PELVIC FLEXION DIFFERENCE BETWEEN SUPINE AND STANDING POSITIONS MEASURED FROM AP RADIOGRAPHS

INTRODUCTION

Individual variation in pelvic flexion and extension during normal daily activities is not well understood. In this study, we have applied a radiographic technique to measure and evaluate the individual variability of pelvic flexion and extension when patients move from a supine to a standing position. Based on a computer-enhanced measurement of cup orientation from anteroposterior (AP) radiographs, we have analyzed individual series of postoperative x-ray images to measure cup orientation, and indirectly the pelvic tilt. Our hypothesis is that there is significant variation of pelvic tilt in these positions which influences the “functional” alignment of the acetabular cup following THR.

METHODS

AP radiographs were obtained three months postoperatively after primary THR surgery. Two radiographs were acquired for each patient, one in a standard supine position and the other in a standing, weight bearing position. The distance of the x-ray source was 40” and the central beam position was noted by using a radioopaque marker in both radiographs. Using the computer based procedure with digitized radiographs [1], the orientation of the cup implant was measured by matching the projection of the cup’s geometric model to the outline of the cup on the radiograph. The corresponding geometric model of the cup was loaded from a database and interactively translated and rotated until its projection matched the cup outline on the radiograph. The measured cup orientation was expressed in terms of cup abduction and flexion, relative to the radiographic plane and the transverse axis identified by the radiographic teardrop landmarks.

RESULTS

We analyzed the pairs of supine and standing AP radiographs for 106 patients. Each measurement point in Figure 2 represents a difference of cup flexion and cup abduction between the supine and standing radiograph for each individual patient. Positive flexion represents forward flexion of the pelvis when going from a supine to a standing position, and negative flexion is retroflexion (extension) when going from the supine to standing position. The mean flexion difference was found to be -4.5° with a SD of 7.5°. The smallest absolute difference of cup flexion for any individual patient was 0°. The range of differences in flexion was from 16.6° to -25.5°. The mean abduction difference was found to be 0.1° with a SD of 2.0° and a range of 4.7° to -7°.

DISCUSSION AND CONCLUSION

Based on our analysis of radiographic measurements of cup orientation between supine and standing radiographs, we can conclude that there is a large individual variation of pelvic flexion between the two positions. More importantly, it was shown that there can be either flexion or extension of the hip when going from the supine to standing position. The encountered variability in measurements of abduction can be attributed to several sources; 1) the error of the cup outline matching, 2) the variation in transverse axis definition, 3) distortion of the radiographic image, and 4) rotation of the pelvis in version. However, this variability in abduction does not significantly alter the measurements of flexion. More than any other variable, pelvic flexion and extension can have a significantly larger effect on the perceived cup orientation and yet it remains that little is known about this important variable. The individual variations of pelvic flexion and extension can significantly alter the postoperative hip ROM and should be taken into account in the planning, simulation and execution of cup implant alignment in THR surgery. In addition, studies of implant wear or dislocation rates that use standard x-rays may be potentially flawed due to these inaccuracies in our traditional radiographic measurement techniques.

REFERENCES

1. Jaramaz et al Trans. 45th ORS, 925, 1999

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