Arch Orthop Trauma Surg (2013) 133:1595–1600
DOI 10.1007/s00402-013-1828-0

HIP ARTHROPLASTY

Surgical approach and prosthesis fixation in hip arthroplasty world wide

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Received: 26 October 2012 / Published online: 4 August 2013

Abstract
Background Hip arthroplasty is one of the most common and successful surgical procedures worldwide. Component design and materials as well as surgical techniques constantly evolve. There is no consensus among surgeons regarding the ideal surgical approach and method of fixation.
Materials and methods 292 orthopedic surgeons of 10 subspecialties from 57 countries were surveyed on their choice of surgical approach and prosthesis fixation in hip arthroplasty. Their preferences were analyzed according to country of origin, field of expertise and seniority, and compared to current publications.
Results The response rate was 95–98 %. Surgeons were split between the posterior approach (45 %) and the direct lateral approach (42 %) followed by the anterior approach (10 %) or other (3 %). North American surgeons favored the posterior approach more often than Europeans (69 % compared to 36 %, $P < 0.0001$) and surgeons from other countries (69 % compared to 45 %, $P = 0.01$). Sixty-eight percent of all surgeons routinely used noncemented hip prosthesis while 16 % use cemented and 16 % hybrid fixation. Noncemented fixation was preferred among surgeons from Europe and North America compared to other countries (73 % compared to 55 %, $P < 0.05$). There were no significant differences based on subspecialty, seniority or the number of years of experience.
Conclusions The most common surgical approaches in use in hip arthroplasty are posterior and lateral. Anterior approach is used by a minority of orthopedic surgeons for that purpose. Cementing hip prosthesis is falling out of favor among orthopedic surgeons worldwide. The trend toward un-cemented hip arthroplasty is not well supported in the current literature.

Keywords Hip · Arthroplasty · Cement · Surgical approach

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Introduction

Hip arthroplasty is one of the most common and successful surgical procedures worldwide. Cemented total hip replacements were the original gold standard, but designs and materials have evolved and new ones have been introduced, among them highly cross-linked polyethylene, metal on metal, ceramics, and their combinations. Prosthetic designs of stem width, shape and coating have also changed. Cemented polished stems are more often being replaced by porous-coated or hydroxyapatite-coated noncemented stems and, in 2003, it was estimated that the latter made up as many as two-thirds of all hip prostheses inserted in the USA [1–3]. The surgical approaches commonly used in hip arthroplasty include the posterior, direct lateral, anterolateral and anterior. There has been much growing interest and considerable research on the use of minimally invasive approaches. These newer approaches involve a lesser degree of acetabular and femoral exposure and may be associated with some complications, such as nerve and muscle damage, risk of fracture and dislocation [4, 5].

Guidelines for diagnosis, treatment and prognosis are ostensibly based on scientific findings rather than on the opinions of experts. Prospective randomized clinical trials are considered the best quality of evidence in the medical

literature, and they are the source for systematic reviews and meta-analyses, together comprising the level-1 evidence and guiding clinical decision making [6, 7]. While physicians are expected to consider high-quality evidence, other factors, such as marketing, peer opinions, preliminary data or lower-quality evidence and tradition also influence decision making [6]. This may be more apparent in areas where high-quality evidence is either not available or inconclusive [7]. Another difficulty with the scientific approach of evidence-based medicine lies in interpreting the outcomes. Clinician-reported outcomes may differ considerably from patient-reported outcomes, making it all that more difficult to judge the advantages of one approach over the other [7].

The purpose of this survey was to determine the current trends and common practices in hip arthroplasty worldwide. We hypothesized that a surgeon's experience, country of origin (in terms of the nature of the infrastructure of medical services and available resources), and area of expertise would influence choices, in addition to guidelines from published level 1 evidence.

Methods

A "PubMed" search was conducted in January 2011 using the key words "hip""+" arthroplasty" or "replacement" and limited to "randomized controlled trials" or "meta-analysis". Two topics with regard to surgical technique in hip replacement were identified as having undergone meta-analyses and multiple randomized controlled trials. They were "preferred surgical approach" and "preferred method of fixation", and they were chosen for analysis by means of a questionnaire. The responders were also asked to provide their country of origin, field of specialty, number of years of experience and professional status (i.e., senior surgeon, fellow or resident).

The survey (Table 1) was distributed to orthopedic surgeons at two major international conferences held in the United States and Europe: The annual meeting of the American academy of orthopedic surgeons (AAOS) held in San Diego, February 2011, and the 2011 EFORT held in Copenhagen, June 2011.

Statistical analysis

A univariate analysis was performed using the Chi square test to detect significant differences in choices between surgeons from different regions of the world (North America, Europe or other), different subspecialties (joint replacement surgery and other), and different levels of experience (seniors, fellows or residents).

Table 1 International survey on hip arthroplasty techniques (circle answer)

In total hip replacement, what is your preferred method of implant fixation?
Cemented
Noncemented
Hybrid
In hip arthroplasty, what is your preferred surgical approach to the hip joint?
Posterior
Direct lateral
Anterior
Other

Results

A total of 292 surgeons of 10 subspecialties (spine, hand, trauma, shoulder, sports, pediatric, joint replacement, foot and ankle, oncology and general orthopedics) took part in this survey. They were comprised of 62 % senior surgeons, 23 % residents, and 15 % fellows from 57 countries (53 % from Europe, 24 % from North America, 8 % from Asia, 7 % from South America, 6 % from the Middle East and 2 % from Africa). The average level of experience was 11 years (range 0–45), and 21 % were hip and adult reconstruction specialists.

The response rate was 95 % for questions on the surgical approach and 98 % for questions about fixation. The surgeons' choices were mainly divided between the posterior approach (45 %) and the direct lateral approach (42 %), followed by the anterior approach (10 %) and others (3 %). North American surgeons favored the posterior approach more often than European surgeons (69 % compared to 36 %, respectively, $P < 0.0001$), and surgeons from other countries (69 % compared to 45 %, respectively $P = 0.01$). There were no significant differences in surgeon's preferences based on subspecialty, seniority or the number of years of experience neither on surgical approach nor fixation. Sixty-eight percent of all surgeons routinely used noncemented hip prosthesis, 16 % use cemented hip prostheses, and 16 % use hybrid fixations. Noncemented fixation was more often preferred among surgeons from Europe and North America than among those from other countries (73 % compared to 55 %, $P < 0.05$), with no significant differences based on subspecialty, experience or seniority (Fig. 1).

Discussion

The purpose of this survey was to investigate which were the actual everyday practices in hip replacement surgery among orthopedic surgeons worldwide, and to determine

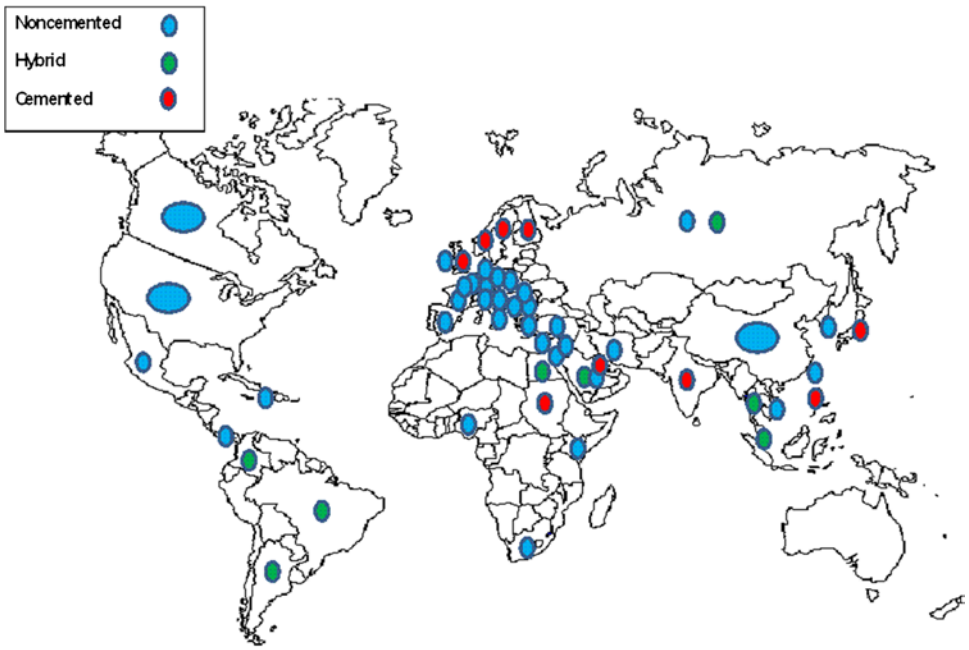

Fig. 1 World-wide preferences of hip prosthesis fixation

whether their choices are supported by published high-quality evidence-based data and/or affected by country of origin, area of expertise and surgeon's seniority and experience.

Surgical approach

The two most commonly reported approaches to the hip joint in arthroplasty are the posterior and the lateral ones. The former is considered easier and less traumatic to perform, but acetabular exposure is more difficult [8, 9]. Historically, the posterior approach was reportedly associated with dislocation rates as high as 4.5 % compared to rates of 0.5–2 % for the anterior or lateral approach [9]. However, more recent publications and meta-analyses showed that when the posterior capsule and soft tissue are repaired, dislocation rates drop to 0.5 %, similar or slightly higher than those reported with the lateral approach [9, 10]. A systematic review and analyses of 4 controlled trials (241 patients) that compared the posterior and lateral approaches found no significant differences in dislocation rates, postoperative pain, Trendelenburg gait and functional results. The posterior approach, however, was associated with lower rates of nerve damage [8, 11]. The authors of that publication concluded that the data do not support favoring one approach over the other and that a good level of evidence can probably be obtained only with a multicenter randomized controlled trial on 1500 patients [8]. Lindgren et al. [9] reviewed 90,662 hip replacement procedures in Sweden and found a higher dislocation rate and a lower rate of aseptic loosening with the posterior approach. Another study that looked at muscle damage also found no differences between the posterior and lateral approaches. Those authors found increased levels of postoperative pain in patients with limited preoperative internal rotation associated with the posterior approach and limited preoperative external rotation associated with the lateral approach [12].

A survey of preferences of trauma surgeons who perform hemiarthroplasties revealed that the posterior approach is favored over the lateral and anterior approaches (47 % compared to 24 and 28 %, respectively) [13]. According to a number of authors, although the anterior approach to the hip can be performed with minimal incision and soft tissue damage and allows shorter rehabilitation time, it may be associated with damage to the lateral femoral cutaneous nerve in up to 70 % of the cases [4, 5]. In contrast, controlled trials that compared hip replacement by the anterior approach to hip replacement by the lateral approach found no differences in nerve damage (only 2 %), functional outcome, gait pattern and in other complications [4, 14, 15]. However, the early postoperative functional outcome, was better and hospitalization was shorter among patients who were operated on using the anterior approach, supporting the argument about a shorter rehabilitation time [4, 14]. Another randomized controlled trial that compared the anterior and lateral approaches in a population of elderly patients with hip fractures who were treated with hemiarthroplasty demonstrated similar rates of positive Trendelenburg sign (8.3–12.5 %), longer operative time and higher early postoperative levels of pain in the anterior approach group [16].

The results of the current survey showed that the posterior and lateral approaches are being used equally in hip arthroplasty, followed by the anterior approach. These

results correlate with the published data that do not support favoring one approach over the other. The less popular anterior approach is more demanding and mostly used with minimally invasive incisions. We have no explanation for our finding that so many North American surgeons favored the posterior approach. We also found no correlation between surgeon's experience and specialty and preference of approach. A larger survey is probably required to determine which surgeons tend to use the anterior approach.

Component fixation

Historically, low-friction cemented arthroplasty were introduced by Charnley and proved to survive at the 25 year follow-up in up to 80 % of the patients [1]. Advancements in technology led to the introduction of high-viscosity cement and advanced cementation techniques as well as new materials and designs allowing noncemented fixation. Stems and cups with porous coating and hydroxyapatite coating that allow bone ingrowth and direct bone-prosthesis fixation are being used more and more. In 2003, an estimated two-thirds of all primary hip arthroplasties in the USA were performed with un-cemented fixation, while cemented fixation is still standard in other countries. [1–3].

Probably of the greatest concern regarding component fixation is survival of the prosthesis and aseptic loosening rates. Earlier data from a Scandinavian registry that included thousands of procedures supported the use of cemented fixation, having shown a 85–99 % survival of stem and cup at 5–8 years [3, 17]. More recent data from this registry, however, found better implant survival with the use of un-cemented hydroxyapatite-coated stems in patients younger than 60 years [18]. The nordic arthroplasty register association reported the highest implant survival in Sweden, where 89 % of the implants are cemented [19]. There is some evidence that supports better long-term survival of un-cemented femoral titanium stems (100 % compared to 84 % for cemented stems after 10 years) [20], CLS Spotorno stem (100 % at 10 years and 99 % at 17 years) [21] and of Mallory head stems (12/124 cemented stems revised compared to 1/126 revisions for un-cemented stems after 6.3 years) [22], although there were no differences between cemented and un-cemented acetabular cup revisions [20, 22]. Another study that focused on younger adults (age < 65 years) found that un-cemented femoral stems subsided and rotated into retroversion within the first 3 months after surgery, but remained stable after that for a mean follow-up of 8 years [23]. On the acetabular side, Burston et al. [24] reported better survival rates of their cemented cups (2.7 % revisions) compared to the un-cemented components (21.8 % revisions), at the 16 year follow-up of 191 patients. In a review of the literature, Clement et al. state that there is no consensus with regard to the optimal fixation mode of the acetabular component and that most surgeons from Scandinavia, England and Wales prefer to use cement. With 11 articles meeting their inclusion criteria they found better overall survival and significantly lower dislocation rates with acetabular cement fixation [25].

In a meta-analysis in which cemented and un-cemented fixation were compared in 20 studies (4 randomized trials), the authors found no advantage to either of the methods for the overall population. However, subgroup analyses showed that titanium stems were more suitable for un-cemented fixation, that stainless steel stems were more suitable for cemented fixation, and that un-cemented stems outlasted cemented stems in publications after the year 1995 [1, 2]. Young patients reportedly have higher failure rates compared to the general population, but they may have an advantage when using un-cemented fixation [1]. In contrast, Kim et al. found no differences between cemented, un-cemented and hybrid fixation in patients younger than 50 years who had a mean follow-up of 18.4 years. [26]. Corten et al. [27] recently published their results of a comparison between cemented and un-cemented fixation after a 20 year follow-up showing fewer revisions with the use of un-cemented fixation (24.6 % compared to 38.7 % all cause revision rate, 0 % compared to 19.4 % femoral stem revision rate and 17.5 % compared to 32.3 % acetabular cup revision rate for un-cemented and cemented components respectively).

Complications of cement fixation other than the ones cited above include fat emboli, deep vein thrombosis, heterotopic ossification, infection and periprosthetic fractures. Cementation of the femoral canal was associated with an increased risk of subclinical, asymptomatic fat embolus in one study [28] but not in another [29]. Further studies demonstrated that the use of vacuum drainage during cement insertion, as opposed to the conventional cementing technique, significantly reduced the rates of fat emboli as detected by trans-esophageal echocardiography and blood gas studies, but that it had no effect on fat emboli syndrome [30, 31].

Studies that compared deep vein thrombosis and heterotopic ossification reported no differences between cemented and un-cemented fixation [31, 32]. The risk of infection may be increased by 1.8-fold with the use of regular cement, but is similar to that of un-cemented fixation with the use of antibiotic impregnated cement [33].

While the evidence in favor of un-cemented fixation in hip replacement is not strong, the current survey identified a clear preference for not using cement (only 16 % of the responding surgeons reported using cement for all components and another 16 % reported using hybrid fixation). We believe that while surgical success rates may not be clearly superior, the un-cemented approach has other benefits, such

as shorter surgical time, easier prosthesis removal in case of a need for revision, and other advantages that affect the surgeon's choice. Commercial interests may also play a role, since new and innovative devices often provide greater revenue. It has yet to be proven whether un-cemented fixation is truly superior and that it will replace the use of cement fixation in primary hip replacement.

We hypothesized that the field of subspecialty, seniority and experience would influence the surgeon's choice. It was found that geography has a much stronger impact on surgeons preferences (Fig. 1).

The results of this study are based on a survey among surgeons. As such, it does not necessarily reflect true patient's data, or even the opinion of the entire orthopedic community. The results should be interpreted with caution and regarded as evidence level 5—expert opinion. The high response rate reflects the fact that questioners were handed and not mailed.

Conclusions

The posterior and lateral surgical approaches are the ones most commonly used for hip arthroplasty. The anterior approach is used by a minority of orthopedic surgeons. Cemented hip prosthesis is falling out of favor among orthopedic surgeons worldwide, even though the trend toward un-cemented hip arthroplasty is not well supported by high-quality evidence in the current literature.

Acknowledgments Esther Eshkol is thanked for editorial assistance.

References

1. Morshed S, Bozic KJ, Ries MD, Malchau H, Colford JM Jr (2007) Comparison of cemented and uncemented fixation in total hip replacement: a meta-analysis. Acta Orthop 78(3): 315–326
2. Huo MH, Osier CJ (2008) Is cement still a fixation option for total hip arthroplasty? J Arthroplast 23(7 Suppl):51–54
3. Puolakka TJ, Pajamäki KJ, Pulkkinen PO, Nevalainen JK (1999) Poor survival of cementless Biomet total hip: a report on 1,047 hips from the finnish arthroplasty register. Acta Orthop Scand 70(5):425–429
4. Restrepo C, Parvizi J, Pour AE, Hozack WJ (2010) Prospective randomized study of two surgical approaches for total hip arthroplasty. J Arthroplast 25(5):671-9.e1
5. Barton C, Kim PR (2009) Complications of the direct anterior approach for total hiparthroplasty. Orthop Clin North Am 40(3):371–375
6. Kuhn JE, Dunn WR, Spindler KP (2005) Evidence-based medicine for orthopedic surgeons. J Knee Surg 18(1):57–63
7. Suk M, Hanson B, Helfet DL (2010) Evidence-based orthopedic surgery: is it possible? Orthop Clin North Am 241(2):139–143
8. Jolles BM, Bogoch ER (2004) Surgical approach for total hip arthroplasty: direct lateral or posterior? J Rheumatol 31(9): 1790–1796
9. Lindgren V, Garellick G, Kärrholm J, Wretenberg P (2012) The type of surgical approach influences the risk of revision in total hip arthroplasty. Acta Orthop 83(6):559–565
10. Kwon MS, Kuskowski M, Mulhall KJ, Macaulay W, Brown TE, Saleh KJ (2006) Does surgical approach affect total hip arthroplasty dislocation rates? Clin Orthop Relat Res 447:34–38
11. Jolles BM, Bogoch ER (2006) Posterior versus lateral surgical approach for total hip arthroplasty in adults with osteoarthritis. Cochrane Database Syst Rev 9(3):CD003828
12. Teratani T, Naito M, Shiramizu K (2010) Intraoperative muscle damage in total hip arthroplasty. J Arthroplast 25(6):977–981 Epub 2009 Jul 4
13. Kakar S, Tornetta P 3rd, Schemitsch EH, International Hip Fracture Research Collaborative et al (2007) Technical considerations in the operative management of femoral neck fractures in elderly patients: a multinational survey. J Trauma 63(3):641–646
14. Alecci V, Valente M, Crucil M, Minerva M, Pellegrino CM, Sabbadini DD (2011) Comparison of primary total hip replacements performed with a direct anterior approach versus the standard lateral approach: perioperative findings. J Orthop Traumatol 12(3):123–129
15. Müller M, Schwachmeyer V, Tohtz S, Tohtz S, Duda GN, Perka C, Heller MO (2012) The direct lateral approach: impact on gait patterns, foot progression angle and pain in comparison with a minimally invasive anterolateral approach. Arch Orthop Trauma Surg 132(5):725–731
16. Auffarth A, Resch H, Lederer S, Karpik S, Hitzl W, Bogner R, Mayer M, Matis N (2011) Does the choice of approach for hip hemiarthroplasty in geriatric patients significantly influence early postoperative outcomes? A randomized-controlled trial comparing the modified Smith-Petersen and Hardinge approaches. J Trauma 70(5):1257–1262
17. Havelin LI, Espehaug B, Vollset SE, Engesaeter LB (1995) The effect of the type of cement on early revision of Charnley total hip prostheses. A review of eight thousand five hundred and seventy-nine primary arthroplasties from the Norwegian arthroplasty register. J Bone Joint Surg Am 77(10):1543–1550
18. Havelin LI, Engesaeter LB, Espehaug B, Furnes O, Lie SA, Vollset SE (2000) The Norwegian arthroplasty register: 11 years and 73,000 arthroplasties. Acta Orthop Scand 71(4):337–353
19. Havelin LI, Robertsson O, Fenstad AM, Overgaard S, Garellick G, Furnes O (2011) A Scandinavian experience of register collaboration: the nordic arthroplasty register association (NARA). J Bone Joint Surg Am 21(93 Suppl 3):13–19
20. Emerson RH Jr, Head WC, Emerson CB, Rosenfeldt W, Higgins LL (2002) A comparison of cemented and cementless titanium femoral components used for primary total hip arthroplasty: a radiographic and survivorship study. J Arthroplast 17(5):584–591
21. Müller LA, Wenger N, Schramm M, Hohmann D, Forst R, Carl HD (2011) 17-year follow-up of the rough-blasted threaded Weill cup in uncemented total hip arthroplasty. Arch Orthop Trauma Surg 131(4):557–561
22. Laupacis A, Bourne R, Rorabeck C, Feeny D, Tugwell P, Wong C (2002) Comparison of total hip arthroplasty performed with and without cement: a randomized trial. J Bone Joint Surg Am. 84(A10):1823–1828
23. Ström H, Kolstad K, Mallmin H, Sahlstedt B, Milbrink J (2006) Comparison of the uncemented Cone and the cemented Bimetric hip prosthesis in young patients with osteoarthritis: an RSA, clinical and radiographic study. Acta Orthop 77(1):71–78
24. Burston BJ, Barnett AJ, Amirfeyz R, Yates PJ, Bannister GC (2012) Clinical and radiological results of the collarless polished tapered stem at 15 years follow-up. J Bone Joint Surg Br 94(7):889–894
25. Clement ND, Biant LC, Breusch SJ (2012) Total hip arthroplasty: to cement or not to cement the acetabular socket? A

critical review of the literature. Arch Orthop Trauma Surg 132(3):411–427
26. Kim YH, Kim JS, Park JW, Joo JH (2011) Comparison of total hip replacement with and without cement in patients younger than 50 years of age: the results at 18 years. J Bone Joint Surg Br 93(4):449–455
27. Corten K, Bourne RB, Charron KD, Au K, Rorabeck CH (2011) Comparison of total hip arthroplasty performed with and without cement: a randomized trial. A concise follow-up, at twenty years, of previous reports. J Bone Joint Surg Am 20 93(14):1335–1338
28. Kim YH, Oh SW, Kim JS (2002) Prevalence of fat embolism following bilateral simultaneous and unilateral total hip arthroplasty performed with or without cement : a prospective, randomized clinical study. J Bone Joint Surg Am 84(A8):1372–1379
29. Christie J, Burnett R, Potts HR, Pell AC (1994) Echocardiography of transatrial embolism during cemented and uncemented hemiarthroplasty of the hip. J Bone Joint Surg Br 76(3):409–412
30. Koessler MJ, Fabiani R, Hamer H, Pitto RP (2001) The clinical relevance of embolic events detected by transesophageal echocardiography during cemented total hip arthroplasty: a randomized clinical trial. Anesth Analg 92(1):49–55
31. Pitto RP, Koessler M, Kuehle JW (1999) Comparison of fixation of the femoral component without cement and fixation with use of a bone-vacuum cementing technique for the prevention of fat embolism during total hip arthroplasty. A prospective, randomized clinical trial. J Bone Joint Surg Am 81(6):831–843
32. Nayak KN, Mulliken B, Rorabeck CH, Bourne RB, Woolfrey MR (1997) Prevalence of heterotopic ossification in cemented versus noncemented total hip joint replacement in patients with osteoarthrosis: a randomized clinical trial. Can J Surg 40(5):368–374
33. Engesaeter LB, Espehaug B, Lie SA, Furnes O, Havelin LI (2006) Does cement increase the risk of infection in primary total hip arthroplasty? Revision rates in 56,275 cemented and uncemented primary THAs followed for 0–16 years in the Norwegian arthroplasty register. Acta Orthop 77(3):351–358