Available online at www.sciencedirect.com

SciVerse ScienceDirect

journal homepage: www.elsevier.com/locate/jor

Original Article

Resurfacing hip arthroplasty in neuromuscular hip disorders – A retrospective case series

Francois Tudor*, Amir Ariamanesh, Anish Potty, Aresh Hashemi-Nejad

Paediatric & Young Adult Hip Department, Royal National Orthopaedic Hospital Trust, Stanmore HA7 4LP, England, UK

ARTICLE INFO

Article history:

Received 27 December 2012

Accepted 1 June 2013

Available online 13 August 2013

Keywords:

Hip

Neuromuscular

Arthroplasty

Resurfacing

ABSTRACT

Background: Management of the degenerate hip in patients with neuromuscular conditions should be aimed at improving quality of life and ease of nursing care. Arthroplasty poses a significant challenge with predisposition to dislocation and loosening due to anatomical abnormalities, soft tissue contractures and impaired muscle tone.

Methods: We present a series of 11 hips (9 patients) following total hip resurfacing arthroplasty for painful osteoarthritis in patients with differing neuromuscular conditions. Patients were assessed clinically and radiographically and also for satisfaction of their carers due to improved ability to provide nursing care.

Mean patient age was 33.1 years (range 13–49 years) with mean follow up at publication 63.7 months (41–89 months). All patients were operated by a single surgeon (AHN) and received the required post operative care and physiotherapy. Soft tissue releases were performed when necessary. All hips were assessed clinically and radiographically at 6 weeks and 6 months and 1 year post-operatively. Six month follow-up also included a questionnaire with scoring of care-provider satisfaction.

Results: Ten hips had good clinical results with improvement in pain and function and radiologically showed no signs of loosening. One hip required revision to proximal femoral excision due to dislocation and loose acetabular component with severe pain. None of the other hips dislocated.

Analysis of care provider satisfaction assessing ability to provide personal care, positioning and transferring, comfort, interaction and communication scored excellent to good in 10 patients and satisfactory in one.

Conclusion: We believe hip resurfacing arthroplasty to be a viable option in the treatment of the complex problem of osteoarthritis in the hips of patients with neuromuscular disease. The improved biomechanics confer greater stability when compared to conventional total hip arthroplasty. Although technically demanding, a successful result has been shown to improve patient pain, function and ease of nursing care.

Level of evidence: Level IV.

Copyright © 2013, Professor P K Surendran Memorial Education Foundation. Publishing Services by Reed Elsevier India Pvt. Ltd. All rights reserved.

* Corresponding author.

E-mail address: francoistudor@yahoo.co.uk (F. Tudor).

1. Introduction

Neuromuscular disorders, particularly cerebral palsy, result in abnormal muscle tone and muscle imbalances around the hip, leading to abnormal position of the thigh, typically adducted and flexed. Associated abnormal anatomy including excessive femoral anteversion and coxa valga may lead to subluxation or dislocation and often a degree of acetabular dysplasia.¹ If undetected, these changes may lead to secondary arthritis of the hip, resulting in a pain and further disability.²

Neuromuscular disease poses many problems for the hip surgeon, requiring a complex and multidisciplinary management approach. Often due to difficulties with communication, osteoarthritis is difficult to diagnose and often late in its presentation. Management is aimed at controlling pain and improving the mobility of the patient to help with nursing care, hygiene and transfers. The hips in these patients may be dislocated or subluxed³ and often have significant contractures, paresis and spasticity and associated proximal femoral deformity, complicating the management further.^{1,4}

In the past the degenerate hip in a patient with a neuromuscular condition was managed with a salvage procedure such as proximal femoral excision but this has been shown to be unreliable in its relief of pain.^{5,6} Attempts at treatment with total hip arthroplasty have shown some good results but concerns remain about hip instability and dislocation rate.^{5,7} The use of constrained components has been advocated in patients with an increased risk of dislocation such as those with cerebral palsy or spinal injury but these implants have an associated risk of early failure due to aseptic loosening.⁸

Due to improved biomechanics conferring improved stability, we believe that resurfacing total hip replacement is a potential solution with a lower dislocation risk⁹ and we have started to use it for patients with neuromuscular conditions in our unit. We present a series of eleven hips with a unique attempt to correlate the surgical outcome with an improvement in the ease of care provision by their carers.

2. Patients & methods

Nine patients (eleven hips) with neuromuscular disease and a painful, degenerate and unstable hip were treated in our unit between September 2005 and June 2009 with hip resurfacing arthroplasty. The indication for surgery was moderate to severe pain that interfered with daily activity and created problems with hygiene, transferring and general care in the presence of joint degeneration.

Mean patient age was 33.1 years (range 13–49 years) and 4 patients were male. Four patients suffered from cerebral palsy, one from spinal cord injury, one from a severe head injury, one from hereditary spastic paraparesis, one from poliomyelitis and one from an extra pyramidal disorder. Two patients had previously undergone surgery on the operated side, one for open reduction of dislocated dysplastic hip, the other a soft tissue release. Of the 9 patients, 5 operations were performed on the left side, two were bilateral. Two patients presented with bilateral hip pain and underwent staged resurfacing. Severe deformity of the femoral head and neck or the acetabulum was not a contraindication for resurfacing (Table 1).

Four patients were found to have scoliosis, 3 were structural and 1 was postural. Two of these patients had fixed pelvic obliquity due to their spinal abnormality, the other 2 had a flexible obliquity.

3. Preoperative radiographic findings

Three hips were centrally located within the acetabulum, six hips were subluxed (with more than one third of the femoral head being uncovered) and two were completely dislocated, with pseudo-acetabulum formation in one of them. There was wind swept deformity in one patient with cerebral palsy with whole body involvement.

4. Procedures

Where possible, the decision to undergo surgery was taken by the patients in conjunction with their carers after in-depth

Table 1 – Patient characteristics.

Patient	Age	Sex	Side	Diagnosis	Hip location	Previous hip operation	Spinal deformity	Perineal access
1	39	F	Left	Cerebral palsy	Located	No	Scoliosis	Poor
2	28	M	Right	Spinal cord injury	Subluxed	No	Scoliosis	Poor
3	15	F	Right	Cerebral palsy	Subluxed	No	No	Poor
4	51	F	Left	Polio	Subluxed	Open reduction of dysplastic left hip	No	Good
5	37	M	Left	Head injury	Subluxed	No	No	Poor
6	54	M	Bilat	Hereditary spastic paraparesis	Bilaterally located	No	No	Poor
7	20	F	Bilat	Extra pyramidal disorder	Bilaterally subluxed	Soft tissue release	No	Poor
8	32	M	Right	Cerebral palsy	Located	No	Scoliosis	Good
9	25	F	L	Cerebral palsy	Dislocated	No	Scoliosis	Poor

discussion about the risks and complications of surgery. In every case, informed consent was gained from either the patient or their legal guardian.

The operations were all performed by a single surgeon (AHN). A posterolateral approach was used in all cases and all operations were performed in a laminar-airflow theatre. All femoral components were accurately sized using the manufacturer's femoral neck measuring device ensuring no femoral neck notching. This also determined acetabular component size.

Soft tissue release was performed at the same time as arthroplasty in six patients (seven hips). It is important to note that this must be planned pre-operatively as muscle imbalance and contractures can be difficult to assess accurately intra-operatively. Adductor longus tenotomy was performed percutaneously but more extensive soft tissue release required a larger medial incision.

Intra-operatively, one patient required extensive pericapsular soft-tissue release; two patients required adductor longus, brevis and gracilis tendon fractional lengthening; one required adductor longus and gluteus maximus release; one required adductor longus release only; and one patient required bilateral adductor longus release (Table 2).

In one patient excessive femoral anteversion necessitated simultaneous femoral de-rotation osteotomy which was performed immediately after hip resurfacing. None of the hips required bone grafting.

All hips were assessed for stability after closing of fascia latae. Two hips were felt to be unstable and were managed in a broomstick abduction cast for 6 weeks. All other hips were managed with abduction pillow for 6 weeks when supine.

Antibiotic prophylaxis was Cefuroxime 1.5 g at induction with two further doses of 750 mg at 8 and 16 h post-op. Thromboprophylaxis used was low-molecular weight heparin, started 24 h post-operatively and continued for 2 weeks combined with TED stockings and intermittent calf compression pumps.

Analgesia was supplied on a regular basis in the post-operative period until pain was manageable.

All hips were managed according to a standard post-operative protocol with physiotherapy-led discharge.

5. Assessment of outcome

The patients were reviewed at 6 weeks, 6 months and 1 year and thereafter an annual review continues for the first five years. Failure due to revision of either femoral or acetabular components was recorded. Post-operative complications such as dislocation, fractures, infection, neurological injuries and re-operations were documented.

All patients were assessed pre-operatively and at follow-up, for pain and gross motor function class and carer satisfaction was assessed at 6 months post-op. Pain was scored using a scale of none, slight, moderate and severe according to a standard pain scoring system for patients with neuromuscular disease.¹⁰ Gross motor functional class was assessed using the Gross Motor Function Classification System.¹¹

Carer satisfaction was scored using the Caregiver Questionnaire (see table).¹² This is a 29-item self-administered questionnaire consisting of four sections: (1) Personal care, (2) Positioning/Transferring, (3) Comfort, and (4) Interaction. Caregivers rate each task by making a mark on an unnumbered line that corresponds to the degree of difficulty. To score the CQ, each mark on each line is transformed into a linear analogue scale in which a score of zero reflects maximum difficulty and 100 reflects maximum ease. For each section, scores are presented as a mean to allow for easier evaluation of outcome.

Each patient was assessed radiographically 3 days after the operation and at 6 months. Radiographs were assessed for loosening or migration and position of components as well as heterotopic bone formation according to the classification of Brooker et al.

6. Results

6.1. Clinical

Mean follow up at publication was 63.7 months (41–89 months). Pre-operative pain scores demonstrated moderate

Table 2 – Intra-operative findings.

Case	Associated procedure	Operation time (min)	Blood loss (ml)	Peri-op surgical complication	Post op. immobilization
1	Right Prox femoral 80° derotation osteotomy & bilateral Add. longus lengthening	125	800	No	Abduction pillow
2	No	70	650	Intra-op instability (in flex/add/IR)	Broomstick cast
3	Extensive soft tissue release	85	400	No	Broomstick cast
4	No	90	1000	No	Abduction pillow
5	Add. longus release	95	600	No	Abduction pillow
6	No	100	800	No	Abduction pillow
7	Fractional lengthening Add longus, brevis & gracilis	95	750	No	Abduction pillow
8	Gluteus maximus & Add. longus release	90	850	No	Abduction pillow
9	Fractional lengthening Add. longus, brevis & gracilis	105	950	No	Abduction pillow

Table 3 – Pain and functional scores.

Patient	Pre-op hip pain	Post-op hip pain	Pre-op. functional class	Post-op functional class
1	Severe	Severe	IV	IV
2	Moderate	None	IV	IV
3	Severe	None	IV	I
4	Moderate	None	II	I
5	Severe	Slight	IV	III
6	Moderate	None right, bilaterally	III	II
7	Moderate	Slight right, bilaterally	IV	II
8	Severe	None	III	I
9	Severe	None	V	IV

pain in 6 hips and severe in 5 hips. At follow-up 8 hips reported no pain, 2 slight and 1 severe. The patient reporting severe pain was found to have a dislocated prosthesis and loose acetabular component. Following revision with removal of implants and proximal femoral excision with interposition arthroplasty, this patient reported no pain.

Preoperatively gross motor functional class assessment showed 1 patient having level II function, 2 patients level III function, 5 patients level IV function and 1 patient level V function. This indicates that 7 of the 9 patients required assistance with mobility, ranging from the use of stick or frame (level III), severely limited mobility often requiring wheelchair (level IV), to reliance on a wheelchair in all settings with limited ability to maintain head, trunk and limb postures (level V).¹¹

Post-operatively, 3 patients were assessed as motor function level I, 2 as level II, 1 as level III and 3 as level IV function (Table 3).

Caregiver satisfaction assessed at 6 months showed that in all but one case, the caregivers were happy with results. Analysis of the results for all cases shows mean satisfaction of 86% with personal care, 83% with ease of positioning and transferring, 78% with comfort and 85% with ease of interaction and communication. The case scoring poorly was the one

case with operative failure due to dislocation and loose acetabular component. If the results for this case are removed from analysis, results show satisfaction of 95% with personal care, 90% with positioning and transferring, 83% with comfort and 84% with interaction and communication (Table 4).

6.2. Radiographic

At final follow-up, there was one reported implant failure, as reported above with loose and displaced acetabular component and head dislocation. Of note, this patient had gross anatomical abnormalities and muscle contractures, requiring 80° de-rotation proximal femoral osteotomy and adductor longus lengthening at the time of arthroplasty. There was no radiographic evidence of loosening in the other 10 hips. There were 3 cases of heterotopic calcification, two of Brooker class I and one class II. There was no radiographic evidence of femoral neck complications or femoral neck fracture (Figs. 1–4 for examples of pre- and post-operative radiographs).

6.3. Complications

There were no reported post-operative infections, neurological injuries or thromboembolic events. There was one dislocation with loosening of acetabular component as discussed above.

7. Discussion

Management of the degenerate neuromuscular hip is difficult and controversial with options including proximal femoral resection and interposition arthroplasty, arthrodesis and total joint replacement.^{13,14}

Koffman reported that the result of proximal femoral resection in eliminating or improving hip pain in neuromuscular disorders is unreliable⁵ and Castle and Schneider found it can afford good pain relief improved hygiene, however they believe this procedure is only indicated in the severely disabled child.⁶ At our institution, we have similar beliefs and

Table 4 – Care-giver questionnaire scores (100 = maximum ease, 0 = maximum difficulty).

Patient number	Personal care satisfaction (post op)	Positioning & transferring easiness score (post op)	Comfort score (post op)	Interaction & communication easiness score (post op)
1	18.8	24	35	90
2	100	87.5	58.33	98.5
3	96	98	90	78
4	97.1	100	100	95
5	81.25	92	80	58
6	91.25	75	80	100
7	90	83	84.23	61.43
8	100	98	96.02	97.1
9	100	88	75	82.5
Mean score	86.04	82.83	77.62	84.5
Mean excluding patient 1	94.45	90.19	82.95	83.82

Fig. 1 – 20-year-old female (patient 7) with extra pyramidal disorder and bilateral painful, subluxed, degenerate hips. Right hip already treated with resurfacing arthroplasty.

rarely use it for primary treatment of the degenerate hip in neuromuscular patients.

Hip arthrodesis in the degenerate neuromuscular hip has had scant mention in the literature, and there are few studies that demonstrate good results.¹⁴ Root reports a case series of patients with cerebral palsy and degenerate hip treated with arthrodesis or total hip replacement concluding that both are viable treatments in correctly selected patients.¹⁵ In a later publication, Root states arthrodesis has only a limited role to play in patients with cerebral palsy and a degenerate hip.¹³ Importantly, patients undergoing arthrodesis should have no evidence of lumbosacral spine deformity and we believe that a large proportion of neuromuscular patients present with concomitant spinal pathology, particularly scoliosis.

The result of total hip replacement in neuromuscular disease is uncertain as there are few studies in the literature. If we disregard the studies looking at the results of hip replacement in Parkinson's disease, the total number of neuromuscular patients managed with joint replacement is very small.⁵

Total hip replacement in these patients has traditionally encountered complications, the most common being

Fig. 3 – 28-year-old male (patient 2), following spinal cord injury with painful, subluxed, degenerate right hip.

instability.^{8,16} To overcome this problem some surgeons resort to constrained liners which can lead to early loosening due to greater forces transmitted at host–implant interface.^{7,8} In this context, constrained total hip replacement may be beneficial in alleviating pain and improving function in the short term but may have long-term consequences with a high failure rate.

Proximal femoral deformity with small size and narrow canal can also cause problems in total hip replacement. Surgeons have resorted to custom made prosthesis but these are expensive and not readily available. Gabos reports using total shoulder replacement components as an interposition arthroplasty, eliminating painful bone-on-bone contact.² This study stimulated the thought that hip resurfacing would function well as a spacer but with greater stability to restore function and improve pain in this group of patients.

Of the eleven hip resurfacings performed (9 patients), 10 of the hips (8 patients) saw improvement in pain and 9 showed improvements in gross motor function. The patient who had no improvement in pain suffered post-operative failure and was found to have dislocated with a loose acetabular

Fig. 2 – female patient (patient 7) with extra pyramidal disorder following bilateral hip resurfacing arthroplasty.

Fig. 4 – Spinal cord injury patient (patient 2) following right hip resurfacing arthroplasty.

component. Following proximal femoral resection the patient had resolution of pain. The two patients who did not see improvement in motor function were in the most severely disabled categories prior to surgery and were not expected to see any change in overall function. In these patients, the procedure was predominantly aimed at controlling pain.

All the patients in this study were, to varying degrees, dependent on others for help with personal care, transfers and positioning. The pain of a degenerate hip can greatly hamper the carers ability to help the patient with these important daily functions. Conventional assessment of outcome using hip scores in patients with neuromuscular disease is felt to be unreliable due to differing functional needs and abilities. By using the Caregiver Questionnaire we have been able to show that performing the resurfacing hip replacement has resulted in excellent care-giver satisfaction, with great ease in personal care and mobilizing of the patient after surgery. Further, the lower scores seen in the patient with the failed resurfacing help to validate this questionnaire, showing how disabling a painful, unstable hip can be both to patient and carer.

Hip resurfacing, when compared to total hip replacement, has been shown to preserve bone stock,^{17,18} have improved biomechanics,¹⁹ lower dislocation rate,^{20,21} and easier revision.^{9,22,23} These are all advantageous in neuromuscular patients and with resurfacing arthroplasty components, femoral canal size and proximal deformity are not as important.

There are limitations to this series. The numbers of patients in this series are small and there is variation in the underlying disorder but all patients have the same principal problem: a painful, arthritic hip making nursing of a neuromuscular disability difficult. At present follow-up is only short but medium and long-term results will be reported when available.

We believe that hip resurfacing is a practical and safe therapeutic option in managing these patients and have shown that the operation can lead to significant improvements in pain and motor function with good carer ability to nurse the patient.

Conflicts of interest

All authors have none to declare.

REFERENCES

1. Saucer D, Hewes R, Root L. Hip changes in spastic cerebral palsy. *Am J Roentgenol*. 1986;146:1219–1222.
2. Gabos PG, Miller F, Galban MA, Gupta GG, Dabney K. Prosthetic interposition arthroplasty for the palliative treatment of end-stage spastic hip disease in nonambulatory patients with cerebral palsy. *J Pediatr Orthop*. 1999;19:796–804.
3. Samilson RL, Tsou P, Aamoth G, Green WM. Dislocation and subluxation of the hip in cerebral palsy. Pathogenesis, natural history and management. *J Bone Joint Surg (Am)*. 1972;54:863–873.
4. Phelps WM. Complications of orthopaedic surgery in the treatment of cerebral palsy. *Clin Orthop Relat Res*. 1967;53:39–46.
5. Koffman Martin. Proximal femoral resection or total hip replacement in severely disabled cerebral-spastic patients. *Orthop Clin North Am*. 1981;12:91–100.
6. Castle ME, Schnider C. Proximal femoral resection–interposition arthroplasty. *J Bone Joint Surg (Am)*. 1978;60:1051–1054.
7. Queally J, Abdulkarim A, Mulhall K. Total hip replacement in patients with Neurological conditions. *J Bone Joint Surg (Br)*. 2009;91:1267–1273.
8. Su EP, Pellicci PM. The role of constrained liners in total hip arthroplasty. *Clin Orthop*. 2004;420:122–129.
9. Amstutz HC. Hip resurfacing arthroplasty. *J Am Acad Orthop Surg*. 2006;14:452–453.
10. Jensen M, Abresch R, Carter G, McDonald C. Chronic pain in persons with neuromuscular disease. *Arch Phys Med Rehabil*. 2005;86:1155–1163.
11. Morris C, Bartlett D. Gross motor function classification system: impact and utility. *Dev Med Child Neurol*. 2004;46:60–65.
12. Schneider J, Gurucharri L, Gutierrez L, Gaebler-Spira D. Health-related quality of life and functional outcome measures for children with cerebral palsy. *Dev Med Child Neurol*. 2001;43:601–608.
13. Renshaw T, Green N, Griffin P, Root L. Cerebral palsy: orthopaedic management. *J Bone Joint Surg (Am)*. 1995;77:1590–1606.
14. Bleck EE. *Orthopaedic Management in Cerebral Palsy*. 2nd ed. Philadelphia: JB Lippincott; 1987.
15. Root L, Goss JR, Mendes J. The treatment of the painful hip in cerebral palsy by total hip replacement or hip arthrodesis. *J Bone Joint Surg (Am)*. 1986;68:590–598.
16. Meek RM, Allan DB, McPhillips G, Kerr L, Howie CR. Epidemiology of dislocation after total hip arthroplasty. *Clin Orthop Relat Res*. 2006;447:9–18.
17. Beaulé PE, Antoniadou J. Patient selection and surgical technique for surface arthroplasty of the hip. *Orthop Clin North Am*. 2005;36:177–185.
18. Mont MA, Ragland PS, Etienne G, Sayler TM, Schmalzried TP. Hip resurfacing arthroplasty. *J Am Acad Orthop Surg*. 2006;14:454–463.
19. Silva M, Lee KH, Heisel C, Dela Rosa MA, Schmalzried TP. The biomechanical results of total hip resurfacing arthroplasty. *J Bone Joint Surg (Am)*. 2004;86:40–46.
20. Bierbaum BE, Sweet R. Complications of resurfacing arthroplasty. *Orthop Clin North Am*. 1982;13:761–775.
21. Vendittoli PA, Lavigne M, Roy AG, Lusignan D. A retrospective randomized clinical trial comparing metal-on-metal total hip arthroplasty and metal-on-metal hip resurfacing in patients less than 65 years old. *Hip Int*. 2006;16:S73–S81.
22. Wagner M, Wagner H. Preliminary results of uncemented metal on metal stemmed and resurfacing hip replacement arthroplasty. *Clin Orthop Relat Res*. 1996;329:S78–S88.
23. Girard J, Lavigne M, Vendittoli PA, Roy AG. Biomechanical reconstruction of the hip: a randomized study comparing total hip resurfacing and total hip arthroplasty. *J Bone Joint Surg (Br)*. 2006;88:721–726.