

Computer-assisted diagnosis and monitoring of degenerative bone diseases

visual computing techniques for automated detection of Osteoporosis (OP) and Osteoarthritis (OA)

background

- early predictors and ways to observe the progression of OA are highly demanded
- clinical detection relies heavily on subjective experience
- assessments based on semi-quant KL grading and manual JSW/A measurements
- highly physician-dependent with subjective interpretation results

objectives

- developing a novel method for the assessment and follow up of osteoarthritis (OA)
- automated joint space width/area (JSW/A) assessment, semi-automatic Kellgren & Lawrence grading
- using high-resolution radiographs
- assessing subchondral bone by bone micro architecture (BMA)

methods

- 274 standardized knee radiographs
- JSW/A and KL assessment by 3 independent physicians
- sw-based analysis of JSW/A
- evaluation of the inter-/intra observer variability, JSW/A cut offs, with or without additional clinical paramters

results

- case/control match: 54%
- JSW – interpersonal variability: 46.52% (CV)
- KL score intrapersonal variability: 29.29% (CV)
- identical KL scores for 274 images: 41 (15%)

conclusion

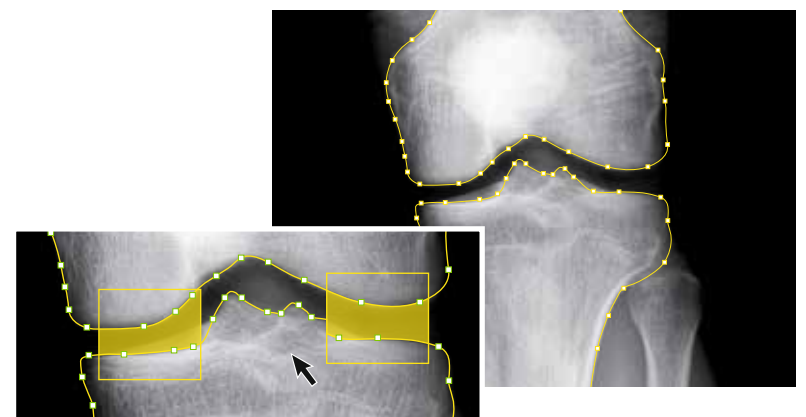
- manual assessment and diagnosis have shown to be highly subjective and physician-dependent
- significant inter- and intra-observer variability observed in regard to JSW and KL scores
- computer-assisted methods have shown to deliver consistent results
- automatic annotation and analysis of JSW/A provide a new method for OA assessment and follow up

workflow

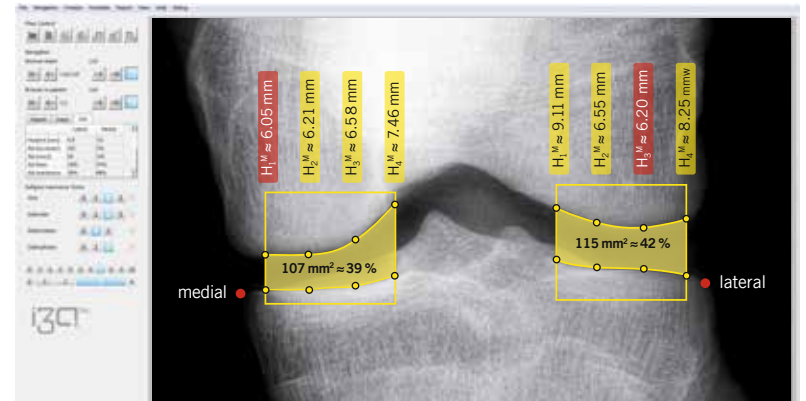
Fully automatic JSW/A assessment based on image annotation and segmentation. Semi-automatic Kellgren & Lawrence grading tool



bone contour detection



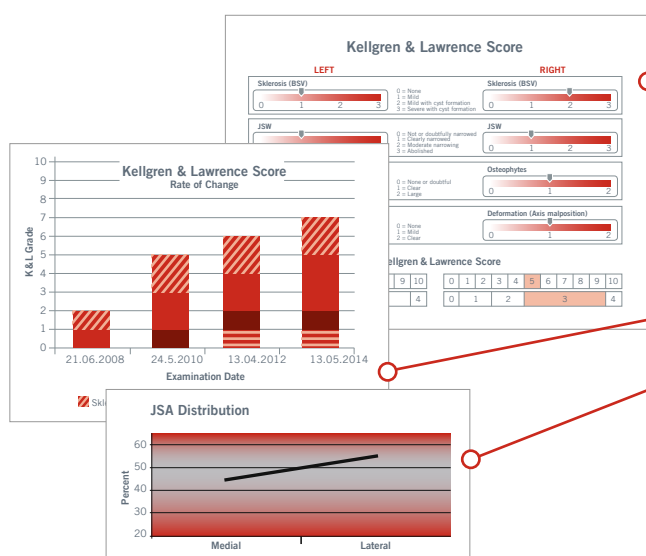
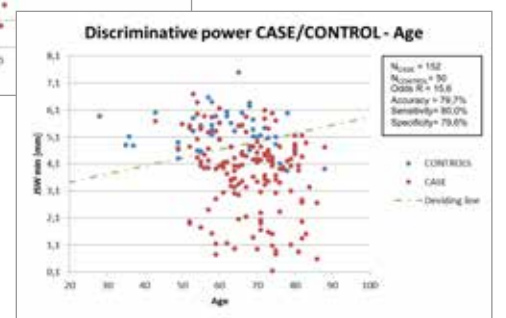
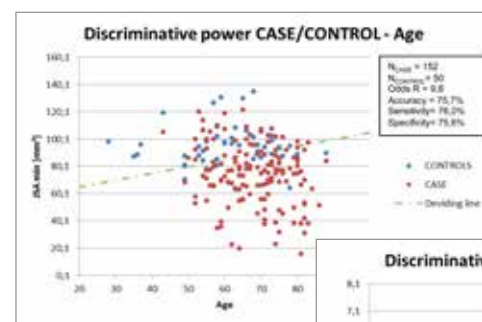
automatic JSW assessment



JSW results



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Patient data is stored in PACS/patient DB



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A novel method for the assessment of joint space width and subchondral bone micro architecture

visual computing techniques for automated detection of Osteoporosis (OP) and Osteoarthritis (OA)

background

- changes in the joint space (narrowing) are currently visually measured
- shortcomings in measuring progression of disease and efficacy of therapy
- no standardized follow up methods
- lack of comparable disease scoring

objectives

- developing a novel method for the early prediction, assessment and traceability of osteoarthritis (OA) and osteoporosis (OP)
- including automated joint space measurement and Kellgren & Lawrence scoring
- using high-resolution radiographs
- assessing subchondral bone by bone micro architecture (BMA)

methods

- 274 standardized knee radiographs of which 109 female patients were selected
- assessment by 3 independent physicians
- sw-based analysis of BMA, JSW/A
- evaluation of the discriminatory power of BMA, with or without additional clinical parameters

results

- current methods often subjective and user-dependent
- texture analysis and automated JSW/A provide an alternative
- significant difference in BSV values between case/controls
- deviation in mean values between case and controls of 704%
- odds Ratio for BSV of 6.39
- combination of BSV and JSA -> discrimination improvement

conclusion

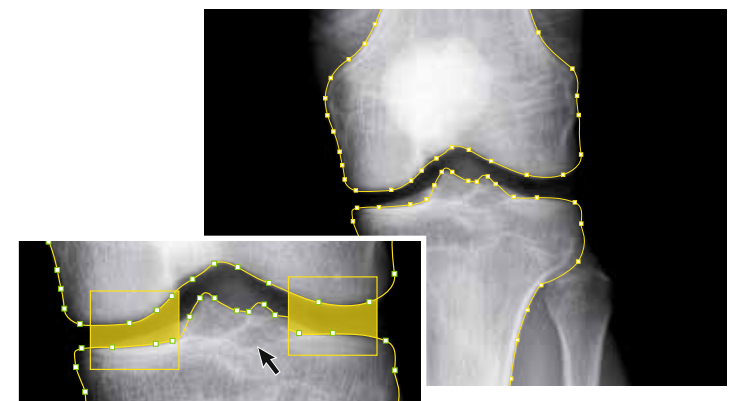
- presented method provides an objective and reproducible analysis for disease prediction, assessment and monitoring
- BMA and automated JSW/A provide a significant discrimination between case and controls
- application of BMA as a possible early disease predictor
- future work should focus on the potential role of BMA to serve as a fracture risk assessment tool

workflow

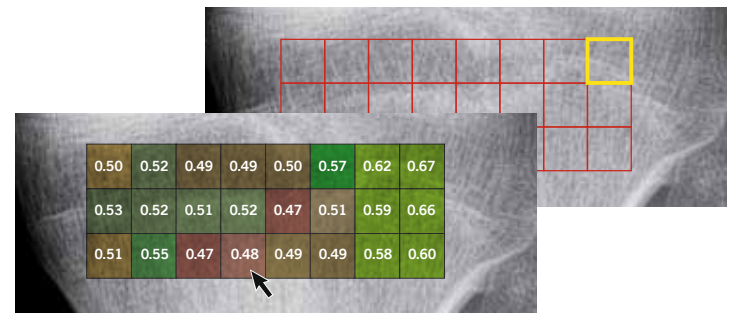
image segmentation and analysis combining an assessment of joint space width/area (JSW/A) and texture analysis of the adjacent subchondral bone micro architecture (BMA)



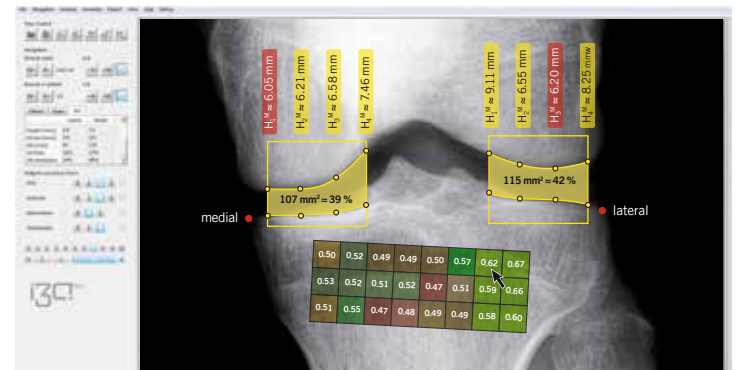
bone contour detection



automatic JSW assessment



ROI placement and BMA calculation



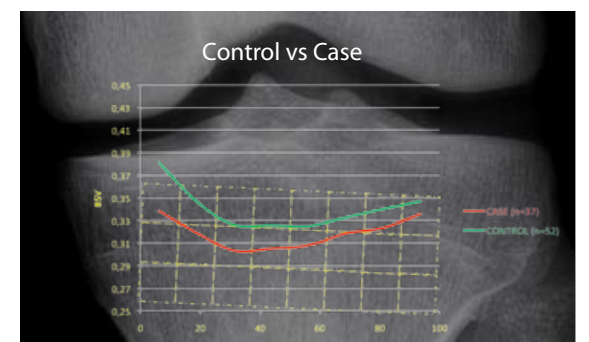
JSW and BMA results



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