

MEASUREMENT OF 3D DISTANCE BETWEEN ARTIFICIAL CEMENT-TYPE CUP AND HEAD AFTER THR

SHIGEYOSHI NAKAJIMA¹, MITSUHIKO IKEBUCHI² AND TAKASHI TORIU¹

¹Graduate School of Engineering
Osaka City University
3-3-138, Sugimoto-cho, Sumiyoshi-ku, Osaka city, 558-8585, Japan
{ nakajima; toriu }@info.eng.osaka-cu.ac.jp

²Graduate School of Medicine
Osaka City University
1-4-3, Asahi-machi, Abeno-ku, Osaka city, 545-8585, Japan
m1298570@msic.med.osaka-cu.ac.jp

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ABSTRACT. *We propose a measurement method of 3D (three dimensional) distance between an artificial cement-type cup and an artificial femoral head. Those implants (a cup and a head) stay in a living patient's body after THR (total hip replacement). We measure from AP (anterior-posterior) Roentgen image and a lateral image. The angle between the two images is unknown. Recently we proposed a measurement method for non-cement-type cup. We modified our 3D measurement method for a non-cement cup with EC (evolutionary computation) and extend the framework for a cement-type cup. Any other method can achieve to measure a cement-type wear, because there are problems inherent to cement-type wear measurement, e.g. physical distortion of a wire, physical duplication of a wire, eroding of a wire shadow, and dilating of a wire shadow. We cleared up those problems. Our method needs only two times of shots using an ordinary Roentgen equipment without measurement of the angle of the two images. So our method is superior to Martell's Method. And it needs no metal balls in a patient body unlike RSA (Roentgen stereophotogrammetric analysis). We show the result of a computer simulation with CG (computer graphics) image we made and the result in vitro with Roentgen images of artificial cup and head moved by a micro-manipulator.*

Keywords: Medical image processing, Total hip replacement, Artificial joint, Roentgen, 3D, Wearing

1. Introduction. Medical image analysis is one of the important techniques today. There are many parts in a human body to investigate. Some methods were proposed to analyze human faces (I. Wijaya et al. [1], Y. Oyama et al. [2]). Also others to analyze human whole body (Masashiko Horie et al. [3], Thi Thi Zin et al. [4]). And there were a bone analysis method (Georg Langs et al. [5]) and an arthroplasty image 2D-3D matching [6].

In orthopedic surgery area, it is very important to know the position and the direction of an artificial prosthesis after a replacement operation. Especially after THR, there is a polyethylene inner between a cup and a head, and most surgeons are interested in the measurement of the wear and the distortion of the inner with 0.1mm accuracy. But the measurement is very difficult. Livermore et al. [7] proposed that the wear of the artificial hip joint is measured from a contour of an artificial cup and a head in a 2D (two dimensional) image. Martell et al. [8] made a computer program to achieve Livermore's method. Martell et al. approximated a cup and a head as circles in a