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THU0595 DEVELOPMENT OF AN AUTOMATED SEGMENTATION ALGORITHM TO IDENTIFY BONES OF THE HAND

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Background: The evaluation of structural damage with plain radiography is important to clinicians and patients. Standard scoring methods include the Sharp-van der Heijde (SVdH) and Ratingen methods [1] however these systems are time-consuming. Therefore, it is difficult to perform large cohort studies. We set out to develop an automated algorithm to identify bones on plain radiographs as a step towards developing automated quantification of structural damage for use on large datasets.

Objectives: To develop a novel algorithm to segment outlines of finger bones in hand radiographs.

Methods: 101 hand radiographs were gathered from the Bath longitudinal cohort (UK). All patients fulfilled the CASPAR criteria for Psoriatic Arthritis (PSA). None of the patients had damage on SVdH and Ratingen scoring (blinded). The metacarpal (MC), proximal phalanx (PP), middle phalanx (MP), and distal phalanx (DP) in the right index finger were delineated by a rheumatologist. These outlines were used to build a statistical model of the shape using a Gaussian Process Latent Variable Model (GPLVM) [2]. Bones are segmented by matching the shape on a radiograph to the statistical model.

Results: The performance of the matching algorithm was compared with a traditional algorithm (snakes) using the Adjusted Rand Score (ARND). The ARND score measures the similarity of the segmentation with the ground truth. A perfect segmentation has a score close to 1. We tested the algorithm on 9 PP, 9 MP and 8 DP and 6 MC bones in the right index finger. The results are reported in table 1. We report a mean improvement in ARAND of 0.19, 0.87, 0.43 and 0.30 for the PP, MP, DP and MC respectively.

Conclusion: We report a reliable algorithm for the identification of metacarpal, proximal, middle and distal phalanx bones of the hand. Future work will focus on using the output of the segmentation algorithm to track damage progression over time.

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Table 1. Adjusted RAND scores for comparing our algorithm to a traditional one (snakes)

	Bone	Snakes ARAND	Shape matching ARAND
Case 1	PP	0.70	0.95
Case 2	PP	0.89	0.96
Case 3	PP	0.82	0.96
Case 4	PP	0.72	0.94
Case 5	PP	0.53	0.96
Case 6	PP	0.87	0.97
Case 7	PP	0.79	0.96
Case 8	PP	0.74	0.96
Case 9	PP	0.88	0.97
Case 1	MP	0.79	0.95
Case 2	MP	0.75	0.95
Case 3	MP	0.75	0.94
Case 4	MP	0.72	0.95
Case 5	MP	0.77	0.96
Case 6	MP	0.51	0.96
Case 7	MP	0.76	0.96
Case 8	MP	0.77	0.96
Case 9	MP	0.83	0.97
Case 10	MP	0.77	0.93

Key: Adjusted Rand Score (ARND) score measures the similarity of the segmentation with the ground truth. A perfect segmentation has a score close to 1. Metacarpal (MC), proximal phalanx (PP), middle phalanx (MP), and distal phalanx (DP)

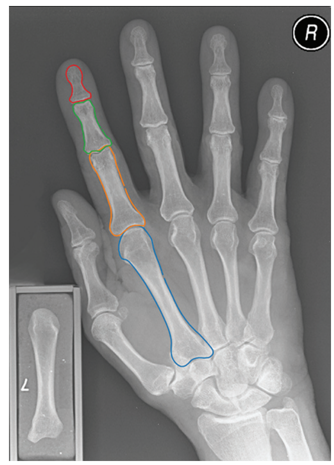

Figure 1. Shape matching algorithm output demonstrating segmented outlines of the DP, MP, PP and MC in red, green, orange, and blue respectively.

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THU0596 DIAGNOSTIC VALUE OF ULTRASOUND AND DUAL ENERGY COMPUTED TOMOGRAPHYTO ACHIEVE ACR-EULAR GOUT CLASSIFICATION CRITERIA IN REAL LIFE CLINICAL PRACTICE

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Background: 2015 ACR/EULAR gout classification criteria (1) include ultrasound with double contour (DC) sign as key ultrasound features and dual energy computed tomography (DECT) with evidence of urate deposition. The positivity of either DECT or ultrasound allows 4 points in addition to others clinical and biological criteria to classify as gout is ≥8/23. However, in routine care, the imaging modality that should be promoted remains unclear between ultrasound or DECT.

Objectives: To validate a possible diagnostic algorithm for the clinical use of DECT and ultrasound in suspected gouty arthritis.

Methods: We conducted a single-center prospective study in the Rheumatology Department of Dijon University Hospital from july 2016 to december 2018, including all patients hospitalized for suspected gouty arthritis. Each patient received joint aspiration if possible, an ultrasound assessment (DC sign and/or tophus) and DECT scanning of symptomatic joints. All these examinations were performed blind of the clinical data and results of joint aspiration. The gold standard used for this study was the 2015 ACR/EULAR gout classification criteria. We have established two

scenarios derived from the algorithm proposed by Nötzel et al (2): in scenario A, the DECT was performed first followed by ultrasound; in scenario B, ultrasound was performed first followed by DECT. Test performance such as sensitivity, specificity, positive and negative predictive value (PPV, NPV)) were calculated for each imaging techniques. Statistical analysis was performed by SAS/STAT software and Macnemar test was used to compare the two scenarios.

Results: 40 consecutive patients were included. 3 patients had a score $\geq$8 from clinical data alone and classified as gout. The remaining 37 patients were included according to the two scenarios. In scenario A, 9/37 patients had a DECT positive with urate deposition leading to the diagnostic of gout with an ACR/EULAR score $\geq$ 8. 7/37 patients had a positive DECT without reaching ACR/EULAR treshold (< 8). 21/37 patients had a negative DECT. The ultrasound study of these 28 patients did not find any sign of gout (DC sign). In scenario B, 6/37 patients had a DC sign and an ACR/EULAR score $\geq$ 8. 1/37 patient had a DC sign but an ACR/EULAR score < 8. 30/37 patients had no ultrasound DC sign. DECT in these 31 patients revealed sodium urate deposits in 3/31 patients, leading to a score $\geq$8. DECT was positive in 7/31 patients with an ACR/EULAR score < 8. The comparison between the 2 scenarios did not find a significant difference (p = 0.250). For the DC sign, sensitivity = 66%, specificity = 96%, PPV = 89% and NPV = 87%. For the presence of DC sign and/or tophus, the values were 91%, 96%, 91%, 96% respectively. For DECT, sensitivity =100%, specificity = 75%, PPV = 63%, NPV = 100%.

Conclusion: Our results confirm that ultrasound (DC sign alone) and DECT have similar diagnostic performance in gouty arthritis in routine care. It seems clinically relevant to propose the ultrasound as first imaging modality considering both the presence of the DC sign and/or ultrasound tophus (not included in ACR-EULAR criteria). It significantly improves the sensitivity of ultrasound while maintaining its PPV, with less false positive patients compared to DECT.

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THU0597

ULTRASOUND REVEALS SUB-CLINICAL ATHEROSCLEROSIS IN PATIENTS WITH GOUT AND ASYMPTOMATIC HYPERURICEMIA

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Background: Accelerated atherosclerosis and the higher risk of developing premature cardiovascular disease are well known in chronic inflammatory rheumatic diseases. Moreover, strong evidence supporting both proatherogenic and protrombotic characteristics of high levels of uric acid have been published.

Ultrasound (US) measurement of the carotid intima-media thickness (cIMT) is a non-invasive outcome measure of premature sub-clinical atherosclerosis with a predictive value in terms of vascular events.

Objectives: To determine the prevalence of increased cIMT, as sign of pre-clinical atherosclerosis, in patients with gout and asymptomatic hyperuricemia by an automated ultrasound (US) method.

Methods: 342 subjects (138 with gout, 105 with asymptomatic hyperuricemia and 99 healthy control subjects) were enrolled. Before the US assessment, all patients underwent a clinical examination aimed to record age, gender, disease duration, smoking, ischemic cardiopathy, comorbidities (including diabetes mellitus, high blood pressure, dyslipidemia, renal insufficiency, obesity), and current therapy. Moreover, ESR, CRP, total cholesterol, HDL-high-density lipoprotein, triglycerides, fasting serum glucose, serum creatinine and uricemia were recorded. Patients with history of myocardial infarction, cerebrovascular events or autoimmune diseases were excluded.

US examinations of the IMT at both common carotids were performed by a rheumatologist expert in US, using a linear probe and an automatic method (QIMT) based on the radio-frequency technology. For the IMT, a cut-off point of 0.8 mm was adopted, according Mannheim cIMT Consensus.

Results: A total of 684 common carotids were assessed. In 65 (47.10%) out of the 138 patients with gout and 50 (47.62%) out of the 105 patients with asymptomatic hyperuricemia, US detected an increased cIMT and only 9 (0.09%) of the control group patients had an increased cIMT (p=0.0001). The regression analysis found a significant positive correlation between increased cIMT and disease duration in gout group (p=0.001) and between the level of uric acid and increased cIMT in asymptomatic hyperuricemic patients (p=0.009). No significant correlation was found with the other clinical and laboratory parameters. There was a significant difference in cIMT between in gout and control groups (p=0.0001) and between asymptomatic hyperuricemia and control group (p=0.0001).

Conclusion: Our results demonstrate that patients with gout and hyperuricemia without clinically evident cardiovascular disease have a high prevalence of atherosclerosis represented by the increased cIMT.

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THU0598

ROLE OF DUAL-ENERGY CT AS A SCREENING TOOL FOR CORONARY GOUT

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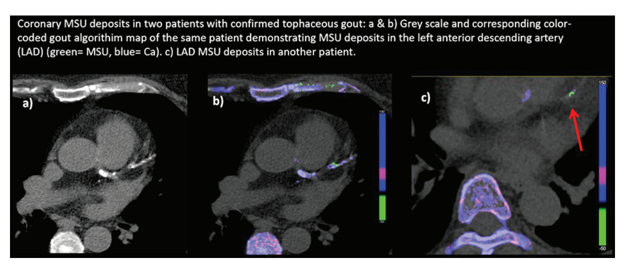
Background: Gout is prevalent in older men and has been demonstrated as independent cardiovascular risk factor. Presence of clinical gout rather than isolated hyperuricemia is related to the increased cardiovascular risk. Dual-Energy CT (DECT) has proven to be of high sensitivity and specificity in detection of monosodium urate (MSU) deposits in joints and soft tissues.

Objectives:

1. Evaluate DECT as a potential screening tool for monosodium urate deposits within the coronary arteries.
2. Calculate prevalence of coronary gout in patients with confirmed tophaceous gout in comparison to asymptomatic control group.

Methods: Cases were retrospectively assigned into two groups. The first (tophaceous gout) group included patients who were referred for DECT gout screening. The inclusion criteria were: males > 50 years of age and clinical diagnosis of tophaceous gout confirmed by DECT. The second (control) group included patients who underwent non-contrast DE Cardiac CT for calcium scoring during the same duration as part of cardiovascular risk workup. Inclusion criteria were males > 50 years of age, no clinical diagnosis of gout and Agatston calcium score less than 400. All DECT scans were done on the same scanner, which was validated and adequately titrated before the start of and during the study. All scans were reviewed by two radiologists with expertise in DECT gout deposits.



Coronary MSU deposits in two patients with confirmed tophaceous gout: a & b) Grey scale and corresponding color-coded gout algorithm map of the same patient demonstrating MSU deposits in the left anterior descending artery (LAD) (green= MSU, blue= Ca). c) LAD MSU deposits in another patient.

Results: Among the 13 cases that met the inclusion criteria for the tophaceous gout group, 11 were positive (84.62%) for coronary MSU deposits. Among the 48 cases that met the inclusion criteria for the control group: 47 were negative and one was positive (2.08%). DECT sensitivity was 84.62% (95% CI: 54.55-98.08%), specificity was 97.92% (95% CI: 88.93- 99.95%), positive predictive ratio was 91.67% (95% CI: 60.94-98.73%), negative predictive value was 95.92% (95% CI: 86.78- 98.83%) and accuracy was 95.08% (95% CI: 86.29- 98.97%).

Conclusion: Coronary MSU deposits are seen in 84.62% of tophaceous gout patients and in 2.08% of gout-asymptomatic individuals (of the same