

RHEUMATOID ARTHRITIS ASSESSMENT USING JOINT SPACE WIDTH IN RADIOGRAPHIC HAND IMAGES

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INTRODUCTION

Arthritis is one of the most common musculoskeletal disorders. It can be divided into two major categories as osteoarthritis and rheumatoid arthritis (RA). RA is a chronic, systemic and inflammatory diseases that primarily involve the joints. The immune system attacks the tissues lining the joints and inflammation occurs causing pain, heat and swelling. Thus, it occurs the joint damages as joint space (JS) narrowing and bony erosions [1].

Radiographic interpretation provides one of the most useful not only for initial diagnosis but also for the assessment of RA progression. Therefore, this study presents RA detection method by making use of JS width assessment in radiographic hand images.

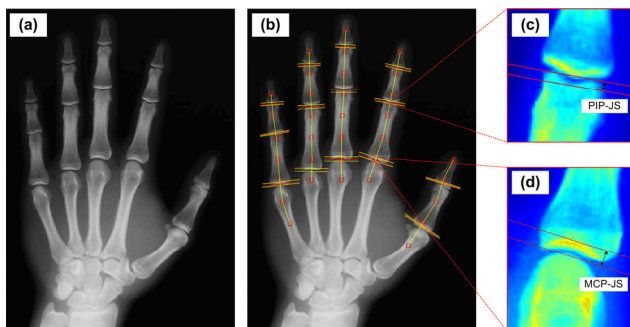


Figure 1: Examples of raw radiographic hand image (a), automatically marked JS (b), and JS width measurements of PIP joint (c) and MCP joint (d) for pointer finger.

METHODS

The methodology is composed of three stages such as radiographic hand image processing, region of interest (ROI) detection, and calculation of JS width. The raw radiographic hand image as shown in Figure 1(a) is first preprocessed by diffusing, masking and segmentation ways. Then the ROI detection process to find 14 target joints as 4 interphalangeal

(DIP), 4 proximal interphalangeal (PIP), 1 interphalangeal (IP) and 5 metacarpophalangeal (MCP) joints from every radiographic hand image is automatically performed with the step-wedge function and local minimum location in profile plot. Finally, JS widths for each joint are measured.

RESULTS AND DISCUSSION

With the method proposed in this study, the resulting example is shown in Figure 1(b). It shows obviously that the marked locations for each joint exactly correspond with those of actual joints. The changes of JS width in RA are generally involved with PIP and MCP joints. In the case of the pointer finger, the JS width measurements for PIP and MCP joints are shown in Figure 1(c) and (d). It shows obviously that the edge locations marked in adjacent bone for every joint exactly correspond with joint shapes, like ellipsoid joints for MCP except for the thumb and the others are hinge joints [2].

The proposed method was tested on 36 radiographic hand images, 12 normal cases and 24 RA patients as 12 seropositive RA cases and 12 seronegative RA cases of rheumatoid factor. Mean JS widths of four joints for three groups are summarized in Table 1. JS widths of RA cases were smaller than those of normal. JS widths in both hands were symmetric. Therefore, it could be surely concluded that the proposed RA assessment method showed very good results. Furthermore, the results of JS widths could be used for discriminating between normal and RA.

ACKNOWLEDGEMENTS

This research was supported by the research fund from Seoul R&BD (grant # CR070054).

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Table 1: Tables may extend across both columns, and those should be included at the bottom of the abstract.

JS width (mm)	DIP joint	PIP joint	IP joint	MCP joint
Normal	0.92 ± 0.17	1.11 ± 0.15	1.21 ± 0.12	1.66 ± 0.22
Seronegative RA	0.80 ± 0.22	1.09 ± 0.45	0.88 ± 0.39	1.24 ± 0.16
Seropositive RA	0.76 ± 0.33	0.84 ± 0.15	1.09 ± 0.38	1.38 ± 0.36