Interact Surg (2007) 2: 220–222

DOI 10.1007/s11610-007-0051-5

ORIGINAL ARTICLE

Reconstructed hip joint architecture with a standard hip arthroplasty with a unique declined offset

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Abstract: Possible advantages of the architectural restoration of the hip joint after total hip arthroplasty (THA) are numerous. The relationship between the femoral offset (FO) and the abductor moment arm and the polyethylene wear, loosening, instability, persistent limp due to *gluteus medius* insufficiency, even dislocation, leg length discrepancy have been reported [1-4]. Architectural and mechanical hip restoration has to be technically easy, reproducible and transmissible. Controversies continue: standard implants or implants with specific offset, variety of series or modular device. We study the influence of using a standard stem series with a progressive unique offset on the hip geometry.

Keywords: Hip restoration – Femoral offset

Introduction

We have drawn 77 cases into a series of 296 consecutive primary THAs performed using the Integrale^{TM} stem during one year in unilateral osteoarthritis without any previous surgery; all contralateral hips were disease-free with normal radiological findings. Acetabular cups were hemispheric cementless cups.

Modular femoral prosthesis has 137° neck-shaft angle. All cases were fully cementless with hydroxyapatite coating; the femoral offset varies with the size of the stem (Table 1) and the selection of the head according the Table 1; FO varies from 38.8 mm to 49.5 mm; the mean FO is 42.7 mm; the neck of the femoral stem is circular (diameter: 10/12 mm); the extra-long neck (skirted head) was never used.

Table 1. Femoral offset varies in an attempt to optimize each hip mechanics based on preoperative radiographs

Head	*ϕ28 Short*	*ϕ28 Medium*	*ϕ28 Long*	*ϕ28 Skirted*
T1	38.8	41.2	43.6	46
T2	39.3	41.7	44.1	46.5
T3	39.8	42.2	44.6	47
T4	40.3	42.7	45.1	47.5
T5	40.8	43.2	45.6	48
T6	41.3	43.7	46.1	48.5
T7	41.8	44.2	46.6	49

T: stem size.

Preoperative planning was based on preoperative anteroposterior standing and supine radiographs of the pelvis with the lower extremities in neutral position using always the contralateral hip to eliminate the stiff hip. FO, cup placement (medialization-lateralization), height of the femoral head center (HC), global offset (GO), abductor moment arm, restoration of the leg length were determined to reproduce hip mechanics using conventional anatomical landmarks with the interteardrop line, lamina densa, top of the greater trochanter, lesser trochanter, symphysis pubis and templates.

Postoperative radiographs of the pelvis, minimum time of 12 months, were analysed and compared according to the Ebra-Fca method [5]. The items of the reconstructed side to that of the non-operated side were then calculated (Metros^{TM} software). *T* test of Student and Wilcoxon test were used with a *P* value of less than 05.

Results

In this clinical series, we observed two intraoperative fractures, which were treated with intertrochanteric wiring, two length leg inequalities with 10 mm shortening, 10 mm lengthening, no revision, no sepsis, no dislocation, no limp and the PMA score was never under 665.

Preoperative FO ranges from 27 to 50 mm (σ: 5.6 mm). Increased FO is noted (mean: 1.7 mm; σ: 4.6 mm; minimum medialization: 6 mm, 14% – maximum lateralization 11 mm, 21%). Three groups were selected (Table 2) based on the neck-shaft angle (coxa vara ≤ 125°; 125 ≤ – ≤ 135°; 135°≤).

The variables for the operated hips measured from the pelvic radiographs are shown in Table 3.

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Table 2. Preoperative FO vs postoperative FO; 45 cases were compared according the Ebra-Fca method

	N	*Mm*	*Ratio %*
Coxa vara ≤ 125°	9	Med. 1.4 mm	Med. 2.2%
	σ	5.2 mm	13.5%
	Mini	Med. 6 mm	Med. 18%
	Maxi	Lat. 7 mm	Lat. 18%
125 ≤ – ≤ 135°	31	Lat. 2.2 mm	Lat. 7.2%
	σ	3.9 mm	11%
	Mini	Med. 6 mm	Med. 13%
	Maxi	Lat. 7 mm	Lat. 19%
Coxa valga 135 ≤	5	Lat.6.8 mm	Lat. 26%
	σ	3.9 mm	
	Mini	Med. 1 mm	Med. 1%
	Maxi	Lat. 11 mm	Lat. 21%
		$P = 0.01$	$P = 0.03$

Med.: medialization; Lat.: lateralization; sigma: standard deviation

Table 3. Postoperative THA FO vs contralateral hip (disease-free). Sixty-six cases were observed according Ebra-Fca method

	N	*mm*	*Ratio %*
Coxa vara ≤ 125°	20	Med.1.4 mm	Med. 2.7%
	σ	4.8 mm	11%
	Mini	Med. 8.3 mm	Med. 20%
	Maxi	Lat. 4 mm	Lat. 13%
125 ≤ – ≤ 135°	36	Lat. 2.9 mm	Lat. 9.6%
	σ	4 mm	7.1%
	Mini	Med. 9 mm	Med. 3%
	Maxi	Lat. 8 mm	Lat. 27%
Coxa valga 135 ≤	10	Lat. 3.9 mm	Lat. 13.4%
	σ	3.9 mm	
	Mini	Med. 1 mm	Med. 3%
	Maxi	Lat. 9 mm	Lat. 29%
		$P = 0.005$	$P = 0.007$

Postoperative radiographic measurements detect a medialization (mean: 7 mm) (Tables 4 and 5).

Discussion

Restoration of normal joint biomechanics on a consistent basis was possible using the Integrale™ stem because of the versatility that stem offers in regards to head center; the center of rotation is located at least ±5 mm compared with the disease-free contralateral hip in 9 out of 10 cases. In this study reconstructed hip function appeared to be achieved through a demanding templating technique to implant the cup and the stem at near normal position. Slightly medializing the lateral position of the acetabular cup is connected with the planning technique using an increased FO and avoiding high cup placement. Mean FO in this serie is 42.7 mm with a 137° neck-shaft angle. Most standard femoral implants are medialized implants and high offset implant are only standard [4]; lateral offset data are available in the literature with a mean FO 42 mm [6]. The similarity of the lateral offset distribution confirms the appropriateness of the head center selection.

Table 4. Preoperative hip center (HC) vs postoperative HC

N	*77*	*Ratio %*
Medialization	7 mm	8.1
σ	7 mm	8
Minimum	Med. 16.5 mm	21
Maximum	Lat. 7.5	10

Table 5. Preoperative global offset (GO) vs postoperative GO

N	*77*	
Medialization	5.5 mm	4.20%
σ	9.6 mm	7.8%
Minimum	Med. 26 mm	Med. 21%
Maximum	Lat. 12.5	Lat. 11%

Delp et al. [7] reported that failure to medialize the cup appeared to have a greater potential negative effect than superior placement. Acetabular components designed with a lateralized center of rotation should not be considered as a means to improve abductor mechanics because, although these designs do result in lateral positioning of the femur, they also increase the body-weight lever arm and thus do not ultimately improve the FO ratio [8].

Medializing the acetabular cup is limited by adequate bone structure; caution is warranted in cases of acetabular deformity, osteoporosis, or otherwise poor bone quality, where stability of fixation clearly must take priority. Potential concerns of over correcting FO with the use of long neck with skirted head may possibly avoided by medializing the acetabular cup because impingement, bursitis, cosmetic implications of trochanteric prominence and an increase in offset led to increased stress at the bone interface and the torsional torque with the use of small-size stems. A new ultimate stem in the serie provides a mean FO 47.1 mm.

This modular implant with a unique decline offset allows leg length adjustments; failure with significant leg length discrepancy is due to improper preoperative planning reconstruction with the relationship between stem size, implant stability, depth of the femoral component, height of the cup.

Anatomical and pathological factors lead to problems with demanding surgical technique, difficult planning, difficult reconstruction of effective hip offset and abductor muscles lever arm, difficult adjustment of leg length with inadequate soft tissue balancing. In such cases there is little correlation between head center location, stem size, FO, neck-shaft angle, version angle. Hip joint reconstruction benefits from the availability of many head centers for every stem size; this may be accomplished with a modular device with different geometries and the CAO even preoperative planning remains the essential stage.

Conclusion

Reconstruction of the hip joint mechanics using a series of standard modular femoral stems with a unique declined offset is safe, effective and provides an architectural restoration with ±5 mm if the series is numerous (seven stems), a neck-shaft angle adequate (137°), an efficient declined femoral offset (mean: 42 mm) and with preoperative planning is a viable solution in unilateral osteoarthritis of the hip joint.

Dislocation and wear debris (lysis) still occur. Improving outcomes needs new technologies as bearing surfaces, modular stems with different geometries and CAO.

Continued long-term follow-up will provide additional information to valid the concepts.

References

1. McGrory BJ, Morrey BF, Cahalan TD, et al. (1995) Effect of femoral offset on range of motion and abductor muscle strength after total hip arthroplasty. J Bone Joint Surg 77-B: 865
2. Amstutz HC, Sakai DN (1975) Total joint replacement for ankylosed hips. J Bone Joint Surg Am 57: 619
3. Devane PA, Horne JG, Martin K, et al. (1997) Three-dimensional polyethylene wear of a press-fit titanium prosthesis. Factors influencing generation of polyethylene debris. J Arthoplasty 12: 256
4. Sakalkale DP, Sharkey PF, Eng K, et al. (2001) Effect of femoral component offset on polyethylene wear in total hip arthroplasty. Clin Orthop 388: 125
5. Biedermann R, Krismer M, Stockl B, et al. (1999) Accuracy of Ebra-Fca in the measurement of migration of femoral components of total hip replacement. Einzel-bild-rontgen-analyse-femoral component analysis. J Bone Joint Surg 81-B: 266
6. Noble PC (1988) The anatomic basis of femoral component design, Clin Orthop: 235
7. Delp SL, Wixon RL, Komatu AV, et al. (1996) How superior placement of the joint center in hip arthroplasty affects the abductor muscles? Clin Orthop 328: 137
8. Asayama I, Chamnongkich S, Simpson KJ, et al. (2005) Reconstructed hip joint position and abductor muscle strength after total hip arthroplasty. J Arthroplasty 20(4): 414