A NOVEL CONCEPT FOR FEMORAL NECK ADJUSTMENT USING COMPUTER ASSISTED THA

Eric Stindel MD,PhD[1], Fabrice Bertrand[2], Julien Leboucher[1], Stephane Lavallee PhD[2]

[1] LaTIM UMR 1101 INSERM, Brest University Hospital, FRANCE, eric.stindel@univ-brest.fr

[2] Blue Ortho, Exactech, Grenoble, FRANCE

INTRODUCTION

CAOS systems have been developed since the mid 90's for improving cup & stem placement as well as neck adjustment [1]. The use of image-free navigation for adjusting modular-neck implants has been developed and studied by Merloz [2]. Lecerf et al. have reported that navigation can help to optimize implant neck length in order to minimize discrepancies in leg length and offset [3]. In this paper, we propose a novel concept that is intended to combine prediction of optimal neck using image free navigation data, and instrumentation adapted to minimize reduction/dislocation manoeuvers for testing with trial implants.

MATERIALS AND METHODS

A novel software and instrumentation has been developed on an existing CAOS system (ExactechGPS®, Blue-Ortho, Grenoble, FR).

The HipBall concept designed by Dr Stiehl [4] offers a simple and fast method to optimize the neck length. Tow trackers are placed in the pelvis and femur. The initial conditions are measured and saved. Then, the cup and the stem are implanted using conventional techniques. One instrument equipped with a tracker is used to measure the cup center and the neck (Fig.1). And the CAOS system proposes immediately the optimal neck length to minimize the variation of leg length and offset.

The Modulhips concept offers the possibility to further adjust the version and inclination of the neck using 3 screws mounted on the neck. The Smart Screwdriver device [5] is used to adjust automatically the 3 screws according to a desired target for leg length and offset (among a finite set of possible real modular necks).

Those concepts have been tested on sawbones to assess their initial feasibility.

RESULTS

The concept has been tested successfully on sawbone by an experienced surgeon. Using the Hip Ball concept, it has been shown that a fast and easy process could be used to optimize the neck length to restore the best possible initial leg length and offset, with a system error of less than 2 mm. And using the Modulhips concept, it has been shown that an adjustable modular neck could be effectively used to optimize the theoretical neck selection and offer at the same time a real test without successive manoeuvers of dislocation of the hip.

DISCUSSION

Optimal restauration of leg length and offset during total hip arthroplasty remains a challenge, for which it is necessary to offer simple and fast solutions, with a minimal number of steps, and if possible with only one manoeuver of reduction and no further dislocation manoeuvers for trials. Two methods have been proposed to offer solutions, the first one (Hip Ball) is optimizing the neck length, and the second one (Modulhips) is optimizing the neck length, version and inclination in order to suggest the best possible modular neck to be implanted, based on both theoretical measurements and real testing.

REFERENCES

1. Di Gioia A, Jaramaz B, Blackwell M. Image guided navigation system to measure intraoperatively acetabular implant alignment Clin Orthop. 1998, 355 : 8 – 22
2. Merloz P. Computer assisted hip surgery by using modular-neck femoral components: principles, technique, advantages and limits, Interact Surg. (2008), 3: 139-147
3. Lecerf G, Fessy M H, Philippot R, Massin P, Giraud F, Flecher X, Girard J, Mertl P, Marchetti E, Stindel E. Femoral offset: anatomical concept, definition, assessment, implications for preoperative templating and hip arthroplasty, Orthopaedics and Traumatology: Surgery and Research. 2009, 95: 210-219
4. Stiehl J, Hip implant registration in computer assisted surgery, US Patent 20100261998 A1
5. De la Fuente M, Jeromin S, Boyer A, Billet S, Lavallee S. Smart screwdriver for accurate intuitive surgery using the Exactech GPS system, Proceedings CAOS Orlando 2013.

DISCLOSURES

The co-authors have received a collaboration grant Modulhips from French ANR for this work.

Fabrice Bertrand is current employee of Blue Ortho

Stephane Lavallee is consultant for Blue Ortho.

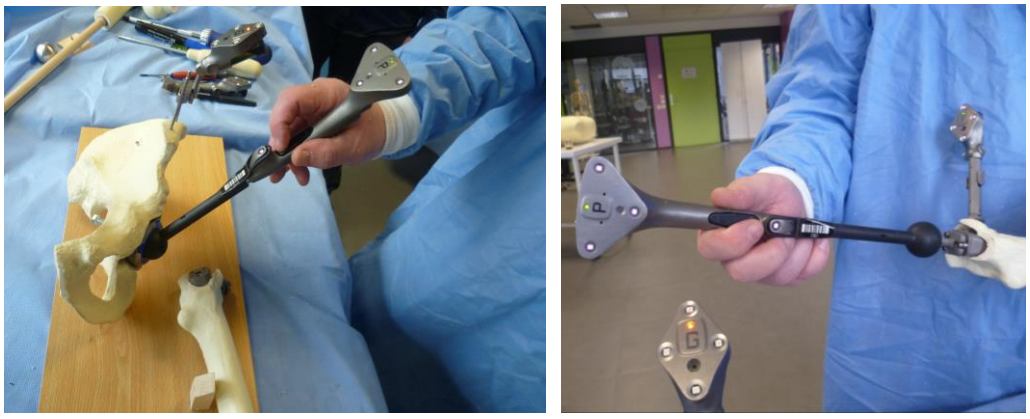

Figure 1. Illustration of the "HipBall" concept with ONE device used to digitize both the cup and the neck.

Figure 2. Illustration of the adjustable modular neck with 3 screws (the screws positions are adjusted using the Smart Screw Driver, not represented here)

A NOVEL CONCEPT FOR FEMORAL NECK ADJUSTMENT USING COMPUTER ASSISTED THA

E. Stindel MD PhD*, F; Bertrand, J. Leboucher, S Lavallee PhD
*LaTIM INSERM UMR1101, Université de Bretagne Occidentale, Brest 29200, France, eric.stindel@univ-brest.fr

CAOS systems have been developed since the mid 90's for improving cup & stem placement as well as neck adjustment. The use of image-free navigation for adjusting modular-neck implants has been developed and studied by Merloz. Lecerf et al. have reported that navigation can help to optimize implant neck length in order to minimize discrepancies in leg length and offset. In this paper, we propose a novel concept that is intended to combine prediction of optimal neck, using image free navigation data, and instrumentation adapted to minimize reduction/dislocation manoeuvers for testing with trial implants.

A novel software and instrumentation has been developed on an existing CAOS system (ExactechGPS®, Blue-Ortho, Grenoble, FR). The HipBall concept designed by Dr Stiehl offers a simple and fast method to optimize the neck length. Tow trackers are placed in the pelvis and femur. The initial conditions are measured and saved. Then, the cup and the stem are implanted using conventional techniques. One specific instrument equipped with a tracker is used to measure the cup center and the neck. Then the CAOS system proposes immediately the optimal neck length to minimize the variation of leg length and offset. The concept has been tested successfully on sawbone by an experienced surgeon.

In conclusion, two methods have been proposed, the first one (Hip Ball) is optimizing the neck length, and the second one (Modulhips) is optimizing the neck length, version and inclination in order to suggest the best possible modular neck to be implanted, based on both theoretical measurements and real testing.