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Comparison of Hallux Valgus Deformity Evaluation on Printed Versus Digital X-Rays

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Abstract

Background: Evaluation of hallux valgus deformity was traditionally made on a printed X-ray image. In the last two decades, digital X-ray systems have begun to replace the analog images, and images are not routinely printed anymore. Clinicians have to evaluate X-rays on digital images viewed on the computer monitors. This study compares the intra- and inter-observer reliability of foot deformity evaluation on printed images with measurements on computer monitors with the guidance of dedicated software.

Methods: Fifteen pre-operative X-rays reports of patients who were candidates for a surgical correction of hallux valgus deformity, were evaluated by ten orthopedic surgeons. Each surgeon had two evaluation sessions on each modality, printed and computer monitor with the guidance of dedicated software.

Results: We found that the hallux valgus deformity evaluations on computer monitors had significantly lower inter- and intra-observer variations than the evaluations performed on printed images. This study validates the use of digital X-ray measurements on computer monitors with the guidance of dedicated software. for evaluation of hallux valgus deformity.

Conclusion: Clinician can use digital images with the guidance of dedicated software to evaluate for deformities without a need to print the images.

Keywords: Hallux Valgus; Digital X-ray; Printed X-ray; Computer monitors

Introduction

Hallux valgus (HV) is a complex, progressive deformity characterized by lateral deviation of the great toe and medial deviation of the first metatarsus. Epidemiological studies have found increased deformity incidence with age, female gender, and a marked decrease in incidence among populations that do not wear shoes [1-5].

Choice of treatment is determined in part by evaluating the type and severity of the deformity [6]. Measuring angles on X-rays is a component of this process. The evaluation is made by measuring specific angles on the X-ray, including the hallux valgus angle (HVA), intermetatarsal angle I-II (IMA), distal metatarsal articular angle (DMAA).

In the last two decades, digital X-ray systems have begun to replace the analog images. As images are rarely printed anymore, this new technology is affecting the traditional methods of measuring the deformity and might affect the evaluation the deformity and its treatment. The objective of this study was to compare the intra- and inter-observer reliability of hallux valgus (HVA), intermetatarsal (IMA) and distal metatarsal articular (DMAA) angles measurements on printed images against measurements performed on computer monitors with the guidance of dedicated software.

Methods

The study includes fifteen digital X-rays of patients, who were candidates for corrective surgery for HV deformity. Three cardinal HV deformity angle assessments were measured on each photograph by ten Orthopedic surgeons, the hallux valgus angle (HVA), intermetatarsal angle (IMA), and the distal metatarsal articular angle (DMAA).

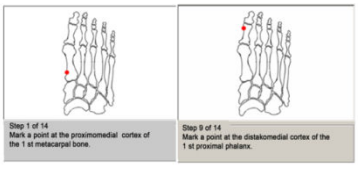

Figure 1: Example of the dedicated software's guidance steps.

Each surgeon performed the measurements on the computer monitors and on a on the same images that were printed. An additional measurement was performed on the same images after 1

month. Measurements on printed X rays were made with classic goniometer while digital X-ray measurements were performed using dedicated software (TraumaCad ®, Brainlab, Petah tikwa, Israel). The software guides the user during the evaluation and calculates the angles measured (Figures 1 and 2).

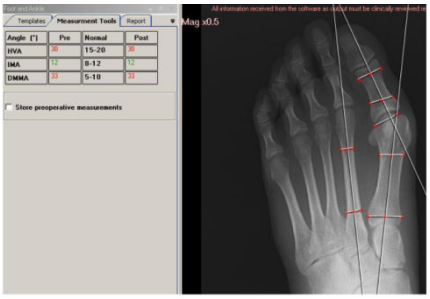

Figure 2: Final deformity evaluation on digital images with the dedicated software.

Statistical inferences between the two variances were made by F test execution. Data were analyzed by statistical software R, version 2.7. The model was built using the command lme.

Results

The differences between the inter and intra observer variability of manual and digital measurements were statistically significant for all 3 measured angles. Figure 3 shows the differences between the digital and manual inter-observer measurements. The inter-observer variability in Hallux Valgus digital angle measurement was 3.76 degrees compared to 8 degrees in the manual measurements (p=0.0001). The digital and manual intermetatarsal angle measurements were 2.64 and 1.64 degrees respectively (p=0.0003), and the DMAA was 15.92 digitally and 5.43 degrees manually (p=0.0001).

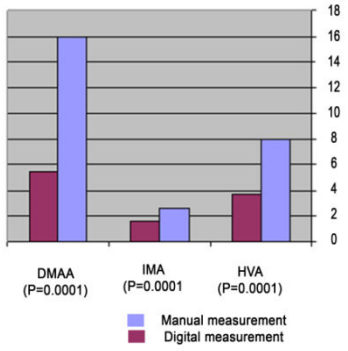

Figure 3: The inter observer variability measurement of manual versus digital measurements of HVA and IMA angles.

The intra-observer variability of the hallux valgus angle digital measurement was 0.17 versus 4.49 in the manual (p=0.0002), inter metatarsal angle measurement variability was 0.06 digital versus 0.59 Manual (p=0.0009) and distal metatarsal articular angle different was 2.02 in the digital measurements versus 1.17 manually (p=0.21) (Figure 4).

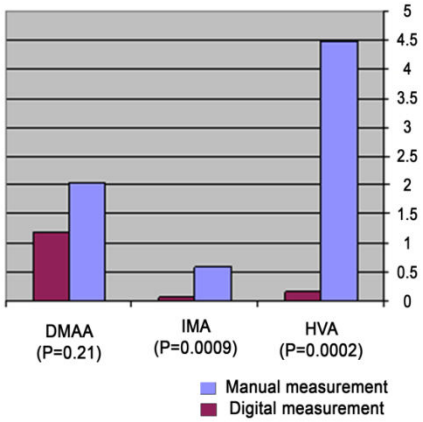

Figure 4: The intra observer variability measurement of manual versus digital measurements of HVA and IMA angles.

Discussion

In recent years, hospitals throughout the world have replaced the analog imaging systems with digital systems. The X-rays are preserved in the digital archives (PACS-Picture Archiving and Communications System) and can be viewed on computer monitors. This creates a new situation for Orthopedic Surgeons who are accustomed to performing various measurements directly on printed X-rays [7-8].

Pique-Vidal et al. compared Manual measurements with a goniometer by an orthopedic surgeon to measurements of an experienced technician on digital images. They found that measurements made on digital radiographs were more reliable than those made with a goniometer [9]. Panchbhavi et al. compared computerized and manual measurements by a single surgeon found no significant difference between the two methods [10].

In our study, we compared measurements of three cardinal HV deformity evaluation angles manually to measurements performed on computer monitors. We found the on screen measurement of HVA, IMA and DMAA on digital X-rays performed by orthopedic surgeons with dedicated software o be more reliable than those using manual measurements on printed images as traditionally performed. The inter and intra observer variability of these measurements were lower with the on screen measurements (Figures 3 and 4) as compared to the printed images. All differences except for the intra-observer DMAA angles were statistically significant (p<0.001). An explanation of these differences might be guidance of the dedicated software, option to zoom in and out, adjust and manipulate the measurements easily on screen as the accuracy of digital angles calculation as compared to the manual performed by goniometer.

Conclusion

Clinician can use on screen digital images with dedicated software to evaluate foot deformities without a need to print the images.

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