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FEE TRANSMITTAL	Application Number				
	Filing Date				
Patent fees are subject to annual revision on October 1. These are the fees effective October 1, 1997.	First Named Inventor	Anthony M. DiGioia			
Small Entity payments <u>must</u> be supported by a small entity statement, otherwise large entity fees must be paid See Forms PTO/SB/09-12.	Examiner Name				
See 37 C.F.R. §§ 1.27 and 1.28.	Group / Art Unit				
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2. X Payment Enclosed: X Check Order Other	113 1,840* 113 1,840* Requesting publication of SIR after Examiner action						
EEE CALCULATION	115 110 215 55 Extension for reply within first month	<u> </u>					
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1. BASIC FILING FEE	117 950 217 475 Extension for reply within third month	<b> </b>					
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101 790 201 395 Utility filing fee	119 310 219 155 Notice of Appeal						
106 330 206 165 Design filing fee	120 310 220 155 Filing a brief in support of an appeal						
107 540 207 270 Plant filing fee	121 270 221 135 Request for oral hearing	<u></u>					
108 790 208 395 Reissue filing fee	138 1,510 138 1,510 Petition to institute a public use proceed	ling					
114 150 214 75 Provisional filing fee	140 110 240 55 Petition to revive - unavoidable						
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2. EXTRA CLAIM FEES	142 1,320 242 660 Utility issue fee (or reissue)						
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103 22 203 11 Claims in excess of 20	146 790 246 395 Filing a submission after final rejection (37 CFR 1.129(a))						
102 82 202 41 Independent claims in excess of 3 104 270 204 135 Multiple dependent claim, if not paid	149 790 249 395 For each additional invention to be						
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PI-283676.01

#### TITLE OF THE INVENTION

Computer-Assisted Surgery Planner and Intra-Operative Guidance System

CROSS-REFERENCE TO RELATED APPLICATIONS

This application is a continuation-in-part application of application Serial Number 08/803,993, filed February 21, 1997.

STATEMENT REGARDING FEDERALLY SPONSORED RESEARCH OR DEVELOPMENT

This work was supported in part by a National Challenge grant from the National Science Foundation Award IRI 9422734.

BACKGROUND OF THE INVENTION

The present invention is directed generally to the implantation of artificial joint components, osteochondral grafts, and osteotomy and, more particularly, to computer assisted surgical implantation of artificial joint components during replacement and revision procedures, computer-assisted osteochondral grafts, and computer-assisted osteotomy.

Total hip replacement (THR) or arthroplasty (THA) operations have been performed since the early 1960s to repair the acetabulum and the region surrounding it and to replace the hip components, such as the femoral head, that have degenerated. Currently, approximately 200,000 THR operations are performed annually in the United States alone, of which approximately 40,000 are redo procedures, otherwise known as revisions. The revisions become necessary due to a number of problems that may arise during the lifetime of the implanted components, such as dislocation, component wear and degradation, and loosening of the implant from the bone.

Dislocation of the femoral head from the acetabular component, or cup, is considered one of the most frequent

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early problems associated with THR, because of the sudden physical, and emotional, hardship brought on by the dislocation. The incidence of dislocation following the primary THR surgery is approximately 2-6% and the percentage is even higher for revisions. While dislocations can result from a variety of causes, such as soft tissue laxity and loosening of the implant, the most common cause is impingement of the femoral neck with either the rim of an acetabular cup implant, or the soft tissue or bone surrounding the implant. Impingement most frequently occurs as a result of the malposition of the acetabular cup component within the pelvis.

Some clinicians and researchers have found incidence of impingement and dislocations can be lessened if the cup is oriented specifically to provide for approximately 15° of anteversion and 45° of abduction; however, this incidence is also related to the surgical approach. For example, McCollum et al. cited a comparison of THAs reported in the orthopaedic literature that revealed a much higher incidence of dislocation in patients who had THAs with a posterolateral approach. McCollum, D.E. and W.J. Gray, "Dislocation after total hip arthroplasty (causes and prevention)", Clinical Orthopaedics and Related Research, Vol. 261, p.159-170 (1990). McCollum's data showed that when the patient is placed in the lateral position for a posterolateral THA approach, the lumbar lordotic curve is flattened and the pelvis may be flexed as much as 35°. If the cup was oriented at 15-20° of flexion with respect to the longitudinal axis of the body, when the patient stood up and the postoperative lumbar lordosis was regained, the cup could be retroverted as much as 10°-15° resulting in an unstable cup placement. Lewinnek et al. performed a study taking into account the surgical approach utilized and found that the cases falling in the zone of  $15^{\circ}\pm10^{\circ}$  of anteversion and  $40^{\circ}\pm10^{\circ}$  of abduction have an instability rate of 1.5%, compared with a 6% instability rate for the cases falling outside this zone.



Lewinnek G.E., et al., "Dislocation after total hip-replacement arthroplasties", Journal of Bone and Joint Surgery, Vol. 60-A, No.2, p. 217-220 (March 1978). The Lewinnek work essentially verifies that dislocations can be correlated with the extent of malpositioning, as would be expected. The study does not address other variables, such as implant design and the anatomy of the individual, both of which are known to greatly affect the performance of the implant.

The design of the implant significantly affects 10 stability as well. A number of researchers have found that the head-to-neck ratio of the femoral component is the key factor of the implant impingement, see Amstutz H.C., et al., "Range of Motion Studies for Total Hip Replacements", Clinical Orthopaedics and Related Research Vol. 111, p. 124-15 130 (September 1975). Krushell et al. additionally found that certain long and extra long neck designs of modular implants can have an adverse effect on the range of motion. Krushell, R.J., Burke D.W., and Harris W.H., "Range of motion 20 in contemporary total hip arthroplasty (the impact of modular head-neck components)", The Journal of Arthroplasty, Vol. 6, p. 97-101 (February 1991). Krushell et al. also found that an optimally oriented elevated-rim liner in an acetabular cup implant may improve the joint stability with respect to implant impingement. Krushell, R.J., Burke D.W., and Harris 25 W.H., "Elevated-rim acetabular components: Effect on range of motion and stability in total hip arthroplasty", The Journal of Arthroplasty, Vol. 6 Supplement, p. 1-6, (October 1991). Cobb et al. have shown a statistically significant reduction of dislocations in the case of elevated-rim liners, compared 30 to standard liners. Cobb T.K., Morrey B.F., Ilstrup D.M., "The elevated-rim acetabular liner in total hip arthroplasty: Relationship to postoperative dislocation", Journal of Bone and Joint Surgery, Vol 78-A, No. 1, p. 80-86, (January 1996). The two-year probability of dislocation was 2.19% for the 35



elevated liner, compared with 3.85% for standard liner.

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