practice. The majority of patients experienced that the inflatable immobilization device helped them keep their hand at rest. However, this was not apparent in the visual grading for motion artefacts. We did not observe any correlation of the patient-reported experiences with RA severity; this shows that the modality should be acceptable for the majority if not all patients.

All patients reported that they sat in an acceptable position; this was indeed positive compared to imaging modality such as MRI. Imaging of the hand with MRI usually requires prone positioning with the arm of interest over the subject's head. This places the anatomy of interest in the best location for imaging but can be uncomfortable and difficult to maintain for long periods of time, which predisposes motion artefacts [18].

Visual grading of motion artefacts

Motion-induced image degradation has been observed to impair the reproducibility in longitudinal studies [5]. Motion artefacts are common both for the tibia and radius where the scan quality is inadequate in a substantial number of cases, especially the radius have shown to be susceptible to motion-induced image degradation [19].

In the present study, the visual grading for motion artefacts was low for acquisitions both with or without the inflatable immobilization device; this was evident as no reacquisition was needed, and the median grade in all parts of the 330-slices stack was one. This indicates that the inflatable immobilization device does not yield either better or worse imaging. Feehan et al. found a high degree of motion-induced image degradation in 220-slices stack of the metacarpal heads (Visual grading of motion artefacts > 3) was detected in 2 out of 12 healthy participants [6]. A previous study by Barnabe et al. found that 5.7% of joints imaged in a group of 15 subjects had to be excluded due to motion-induced image degradation. However, they investigated 220-slices stack of the 1st to 5th MCP and the 2nd to 5th proximal interphalangeal joints and not only the 2nd and 3rd MCP joints, which we investigated in the present study [7]. Therefore, it appears that motion artefacts in HR-pQCT imaging of the MCP joints are less of a problem compared to the radius shown in other studies. The imaging time for the MCP joints is three times longer than the radius. Therefore, we expected that motion artefact would be a greater problem for the MCP joints. However, for imaging of the patient's wrist, the hand is positioned around a handle. It may be hard not to alternate the force of the hand's grip during the scan. The variations in the patient's grip will result in motion-induced image degradation as the variation in the force of the handgrip results in movement of the wrist. For MRI of the hand, motion-induced image degradation has not been thoroughly investigated, but motion artefacts are a known predicament. In order to reduce the motion-induced artefacts, the common advice is

reassuring the patient, using sequences with shorter acquisition time, using an appropriate coil, performing the scan under sedation, using soft pads between the inner surface of the coil and the patient's skin, and the use of immobilizing devices like Velcro straps [20].

Comparability

We did not see any clinically relevant difference in the visual grading for motion artefacts between the acquisitions with or without the inflatable immobilization device, neither did we observe a significant difference in any of the erosion measures. Hence, further immobilization does not appear to be the most prudent way to ensure images without disruptive motion artefacts. The scan time has improved for the second-generation HR-pQCT scanner. Presumably, shorter scan time would reduce the risk for motion artefacts. However, for the first-generation HR-pQCT scanner, the imaging time cannot be reduced further without also reducing the resolution. Therefore, the most pragmatic advice for reducing motion artefacts are proper patient instruction.

Repeatability

The repeatability for visual grading for motion artefacts and number, width, depth and length of erosions of the 2nd and 3rd MCP Joints were all high. We observed no discernible difference in the intrareader repeatability between the acquisitions with or without the inflatable immobilization device.

Limitations

There are several limitations to this study. Firstly, we evaluated whether the total number of erosions per patient corresponded between the two manners of acquisitions but did not consider correspondence of erosions in the exact the same location. This might have led to an overestimation of repeatability. Secondly, the study only included patients with established RA. These patients often have chronic damage to the joints, which make scanning more challenging and might impair the image quality. Conversely, patients with established RA, are less prone to active inflammation (Fig. 2) compared to newly diagnosed RA patients. The pain associated with active inflammation may offer potential risk for movement, thereby impairing the image quality. Thirdly, only intrareader repeatability was investigated as all image analysis was carried out by one reader. Interreader repeatability is generally lower in comparison with intrareader repeatability [21]. Finally, only one operator with extensive experience with the HR-pQCT imaging scanned all the patients. As such, the results might vary between other imaging facilities with operators less familiar with or trained in HR-pQCT image acquisition.

Conclusion

The high acceptance shown by the patient-reported experience measures adds to the feasibility of the HR-pQCT imaging of the MCP joints in patients with RA, as more patients prefer HR-pQCT over conventional radiographs. The inflatable immobilization device did not improve the overall image quality as the visual grading of motion-induced image degradation was low with both acquisitions.

List Of Abbreviations

MCP - Metacarpophalangeal

HR-pQCT - High Resolution peripheral Quantitative Computed Tomography

RA - Rheumatoid Arthritis

SPECTRA - Study group for xtrEme-Computed Tomography in Rheumatoid Arthritis

ICC - Intraclass correlation coefficient

Declarations

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Conflict of interest

Ellen-Margrethe Hauge reports personal fees from MSD, personal fees from Pfizer, personal fees from UCB, personal fees from Sobi, grants from Roche, grants from Novartis, outside the submitted work. Bente Langdahl reports personal fees from Eli Lilly, Amgen, UCB, Gilead, and Gideon-Richter and grants from Novo Nordisk and Amgen outside the submitted work. Rasmus Klose Jensen and Kresten Krarup Keller have no conflicts of interest to declare.

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Author contributions

All authors were involved in drafting the article or revising it critically for important intellectual content, and all authors approved the final version to be published.

Study conception and design: Rasmus Klose-Jensen, Kresten Krarup Keller, and Ellen-Margrethe Hauge.

Image acquisitions: Rasmus Klose-Jensen.

Image analysis: Rasmus Klose-Jensen.

Analysis and interpretation of data: Rasmus Klose-Jensen, Kresten Krarup Keller, Bente Langdahl and Ellen-Margrethe Hauge.

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Tables

Table 1

Clinical Characteristics of the Participants

Age (years), mean (95%CI)	62.6 (59.4 – 65.8)
Female, n (%)	36 (72)
BMI, mean (95%CI)	25.9 (24.5 – 27.4)
Disease Duration (years), mean (95%CI)	18.1 (15.2 – 21.0)
Serum CRP (mg/L), median [IQR]	2.0 [1.0 – 5.8]
HAQ, median [IQR]	0.25 [0 – 0.75]
Visual Analog Scale Pain, median [IQR]	18.5 [5.0 – 30.0]
SDAI, median [IQR]	5.4 [2.5 – 11.1]
RF positive, n (%)	28 (56)
ACPA positive, n (%)	35 (70)
ACPA and RF positive, n (%)	26 (52)
Charlson Comorbidity Index, median [IQR]	1.0 [1.0 to 1.0]
Sharp van der Heijde Score, geometric mean (95%CI)	19.2 (13.4 to 27.4)
Anti-Citrullinated Protein Antibody (ACPA), Body Mass Index (BMI), C-Reactive Protein (CRP), Health Assessment Questionnaire (HAQ), Interquartile range (IQR), Rheumatoid Factor (RF) Simplified Disease Activity Index (SDAI).	

Table 2

The patient-reported procedure experience according to the HR-pQCT imaging and the inflatable immobilization device.

	Strongly disagree		Disagree		Neither agree nor disagree		Agree		Strongly agree	
	n (%)		n (%)		n (%)		n (%)		n (%)	
	A	B	A	B	A	B	A	B	A	B
I felt well informed about the radiation risk.				1(2)	1(2)	1(2)	6(12)	7(14)	18(36)	16(32)
I had the opportunity to ask questions before the imaging.							5(10)	6(12)	20(40)	19(38)
I felt well informed about how the imaging would proceed.							5(10)	6(12)	20(40)	19(38)
I felt that I could stop the imaging at any time.						1(2)	3(6)	6(12)	22(44)	18(36)
The imaging time was acceptable.						1(2)	6(12)	8(16)	19(38)	16(32)
I sat in an acceptable position during the imaging.							7(14)	9(18)	18(36)	16(32)
It was challenging to keep my arm at rest.	14(28)	7(14)	8(16)	9(18)		4(8)	3(6)	2(4)		3(6)
I did not experience significant pain during the imaging.		1(2)					7(14)	5(10)	18(36)	19(38)
It was challenging to keep my fingers at rest during the imaging.	15(30)	5(10)	7(14)	10(20)		3(6)	3(6)	4(8)		3(6)

If asked, would you be examined by this type of imaging again?					1(2)	5(10)	6(12)	20(40)	18(36)	
I would prefer to be examined with HR-pQCT imaging rather than ordinary X-ray in the future.	1(2)	1(2)	1(2)	12(12)	15(30)	4(8)	3(6)	8(16)	5(10)	
Imaging with the inflatable cushion helped me keep my fingers at rest.	1(2)	1(2)	1(2)	6(6)	11(22)	7(14)	7(14)	10(20)	6(12)	
Imaging with the inflatable cushion was more comfortable.		1(2)	4(8)	4(8)	7(14)	13(26)	6(112)	3(6)	8(16)	4(8)
A: Patients scanned first without the inflatable immobilization device and subsequently, with the inflatable immobilization device (n = 25). B: Scanned first with the inflatable immobilization device and subsequently without the inflatable immobilization device in order to minimize bias (n = 25).										

Table 3

Visual grading of motion artefacts and the number, width, depth and length of erosions. Intrareader repeatability of visual grading of motion artefacts and the number, width, depth and length of erosions.

	With the inflatable immobilization device	Without the inflatable immobilization device	P-value
Visual grading of motion artefacts	1 [1 to 1]	1 [1 to 1.33]	0.038
Cohen's kappa coefficient (κ).	0.85 (0.66 to 1.00)	0.78 (0.55 to 0.91)	
Erosions (n)	4 [0 to 10]	3 [0 to 9]	0.749
ICC [95%CI]	0.99 (0.94 to 1.00)	0.98 (0.91 to 1.00)	
Average maximum width(mm)	2.04 [1.37 to 2.20]	1.87 [1.68 to 2.49]	0.422
ICC [95%CI]	0.98 (0.92 to 0.99)	0.99 (0.95 to 1.00)	
Average maximum depth(mm)	1.69 [1.37 to 2.13]	1.91 [1.49 to 2.34]	0.673
ICC [95%CI]	0.98 (0.92 to 0.99)	0.97 (0.89 to 0.99)	
Average maximum length(mm)	2.44 [1.74 to 3.19]	2.26 [1.81 to 3.18]	0.845
ICC [95%CI]	0.93 (0.75 to 0.98)	0.98 (0.94 to 1.00)	
Data presented as median [IQR], statistical significance was tested using the Mann-Whitney U test. Cohen's kappa coefficient and Intraclass correlation coefficients are presented as mean (95% confidence intervals).			

Figures

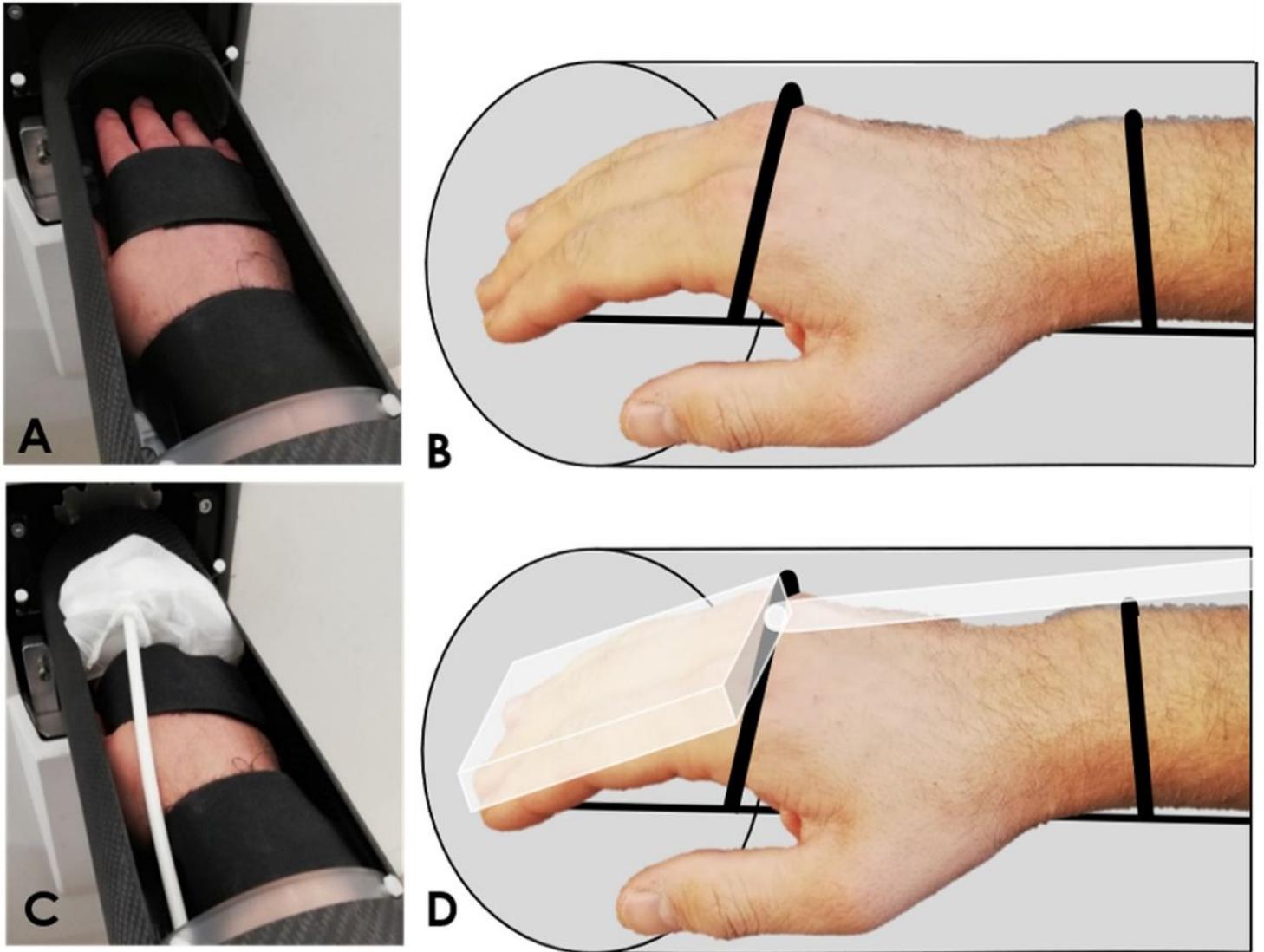


Figure 1

Hand positioning. (A) Without the inflatable immobilization device (acquisition A). The hand is placed in a rigid splint with straps to immobilize the fingers. (B) Schematic illustration of the hand placed in the rigid splint. (C) With the inflatable immobilization device (acquisition B). The splinted hand is placed in the rigid splint, and the inflatable immobilization device is inflated around the hand. (D) Schematic illustration of the hand placed in the rigid splint, with the inflatable immobilization device.

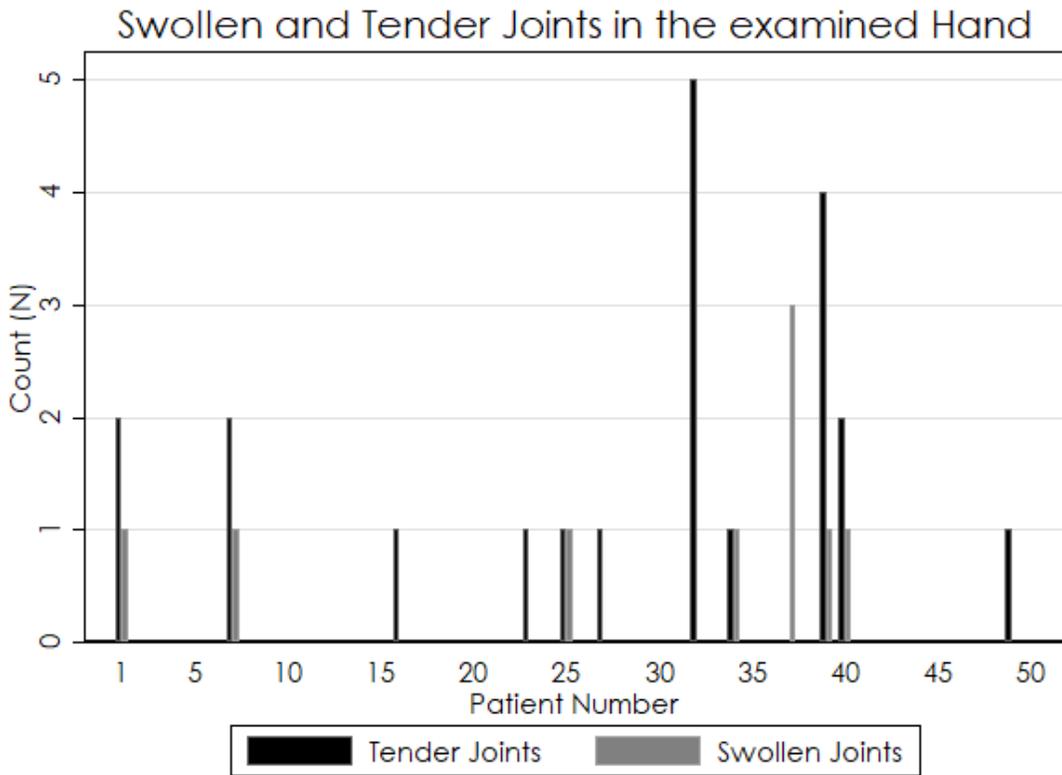


Figure 2

The number of swollen and tender joints in the imaged hand of the individual patient at baseline. This includes wrist, the 1st to 5th metacarpophalangeal joints, the 2nd to 5th proximal interphalangeal joints and the thumbs interphalangeal joint.

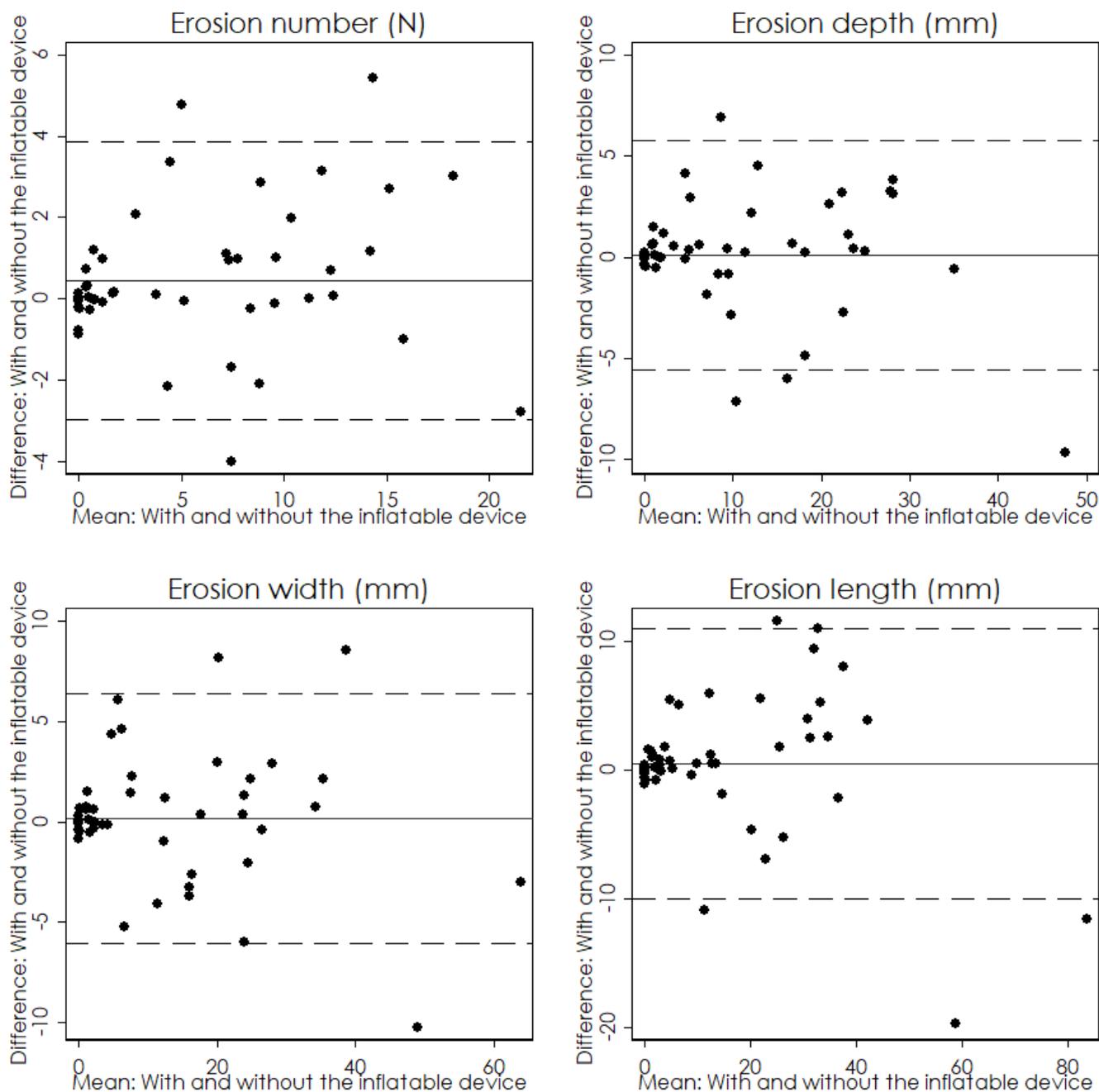


Figure 3

Bland-Altman plots for assessing agreement between acquisitions with and without the inflatable immobilization device, Erosion number (A), depth (B), width (C) and length (D). For each plot: on the x-axis, the mean of the acquisitions with and without the inflatable immobilization device; on the y-axis, the difference between the acquisitions with and without the inflatable immobilization device; the central line shows the mean difference between the two measurements; the dotted lines represent the limits of agreements, which correspond to 1.96 SD of the mean difference between the two measurements.