Purpose: Greulich-Pyle and Bayley-Pinneau (GP-BP) method and Tanner and Whitehouse (TW3) method are used to measure bone age. GP-BP method is easy, but it has a disadvantage that the detailed of analysis is difficult. It compares radiograph and standard image at a wide interval. TW3 method is derived from a more mathematical base, which scores skeletal maturity. So, subjective errors are reduced, taking 7~10 minutes to examine. Therefore, we developed algorithm that decides bone stage by matching bone stage with reference image of ROI (Region of Interest) to make a high efficiency of TW3 method.
Methods: To reduce time-consuming, we used only 4 ROI. We detected edges of bone by using Sobel Edge Detection through Input image of the ROI. And then, we mapped them by using Chamfer Distance Transform through reference image of ROI. Next, we compared the edge image to the mapped reference image. Then, the reference image having the minimum distance errors was decided the bone stage that is suitable for input image. And, bone stages of 128 radiographs aged 2 ~ 17 yrs were evaluated by the algorithm and a clinician, and we compared assessment differences.
Results: Differences of bone stage assessment were 0.97~1.73 in average. Algorithm accuracy of radius, ulna, 3th and 5th middle phalanges were 78%, 55%, 52% and 45% respectively. To improve the lack of accuracy according to maturity variability of the finer region, image quality and conditions, we needed to design a semi-automatic system to be selected by a clinician. So some occasions that haven't been selected could increase the accuracy to 100%.
Conclusions: In this study, bone age estimation method was developed semi-automatically. This is more useful to clinicians since its use is easier and less time-consuming than the same level of accuracy of the manual TW3 method contains.