NATIONAL INSTITUTE FOR CLINICAL EXCELLENCE

INTERVENTIONAL PROCEDURES PROGRAMME

Interventional procedures overview of minimally invasive two-incision surgery for total hip replacement

Introduction

This overview has been prepared to assist members of the Interventional Procedures Advisory Committee (IPAC) in making recommendations about the safety and efficacy of an interventional procedure. It is based on a rapid review of the medical literature and specialist opinion. It should not be regarded as a definitive assessment of the procedure.

Date prepared

This overview was prepared in May 2004.

Procedure name

- Minimally invasive two-incision surgery for total hip replacement.

Procedure number

240

Specialty societies

- British Orthopaedic Association

Indication(s)

The most common indication for a total hip replacement is degenerative arthritis (osteoarthritis) of the hip joint. Other indications include rheumatoid arthritis, injury, bone tumours, and necrosis of the hip bone.

Current treatment and alternatives

Conservative treatments for arthritis include medications for pain and inflammation, and physiotherapy. If conservative treatments fail, a hip replacement may be necessary.

A traditional hip replacement involves making a large incision (20 to 30cm) above the hip joint and cutting through the muscles, ligaments and tendons to access the joint. The head and neck of the femur is removed by cutting it with a saw and replaced with a metal ball and stem. The surface layer of the socket is removed and an artificial socket is attached to the hip bone. Special glue, or cement, may be used to bond the artificial joint to the existing bone (cemented procedure) or the artificial parts may be

made of a porous material that allows bone to grow into the pores to hold the parts in place (uncemented).

What the procedure involves

Two small incisions (3 to 6 cm in length) are made, one at the front of the hip directly over the femoral neck and one at the back in line with the femoral canal. Fluoroscopy may be used to define the femoral neck before the incisions are made and to confirm the position of instruments and prostheses during the procedure. The muscles are retracted to expose the joint capsule. After the capsule is divided and retracted, using specially designed illuminated retractors, a saw is used to remove the femoral head and neck. Specially designed reamers are used to prepare the socket and a specially designed inserter is used to position the artificial socket through the front incision. Specialised reamers are used to prepare the femoral canal before the stem is inserted through the posterior incision. The prosthetic head is placed on the stem, gently impacted in place and the incisions are closed.

This procedure uses the same prostheses that would be used in a conventional hip replacement. The minimally invasive two-incision surgery entails less muscle and tendon trauma than conventional surgery. The potential advantages include a faster and less painful recovery, reduced blood loss, less scarring and a shorter hospital stay.

Efficacy

Results on this procedure have been published from five centres, describing a total of 517 patients.[1-4] Efficacy outcomes were poorly reported and mainly focused on the operating time and length of hospital stay, rather than the function of the prosthesis. One study reported on 30 patients after a minimum follow-up of one year and found that 91% of the implanted femoral stems were in a neutral alignment.[2] All the prostheses (30/30) had tissue ingrowth and had not migrated. In one study of 142 patients followed up for between 6 weeks and 2 years, the acetabular components were satisfactory in 99% (141/142) of patients.[1] The mean operating time was reported by all five centres and ranged from 62 minutes to 101 minutes. In four studies, the proportion of patients discharged from hospital within 24 hours of the surgery ranged from 77% (58/75) to 90% (90/100).[2,3]

There are no published studies comparing the efficacy of the minimally invasive two-incision hip replacement with a conventional total hip replacement. A large UK study of 1198 conventional total hip replacements reported a failure rate of approximately 9% (44/499), with clinical and radiological assessment, after a follow-up period of five years.[5] 3% (35/1080) of prostheses had undergone revision for loosening, infection, and recurrent dislocation.

An American study reported a median hospital stay of 5 days for 58,521 elective primary total hip replacements performed in 1995 and 1996.[6] The median length of hospital stay for all patients with a total hip replacement in NHS hospitals in England during 2002 and 2003 was 9 days.[7]

Specialist Advisors stated that there was some uncertainty about the long term outcome of this procedure, compared with a conventional total hip replacement.

Safety

Femoral fracture was reported as a complication in all five studies, affecting between 1% (1/100) and 3.5% (5/142) of patients. One study reported that 21% (16/75) of patients suffered from hypoesthesia of the anterior part of the thigh.[3] Other less common complications that occurred in less than 1% of patients across all five

studies included hip dislocation (5 people), infection (4 people), deep vein thrombosis (3 people), heterotopic bone formation (3 people), partial femoral nerve palsy (2 people), stem subsidence (2 people), haematoma (1 person) and bowel obstruction (1 person).

There are no published studies comparing the safety of the minimally invasive two-incision hip replacement with a conventional total hip replacement. A large UK study of 1198 conventional total hip replacements reported a femoral fracture in 2% (20/1130) of operations.[5] Postoperative complications in 1080 patients included urinary retention (6%), dislocation (5%), pulmonary embolism (3%), wound infection (3%), deep vein thrombosis (3%), loosening of the prosthesis (2%), deep infection (1%), and upper gastrointestinal haemorrhage (1%).

Specialist Advisors stated that malposition of components, nerve damage, vascular damage and femoral fracture were theoretical adverse events which may potentially be associated with this procedure.

Literature review

Rapid review of literature

The medical literature was searched to identify studies and reviews relevant to minimally invasive two-incision surgery for total hip replacement. Searches were conducted via the following databases, covering the period from their commencement to May 2004: MEDLINE, PREMEDLINE, EMBASE, Cochrane Library and Science Citation Index. Trial registries and the Internet were also searched. No language restriction was applied to the searches.

The following selection criteria (Table 1) were applied to the abstracts identified by the literature search. Where these criteria could not be determined from the abstracts the full paper was retrieved.

Table 1 Inclusion criteria for identification of relevant studies

Characteristic	Criteria
Publication type	Clinical studies included. Emphasis was placed on identifying good quality studies. Abstracts were excluded where no clinical outcomes were reported, or where the paper was a review, editorial, laboratory or animal study.
Patient	Patients with degeneration of the hip joint
Intervention/test	Minimally invasive two-incision surgery for total hip replacement
Outcome	Articles were retrieved if the abstract contained information relevant to the safety and/or efficacy.
Language	Non-English-language articles were excluded unless they were thought to add substantively to the English-language evidence base.

List of studies included in the overview

Three published articles and a conference abstract were identified, describing the results of case-series from five centres. [1,2,3,4]

A Health Technology Report on minimally invasive hip arthroplasty was published in 2003. [8] This report did not identify any publications with outcome data on the minimally invasive two-incision procedure in the peer-reviewed literature.

Table 2 Summary of key efficacy and safety findings on minimally invasive two-incision surgery for total hip replacement

Study Details	Key efficacy findings	Key safety findings	Comments
Irving JF, 2004[1] Case series 2001 – 2003 USA 142 patients Mean weight: 78.7 kg (range 45.9 – 159 kg) Follow-up: 6 weeks to 2 years Indications: Osteoarthritis No patients were excluded based on BMI, age, physical or social situation.	Mean operating time = 65 minutes Discharged home on postoperative day 3 or 4 = 28% (23/82) Using a cane by hospital discharge = 50% (71/142) Using a cane by 3rd week = 98% (135/142) Not using a cane after 1 month = 75% (107/142) No components were revised for loosening. Acetabular component angles were satisfactory in 99% (141/142) patients.	**Complications** Intraoperative proximal femoral cracks = 3.5% (5/142) Deep vein thrombosis = 1.4% (2/142) Superficial infections = 2.1% (3/142) Haematoma requiring readmission = 0.7% (1/142) Grade 4 heterotopic bone = 0.7% (1/142) Transient numbness = 2.1% (3/142) Anterior dislocations = 2.1% (3/142)	All patients with osteoarthritis undergoing total hip replacement were treated with this procedure during the study period. 25 patients had simultaneous bilateral procedures during the same time period. Results for these patients were not presented. Fluoroscopy was not used for implant positioning. 19 cemented stems, 123 uncemented stems. No details of follow-up compliance.

Study Details	Key efficacy findings	Key safety findings	Comments
Berger RA, 2003[2] Case series 2001 USA 100 patients Mean age: 55 years (range 30 to 76 years) Mean weight: 176 lb 30 patients with minimum 1-year follow-up Indications: osteoarthritis, developmental dislocation of the hip, osteonecrosis Exclusion criteria: patients with morbid obesity, marked abnormal hip anatomy, prior surgery (other than core decompression), or complete hip dislocation.	Patients electing to go home the same day as surgery = 85% (75/88) Patients electing to go home the day after surgery = 15% (13/88) Mean operative time for the last 88 patients = 101 minutes (range 80 to 120 minutes) Radiographic analysis after minimum 1-year follow-up (n = 30): Femoral stems in neutral alignment = 91% Stems between neutral and 3° valgus = 100% Ingrowth of prostheses without migration = 100% Mean abduction angle = 45° (range 36° - 54°)	**Complications** Femoral fracture = 1% (1/100) (stem removed and replaced without extending the incisions. 1.5 years postoperative – stem has ingrown and fracture healed) No dislocations, infections or reoperations were reported.	Consecutive recruitment. The first five patients were lean with relatively normal anatomy of the hip. As experience was gained, the procedure was done successfully on heavier patients. Paper presents radiographic analysis of first 30 patients only, followed up for a mean of 18 months. Uncemented.

Study Details	Key efficacy findings	Key safety findings	Comments
Duwelius PJ, 2003[3] Case series USA (four centres) **Centre 1**: 100 patients Mean age: 57 years for men, 60 years for women Mean weight: 184 lb for men, 141 lb for women Follow-up: 1 year Indications: osteoarthritis, osteonecrosis, rheumatoid arthritis Inclusion criteria: weight less than 220lb, <75 years old, no major comorbidities, osteoporosis, or cognitive impairment and no prior surgery on ipsilateral hip	Patients discharged home with 24 hours = 90% (90/100) Patients discharged on 2nd postoperative day = 10% (10/100) Mean operating time = 90 minutes (range 80 – 120 minutes) Mean Harris hip score improved from 52 points preoperatively to 90 points at one year postoperatively (maximum score possible 100)	**Complications** Posterior hip dislocations = 2% (2/100) (treated with closed reduction and use of a brace for 6 weeks) Stem subsidence and loosening of femoral component, requiring revision = 1% (1/100) Femoral fracture = 1% (1/100) (healed without incident) Infection around prosthesis = 1% (1/100) (9 months postoperatively, probably due to haematogenous infection from a lung abscess)	Selected group of patients. Uncemented.
Centre 2: 100 patients (56 men, 44 women) Mean age: 56 years Mean weight: 194 lb for men, 148 lb for women Mean follow-up: 1 year (range 3 months to 18 months) Indications: osteoarthritis, developmental hip dysplasia, osteonecrosis, trauma. **Centre 3**: 100 patients (see reference 1 for details)	Patients discharged home within 24 hours = 77% (77/100) Mean operating time = 62 minutes (range 38 – 140 minutes)	**Complications** Femoral fractures = 2% (2/100) Deep vein thrombosis = 1% (1/100) Bowel obstruction = 1% (1/100)	Selected group of patients. Uncemented.

Study Details	Key efficacy findings	Key safety findings	Comments
Duwelius PJ, 2003[3] (continued) **Centre 4**: 75 patients, 3 with a bilateral procedure Mean age: 58 years for men, 62 years for women Mean weight: 229 lb for men, 184 lb for women Indications: osteoarthritis, post-traumatic arthritis, developmental hip dysplasia, rheumatoid arthritis.	Patients discharged on day of surgery = 9% (7/75) Patients discharged within 24 hours of surgery = 77% (58/75) Mean operating time = 85 minutes (range 55 – 125 minutes)	**Complications** Femoral fracture = 3% (2/75) (treated with a cerclage wire, healed uneventfully) Asymptomatic stem subsidence = 1% (1/75) Grade I heterotopic bone = 3% (2/75) Partial femoral nerve palsies= 3% (2/75) (fully resolved within 8 weeks) Hypoesthesia of the anterior part of the thigh = 21% (16/75) (9 had full recovery, 7 had partial resolution)	Consecutive patients. Uncemented.
Berger RA, 2004[4] Case series USA 30 patients Mean age: 54 years (range 29 to 68 years) Mean follow-up: 25 months	Mean time on crutches = 5 days Mean time using a cane = 8 days Mean time to be off all narcotics = 6 days Mean time to return to work = 8 days Radiographic analysis: Femoral stems in neutral alignment = 91% Mean abduction angle = 45° (range 36° - 54°)	**Complications** Femoral fracture = 3.3% (1/30) No dislocations, no failure of ingrowth, no reoperations.	Conference abstract. Patients likely to also be included in Berger, 2003.[2] No patients were lost to follow-up.

Validity and generalisability of the studies

- The longest reported mean follow-up was 25 months.
- Two of the study centres excluded patients with morbid obesity and those with prior hip surgery.
- There are differences in the techniques used to perform this procedure; fluoroscopy may or may not be used for implant positioning.

Specialist advisors' opinions

Specialist advice was sought from consultants who have been nominated or ratified by their Specialist Society or Royal College.

- The procedure is technically challenging and training is important.

Issues for consideration by IPAC

None.

References

1 Irving JF. Direct two-incision total hip replacement without fluoroscopy. *Orthopaedic Clinics of North America* 2004; 35: 173 – 181.

2 Berger RA. Total hip arthroplasty using the minimally invasive two-incision approach. *Clinical Orthopaedics and Related Research* 2003; 417: 232 – 241.

3 Duwelius PJ, Berger RA, Hartzband MA, and Mears DC. Two-incision minimally invasive total hip arthroplasty: operative technique and early results from four centers. *Journal of Bone and Joint Surgery* 2003; 85: 2240 – 2242.

4 Berger RA. Minimally invasive total hip arthroplasty using a two incision technique. *American Academy of Orthopaedic Surgeons 2004 Annual Meeting conference abstract 207*. March 2004.

5 Fender D, Harper WM, and Gregg PJ. Outcome of Charnley total hip replacement across a single health region in England. *Journal of Bone and Joint Surgery* 1999; 81: 577 – 581.

6 Phillips CB, Barrett JA, Losina E, Mahomed NN, Lingard EA, Guadagnoli E, et al. Incidence rates of dislocation, pulmonary embolism, and deep infection during the first six months after elective total hip replacement. *Journal of Bone and Joint Surgery* 2003; 85: 20 – 26.

7 Department of Health. Hospital Episode Statistics. London: HMSO, 2003. Available from www.dh.gov.uk (accessed 05/08/2004).

8 Hailey D. Minimally invasive hip arthroplasty. HTA Initiative # 8. Calgary Health Region and Alberta Heritage Foundation for Medical Research, 2003.

Appendix A: Literature search for minimally invasive two-incision surgery for total hip replacement

The following search strategy was used to identify papers in Medline. A similar strategy was used to identify papers in EMBASE, Current Contents, PreMedline and all EMB databases.

For all other databases a simple search strategy using the key words in the title was employed.

#	Search History
1	hip arthroplasty.mp. [mp=ti, ab, rw, sh]
2	hip replacement.mp. [mp=ti, ab, rw, sh]
3	1 or 2
4	total.mp. [mp=ti, ab, rw, sh]
5	3 and 4
6	2 incision.mp. [mp=ti, ab, rw, sh]
7	two incision.mp. [mp=ti, ab, rw, sh]
8	6 or 7
9	5 and 8
10	minimally invasive.mp. [mp=ti, ab, rw, sh]
11	3 and 10