Acta Orthop. Belg., 2005, **71**, 540-547

ORIGINAL STUDY

Do pain referral patterns determine patient outcome after total hip arthroplasty ?

John STREET, Brian LENEHAN, Robert FLAVIN , Eilish BEALE , Padraig MURRAY

From Cappagh National Orthopaedic Hospital, Dublin, Ireland

Quality of life outcome and patient satisfaction after total hip arthroplasty are complex phenomena and many confounding determinants have been identified. Degenerative disease of the hip joint may present with variable patterns of pain referral in the lower limb. However the effect of varied preoperative pain referral patterns on patient outcome and satisfaction after total hip arthroplasty has not previously been examined.

From 2000 to 2003, 236 eligible patients scheduled to undergo primary total hip arthroplasty were prospectively enrolled. The principal pain referral pattern (as hip, thigh or knee) was identified in all patients. Health related quality of life (HRQOL) was examined using the Harris Hip score (HHS), the Western Ontario McMaster Universities Osteoarthritis Index (WOMAC) and the 36-Item Short-Form Health Survey (SF-36) pre-operatively, 1 year and 2 years postoperatively and with the HHS at 3 months postoperatively. All patients were followed up for a minimum of 2 years.

The frequency of the pain referral distributions were ; hip pain 41%, knee pain 32% and thigh pain 27%. Patients in all groups were comparable preoperatively with respect to age, HHS, and both mean and domain specific WOMAC and SF-36 scores. The mean duration of symptoms was significantly greater in patients with knee pain when compared to the remaining two pain patterns. All patients demonstrated improvements in HHS, SF-36 and WOMAC scores after surgery. At all times postoperatively there were significant differences in mean HHS and mean and domain specific WOMAC and SF-36 scores between patients with hip or thigh pain and those with knee pain ($p < 0.001$). While notable, differences between hip and thigh pain were not as consistent however.

Based on these findings, it appears that pre-operative pain referral patterns of hip arthritis are among the determinant factors for patient outcome and satisfaction after total hip arthroplasty, as measured using validated HRQOL scoring systems.

Keywords : hip arthroplasty ; pain referral patterns.

INTRODUCTION

Joint replacement remains the most effective healthcare measure in improving patient health related quality of life (HRQOL). Pain incompatible

■ John Street, PhD, FRCS (Tr&Orth.) Orthopaedic Senior Specialist Registrar.

■ Brian Lenehan, MCh, AFRCSI. Orthopaedic Registrar.

■ Robert Flavin, MCh, AFRCSI. Orthopaedic Senior House Officer.

■ Eilish Beale, RGN. CNM II.

■ Padraig Murray, MCh, FRCS (Tr&Orth.) Consultant Orthopaedic Surgeon.

Department of Orthopaedic Surgery, Cappagh National Orthopaedic Hospital, Finglas, 11, Dublin, Ireland.

Correspondence : Brian Lenehan, 14 Priory Court, St Raphaels Manor, Celbridge,Co. Kildare, Ireland.
E-mail : brian@blenehan.com

with normal daily living remains the primary indication for both hip and knee arthroplasty. Recently, three healthcare factors in particular have placed total joint arthroplasty under increased scrutiny. The first is the increasing cost, the second reflects concerns of the appropriateness of such surgery and the third is the phenomenon of geographic area variation in delivery of care and outcome of surgery. Subsequently, numerous orthopaedic outcome measures, both generic and disease specific, have evolved to answer 'cost-effectiveness' and HRQOL issues in a meaningful and scientifically valid manner (*4*).

Patient satisfaction after total hip arthroplasty is a complex phenomenon and many confounding variables have been identified including expectations prior to surgery (*2*), patients understanding of the procedure being undertaken (*20*) and of course the resulting outcome. Therefore the 'objective' surgeon-measured outcomes of the past have been largely abandoned and replaced by patient-based outcome measures which are meant to focus on aspects of the disease and treatment believed by the patient (and the surgeon) to be relevant. These include generic measures such as the SF-36 and disease specific measures such as the Harris Hip Score and the Western Ontario and McMaster Universities (WOMAC) Osteoarthritis Index. These outcomes measures have been used extensively to assess quality of life after total hip arthroplasty and their validity (they measure what they purport to measure) and reliability (consistency with repeated measures) are well accepted (*2, 12, 15*).

Four nerves : sciatic, femoral, obturator and superior gluteal are known to contribute to the innervation of the hip joint (*10*). Therefore, pathological conditions of the hip joint may present with variable patterns of pain referral in the lower limb. Khan and Woolson (*13*) demonstrated that 47% of their patients with hip osteoarthritis have pain below the knee. They also concluded that radiographic features of OA, visual analogue pain score or Oxford hip score had no significant association with the patients distribution of pain preoperatively. Literature reports suggest that up to 27% of THA's are performed on patients with hip pain referred to the knee (*13*).

However the effect of varied pain referral patterns on patient outcome and satisfaction after total hip arthroplasty has not previously been examined. It is not known whether the distribution of preoperative pain in hip osteoarthritis can affect validated HRQOL measures. This prospective study was undertaken to determine the most common referral patterns of hip pain in patients scheduled to undergo primary total hip replacement and to examine whether initial pain referral patterns predicted ultimate patient outcome.

MATERIALS AND METHODS

From 2000 to 2003, all 616 patients scheduled to undergo primary total hip arthroplasty by the senior surgeon at our institution were prospectively enrolled for this study. Patients with primary osteoarthritis and isolated unilateral hip joint disease only were included ; patients were excluded if they had inflammatory arthropathy or demonstrated multi joint disease, in particular ipsilateral knee pathology. To ensure that the strict inclusion criteria were met, all patients received a diagnostic hip injection of local anaesthetic under asepsis and image guidance, and only those whose pain was completely relieved, however temporarily, were included.

All patients were assessed with the Harris Hip score (HHS), the Western Ontario McMaster Universities Osteoarthritis Index (WOMAC) and the 36-Item Short-Form Health Survey (SF-36) pre-operatively, 1 year and 2 years postoperatively and with the HHS at 3 months postoperatively. Preoperative questionnaires were completed one to three months before the date of surgery. The age, gender, duration of symptoms and preoperative pain patterns were all documented.

Patients were asked to mark on a simple surface body diagram the primary area of pain distribution only. The options were groin, thigh or knee as shown in fig 1. If more than one area was involved, the patient was asked to mark only that where the pain was primarily felt. If the patient was unable to indicate one particular pain area, then he/she was excluded from the study. Based on these criteria, 236 patients were eligible for this study. None of the patients had had a previous orthopaedic procedure or were known to suffer a psychiatric pathology. All patients were followed up for a minimum of 2 years. In accordance with the institution's ethics guidelines, written consent was obtained from all patients after a verbal and written explanation of the study.

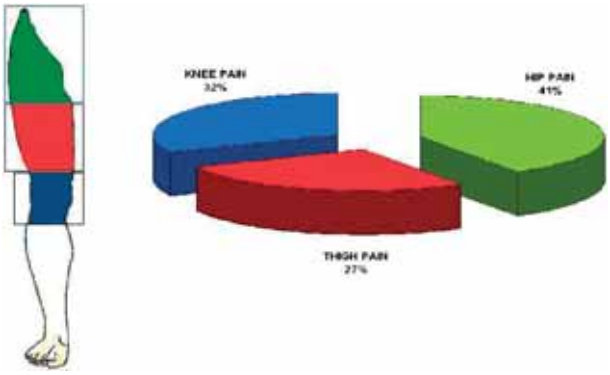

Fig. 1. — Frequency of pain referral distribution

The standard Hardinge anterolateral approach was used in all cases. All patients received the same THA implant, a cemented FC2 femoral prosthesis (Stryker Howmedica) and a cemented Ogee LPW all polyethelene acetabular component (DePuy).

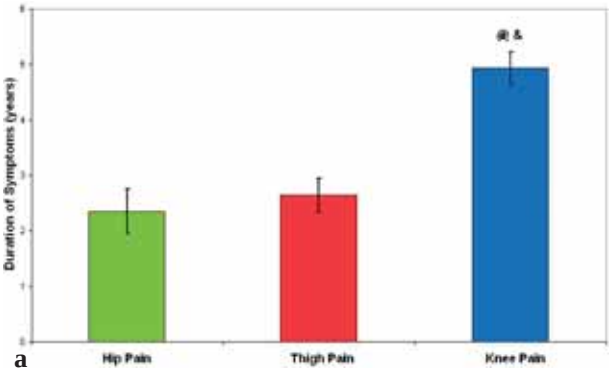

Fig. 2a. — Duration of Symptoms

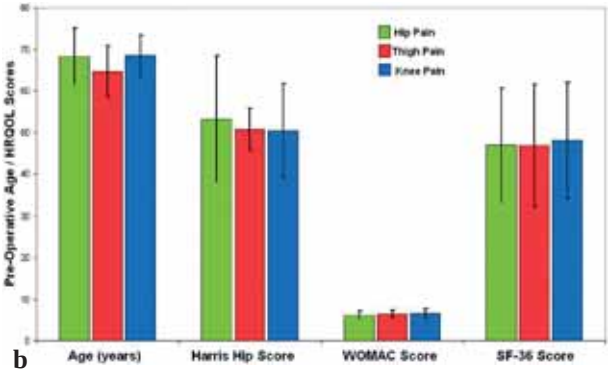

Fig. 2b. — Pre-op Age and HRQOL

The HHS is divided into four domains : pain, function (gait and activities), absence of deformity and range of motion. The best achievable score is 100 points, with pain and mobility accounting for the most of the score (44 and 47 points respectively). The SF-36 scoring system is divided into 8 domains, each measured on a 100 point scale : role physical, physical function, bodily pain, vitality, role emotional, social function, general health and mental health. The WOMAC scoring system is divided into 3 domains : pain (5 questions), stiffness (2 questions) and physical function (17 questions). For the WOMAC the patients document the level of their individual symptoms on a 0-10 visual analogue scale for each domain.

Statistical Analysis

Underlying assumptions of normality were evaluated using Kolmogorov-Smirnov tests with Lilliefor's correction. The outcome variables were determined to be normally distributed : therefore, means and standard deviations were used as summary statistics for all data. Statistical significance was tested between all groups (hip pain versus thigh pain (#), thigh pain versus knee pain (&) and hip pain versus knee pain (@)). For comparison of preoperative and postoperative questionnaire data Wilcoxon's signed rank test was used. For comparisons between the subgroups the Mann-Witney test was used. Analysis of Variance (ANOVA) was used for comparison between the differences in the clinical variables which could be explained by subgroup. A simple linear analysis of regression was made to assess how much of the variation in outcome measures at 12 and 24 months post operatively could be explained by the preoperative values, in particular duration of symptoms.

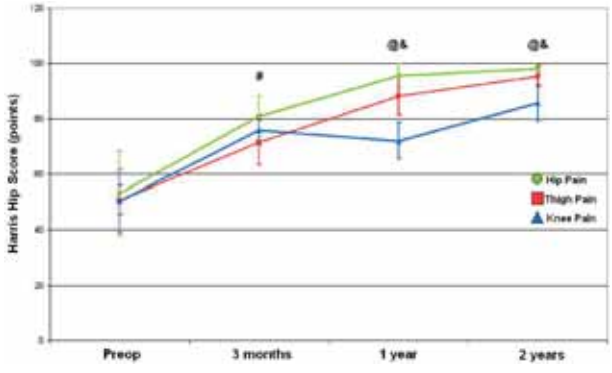

Fig. 3. — Post-op changes in Harris Hip Score

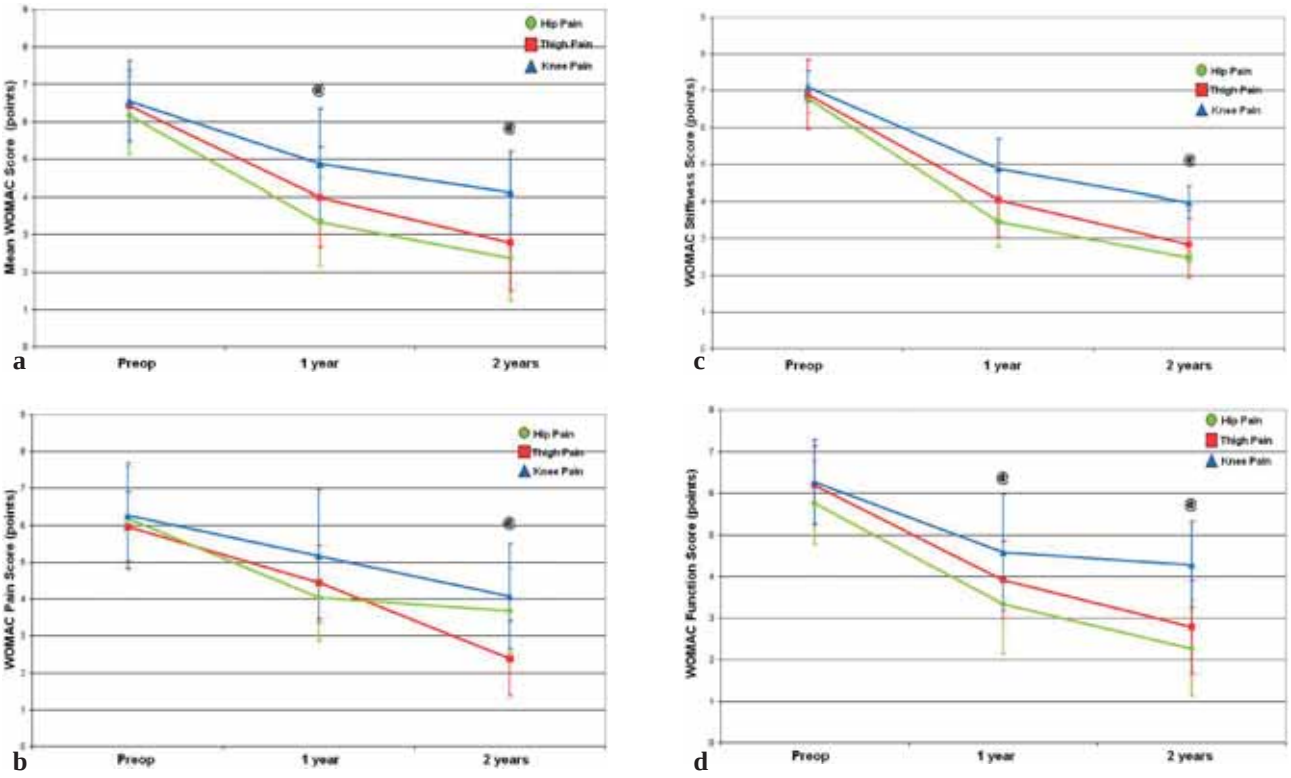

Fig. 4a, b, c, d. — Post-op changes in WOMAC Score

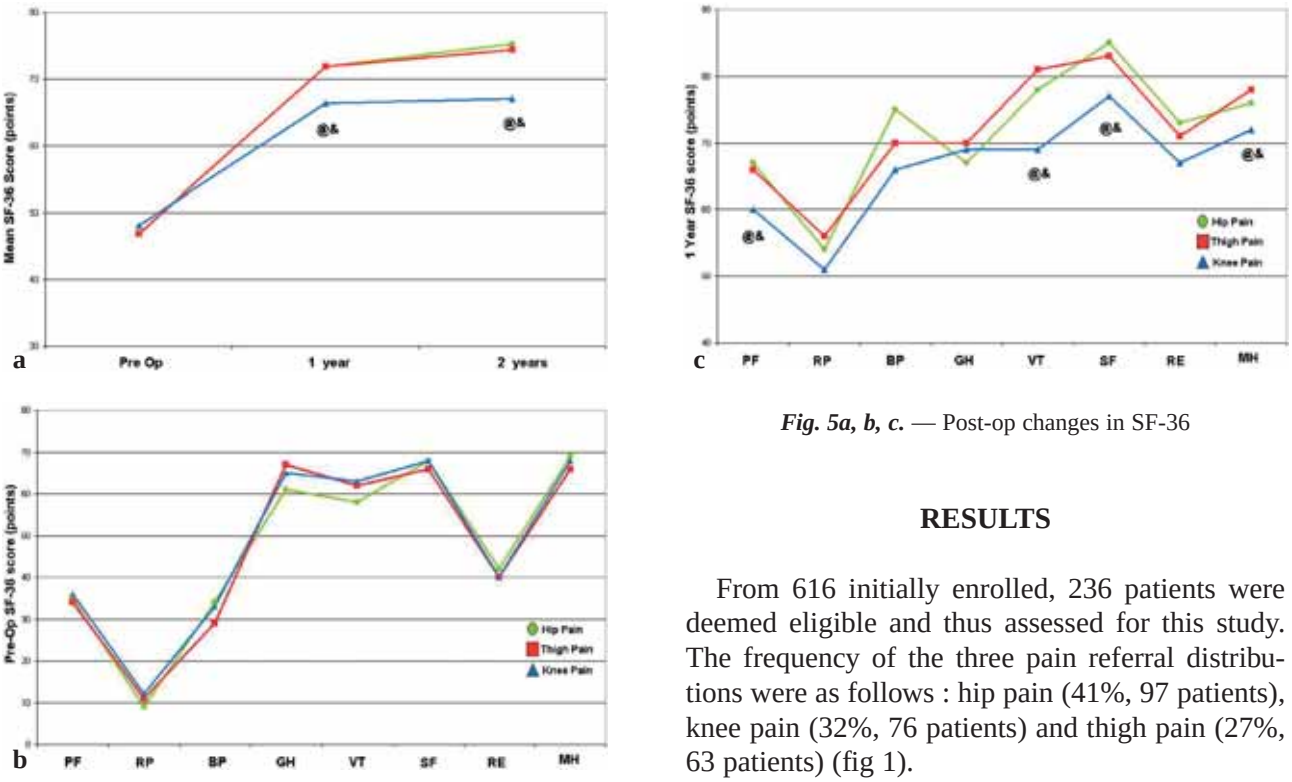

Fig. 5a, b, c. — Post-op changes in SF-36

RESULTS

From 616 initially enrolled, 236 patients were deemed eligible and thus assessed for this study. The frequency of the three pain referral distributions were as follows : hip pain (41%, 97 patients), knee pain (32%, 76 patients) and thigh pain (27%, 63 patients) (fig 1).

Overall the mean age was 67.1 years (SD : 6.1) and the mean duration of symptoms prior to surgery was 3.5 years (SD : 2.0). The mean duration of symptoms prior to surgery was significantly greater in the patients who presented with primarily knee pain when compared to the remaining two pain patterns (fig 2a).

Using two variable linear regression analyses there was no correlation between the outcome scores at one and two years when comparing the patients presenting with knee pain and the other two groups, demonstrating that the duration of symptoms is an independent factor in functional outcome (data not shown here).

There was no statistically significant difference in the preoperative age, HHS, WOMAC or SF-36 scores, demonstrating that the groups were comparable preoperatively (fig 2b).

All patients regardless of pain pattern followed the expected trend of increasing HHS postoperatively. At 12 and 24 months follow-up, patients who presented with knee pain showed significantly less improvement than those with hip or thigh pain (fig 3). Patients with thigh pain had significantly lower HHS at 3 months post op but this difference did not continue to 1 or 2 years.

Figure 4 illustrates the improvements in WOMAC scoring (mean or domain specific) following total hip arthroplasty (lower scores represent better outcome). The standard deviations for both mean and domain specific scores at all time points were large. However, patients with knee pain had significantly higher (worse) mean and function specific scores at 12 months, and higher scores for all domains at 2 years post operatively, than those who presented with hip pain. Scores for patients with thigh pain did not differ significantly from the other two groups.

The preoperative domain specific SF-36 scores were almost identical for all patients regardless of pain referral pattern (fig 5a). Figure 5b illustrates the improvements in mean SF-36 scoring following total hip arthroplasty (Higher scores represent better outcome). Patients with knee pain had statistically significant lower scores at 1 and 2 years. When compared to patients with hip or thigh pain, patients with knee pain scored significantly worse in the domains of physical function, vitality, social function and mental health at one year follow-up. At two years post op there were statistically significant differences in physical function, vitality, social function and mental health as well as role physical (fig 5c and 5d respectively). All data illustrating changes in SF-36 scores is represented in table I in the format of mean (standard deviation).

DISCUSSION

The findings of this study clearly demonstrate that pre-operative pain referral patterns of hip arthritis determine patient outcome and satisfaction after total hip arthroplasty, as measured using validated HRQOL scoring systems. Patients who present with primarily knee pain will have significantly poorer medium term (up to 2 years) outcome as measured using the Harris Hip Score, the Medical Outcomes Study Short Form-36 (SF-36) and the

Table I. — SF-36 Data

		PRE			1 yr POST			2 yr POST	
	HIP	THIGH	KNEE	HIP	THIGH	KNEE	HIP	THIGH	KNEE
PF	35 (9)	34 (11)	36 (9.8)	67 (11.9)	66 (12.9)	60 (14.4)	69 (8.9)	68 (9.7)	59 (11.2)
RP	9 (6.2)	11 (10.1)	12 (8)	54 (6.3)	56 (9)	51 (12.7)	59 (13.2)	59 (18.6)	51 (18.4)
BP	34 (14.8)	29 (11.2)	33 (9.3)	75 (10.8)	70 (16.2)	66 (13.7)	78 (16.3)	74 (21.2)	68 (19.3)
GH	61 (17.3)	67 (19.7)	65 (20.1)	67 (19.7)	70 (14.8)	69 (15.6)	69 (17.8)	70 (12.7)	68 (15.5)
VT	58 (21.9)	62 (19.7)	63 (22)	78 (19.6)	81 (14.8)	69 (19.8)	80 (17.3)	80 (24.7)	68 (18.6)
SF	68 (16.3)	66 (19.6)	68 (12.7)	85 (14)	83 (28)	77 (21.6)	91 (15.3)	89 (21.6)	80 (9.7)
RE	42 (10.8)	40 (14)	40 (13.7)	73 (12.4)	71 (19.3)	67 (11.2)	75 (18.8)	74 (12.4)	69 (13.9)
MH	69 (12.9)	66 (12.4)	68 (15.6)	76 (21.1)	78 (28.1)	72 (29.7)	81 (13.9)	81 (16.7)	73 (15.1)

Western Ontario and McMaster University Osteoarthritis Index (WOMAC).

Almost one third of our patients presented with pain primarily felt about the knee. This is not unusual as others have reported from 25-50% of study patients with hip osteoarthritis presenting with pain about and below the knee. The pattern of pain distribution does not appear to be related to preoperative status as measured using a visual analogue pain score or the Oxford hip score. Nor is there any correlation with the extent of radiological features of OA. We were unable to identify any significant difference between the patient groups in respect to age or preoperative QOL measure. The fact that the mean pre-op HHS, SF-36 and WOMAC were no different confirmed that we had similar groups for comparison.

Anatomical, histological and ultrastructural studies have confirmed that the sciatic, femoral, obturator and superior gluteal nerves contribute to the innervation of the hip joint and its capsule (*10, 13*). Sensory and autonomic distribution of these nerves, and their branches, in the lower limb is well described. Khan and Woolson (*13*) have used body image maps to investigate the lower limb distribution of pain in patients awaiting both total hip arthroplasty and spinal decompression. They found that groin pain was 84.3% sensitive for hip pathology while 47% of patients with hip OA had pain about or below the knee.

As patients' concerns have become central to the monitoring of medical outcomes, a number of generic and disease specific HRQOL measures have been developed. A recent literature review concluded that those most widely used measures in orthopaedics are the SF-36 and the WOMAC systems. We have employed these in the outcomes assessment of hip arthroplasty patients in our study. In general comparatively greater and faster improvements are noted in respect to pain, with improvements in mental and social health being less obvious.

While there have been considerable strides to improve the technical aspects of total hip arthroplasty and reduce the complication rates associated with it, the fulfilment of expectations is still considered one of the most important factors affecting satisfaction (*17, 18*). Despite recent increased interest in HRQOL issues, much of the literature remains inconclusive. Patients with a poorer preoperative functional status are likely to have a significant improvement after THA relative to the patients with a better preoperative functional status (*7, 16*). However the poorer the functional preoperative status the worse the functional outcome is predicted (*6, 8*).

There are various factors that influence functional outcome, including age (*12*), preoperative functional status and co-morbidities. Studies have compared the satisfaction with surgical care and preoperative information with outcome satisfaction (*3, 6, 9*). Other studies have focused specifically on satisfaction with regards to outcome of total hip arthroplasty (*5, 11*). Lieberman *et al* (*14*) reported that a lower preoperative functional score correlates with a significant improvement after total hip arthroplasty when compared with patients with better preoperative functional scores. However Fortin *et al* (*8*) further documented that the lower the preoperative functional status the poorer the functional outcome is predicted.

To date the effect of varied pain patterns on patients' functional outcome has not been examined. In our study an even distribution of patients presented with the three types of pain patterns. All had similar preoperative functional scores and demographics, however the differences in the duration of symptoms and postoperative functional scores were significant. The patients who presented with primarily knee pain had a significantly longer duration of symptoms when compared with the hip and thigh pain groups. This duration of symptoms could relate to a delay in formulating an accurate diagnosis or the delay in patients consulting their primary carer. However even though the postoperative functional scores of the isolated knee pain group were significantly less when compared with the other two groups, the duration of symptoms was an independent factor. Knahr *et al* (14) reported a similar result when comparing patients one year after total hip arthroplasty with their preoperative functional status.

The SF-36 is divided broadly into physical function, pain, mental health and general health.

Previous meta-analysis of the literature with regards to SF-36 after THA demonstrated a significant increase in the SF-36 scores after THA after one year in the physical function and pain domains, however this difference was absent in the mental health and general health domains (*1*). In our study there was significant increase in all domains of the SF-36 scores one and two years after surgery. However those patients presenting with knee pain had lower scores for physical function, vitality, social function and mental health as well as role physical at 2 years follow up. Thus the poorer outcome can not be simply explained by failure to eliminate the preoperative pain. Not surprisingly it appears to be a much more complex physical and psychosocial phenomenon than just pain relief.

WOMAC has shown greater responsiveness to change over time than SF-36, whereas SF-36 discriminates better between subjects based on levels of self reported general health. While WOMAC is a excellent indicator of improved HRQOL in an individual, our data supports the argument that it may not be as reliable in comparing outcomes between different groups of patients. In our study we found that by two years post op, all domains of the WOMAC score were significantly worse in patients who presented with knee pain.

The differences in HHS at 3 months initially appear inconsistent. However there are limitations with this measurement which must be considered. The HHS measures function by the use of a walking aid or the maximum walking distance and the measurement of range of motion is performed clinically. Both these domains are being biased by the fact that most patients will still be ambulating with sticks or crutches and the range of motion will be poorly assessed due to the postoperative risk of dislocation which is relatively high at this time period.

The results of this study demonstrate that the different referral pain patterns of patients undergoing THA have a profound affect on patients' outcome. Based on these findings, we would suggest that we must tailor the expectations of both patients and surgeons prior to undergoing THA. However future studies should be undertaken to focus on the long-term relationship between patients' outcome and referral pain patterns.

REFERENCES

1. **Australian Bureau of Statistics National Health Survey** : SF-36 population norms, A., 1995. (1997). Canberra : ABS. : (Catalogue No. 4399.0).
2. **Bachmeier CJ, March LM, Cross MJ *et al.*** Arthritis Cost and Outcome Project Group. A comparison of outcomes in osteoarthritis patients undergoing total hip and knee replacement surgery. *Osteoarthritis Cartilage* 2001 ; 9 : 137-146.
3. **Barrack RL, Lebar RD.** Clinical and radiographic analysis of the uncemented LSF total hip arthroplasty. *J Arthroplasty* 1992 ; 7 : 353-363.
4. **Bourne RB, Maloney WJ, Wright JG.** An AOA Critical issue. The Outcome of the Outcomes Movement. *J Bone Joint Surg* 2004 ; 86-A : 633-640.
5. **Burton KE, Wright V, Richards J.** Patients' expectations in relation to outcome of total hip replacement surgery. *Ann Rheum Dis* 1979 ; 38 : 471-474.
6. **Cleary PD, Greenfield S, Mulley AG *et al.*** Variations in length of stay and outcomes for six medical and surgical conditions in Massachusetts and California. *JAMA* 1991 ; 266 : 73-79.
7. **Fortin PR, PJ, Clarke AE, St-Pierre Y *et al.*** Timing of total joint replacement affects clinical outcomes among patients with osteoarthritis of the hip or knee. *Arthritis Rheum* 2002 ; 46 : 3327-3330.
8. **Fortin PR, Clarke AE, Joseph L *et al.*** Outcomes of total hip and knee replacement : preoperative functional status predicts outcomes at six months after surgery. *Arthritis Rheum*1999 ; 42 : 1722-1728.
9. **Garrellick G, Herberts P, Stomberg C, Malchau H.** Long-term results of Charnley arthroplasty : a 12- to 16-year follow-up study. 1994 ; 9 : 333-340.
10. **Gray H.** *Gray's Anatomy*. R. Warwick, Longman Group Ltd :1978 ; 1052-1060.
11. **Haworth RJ, Hopkins J, Ells P, Ackroyd CE, Mowat AG.** Expectations and outcome of total hip replacement. *Rheumatol Rehabil* 1981 ; 20 : 65-70.
12. **Jones CA, Voaklander DC, Johnston DW.** The effect of age on pain, function, and quality of life after total hip and knee arthroplasty. *Arch Intern Med* 2001 ; 161 : 454-460.
13. **Khan NQ, Woolson ST.**. Referral patterns of hip pain in patients undergoing total hip replacement. *Orthopedics* 1998 ; 21 : 123-126.
14. **Knahr K, Kryspin-Exner I, Jagsch R, Freilinger W, Kasparek M.** Evaluating the quality of life before and after implantation of a total hip endoprosthesis. *Z Orthop Ihre Grenzgeb* 1998 ; 136 : 321-329.
15. **Kiebzak GM, Vain PA, Gregory AM, Mokris JG, Mauerhan DR.** SF-36 general health status survey to determine patient satisfaction at short-term follow-up after total hip and knee arthroplasty. *J South Orthop Assoc* 1997 ; 6 : 169-172.

16. **Lieberman JR, Hawker G, Wright JG.** Hip function in patients >55 years old : population reference values. *J Arthroplasty* 2001 ; 16 : 901-904.
17. **Linder-Pelz S.** Social psychological determinants of patient satisfaction : a test of five hypotheses. *Soc Sci Med* 1982 ; 16 : 583-58.
18. **Lochman JE.** Factors related to patients' satisfaction with their medical care. *J Community Health* 1983 ; 9 : 91-109.
19. **Mahomed NN, L. M., Cook EF, Daltroy LH, Fortin PR, Fossel AH, Katz JN.** The importance of patient expectations in predicting functional outcome after total joint arthroplasty. *J Rheumatol* 2002 ; 29 : 1273-1279.
20. **Mancuso CA, Salvati EA, Johanson NA, Peterson MG, Charlson ME.** Patient's expectations and satisfaction with total hip arthroplasty. *J Arthroplasty* 1997 ; 12 : 387-396.