The Knee 18 (2011) 474–479

Contents lists available at ScienceDirect

The Knee

Case Report

A randomised controlled trial investigating the effect of posterior capsular stripping on knee flexion and range of motion in patients undergoing primary knee arthroplasty

Brian Hanratty [a,*], Damien Bennett [a], Neville W. Thompson [b], David E. Beverland [a]

[a] Orthopaedic Outcomes Assessment Unit, Musgrave Park Hospital, Stockman's Lane, Belfast, BT9 7JB, United Kingdom
[b] Department of Trauma and Orthopaedics, Altnagelvin Area Hospital, Glenshane Road, Londonderry BT47 6SB, United Kingdom

ARTICLE INFO

Article history:
Received 6 April 2009
Received in revised form 21 September 2010
Accepted 1 October 2010

Keywords:
Release
Posterior capsule
Knee arthroplasty
Flexion
Range of motion

ABSTRACT

Increasing knee flexion following total knee arthroplasty (TKA) has become an important outcome measure. Surgical technique is one factor that can influence knee motion.
In this study, it was hypothesised that stripping of the posterior knee capsule could improve flexion and range of motion (ROM) following TKA.
Patients who were undergoing TKA were prospectively randomised into two groups — one group (62 patients) were allocated stripping of the posterior knee capsule (PCS), the other group (66 patients) no stripping (no-PCS).
The primary outcome was change in flexion and ROM compared to pre-operative measurements at three time points; after wound closure, 3 months and 1 year post-operatively. Secondary outcomes were absolute measurements of flexion, extension, ROM and complications. All operations were performed by a single surgeon using the same implant and technique. All patients received identical post-operative rehabilitation. There was a significant gain in flexion after wound closure in the PCS group ($p = 0.022$), however there was no significant difference at 3 months or 1 year post-operatively. Absolute values of extension ($p = 0.008$) and flexion ($p = 0.001$) 3 months post-operatively were significantly reduced for the PCS group. The absolute value of ROM was significantly higher for the no-PCS group at 3 months ($p = 0.0002$) and 1 year ($p = 0.005$). There were no significant difference in the rate of complications.
Posterior capsular stripping causes a transient increase in flexion that does not persist post-operatively. We do not recommend routine stripping of the posterior knee capsule in patients undergoing TKA.

1. Introduction

The key goals of total knee arthroplasty (TKA) are pain relief and improved function [1]. Most clinical studies report a final measure of knee flexion that averages between 100 and 110° [2–6] which is adequate for most activities of daily living in the western world [7]. However, many patients undergoing TKA are now younger and more active with a functional demand for greater flexion. Patient satisfaction following TKA has been associated with the ability to participate in activities such as kneeling and crouching [8]. Maximising knee flexion and range of motion (ROM) following TKA has thus become an area of focus for those involved in knee replacement surgery and implant design [9]. Multiple factors are known to influence post-operative knee flexion, including pre-operative flexion, prosthetic design, post-operative rehabilitation and surgical technique [1,10–14]. This study investigated the effect of stripping the posterior knee capsule in patients undergoing TKA to determine if this surgical technique would provide greater post-operative flexion and ROM.

The concept of stripping the posterior capsule was first described by a visiting Japanese surgeon to our unit who believed that this technique improved post-operative ROM. The proposed rationale was that creation of extra space behind the posterior femoral condyle would accommodate the posterior tibial component during deep knee flexion (Fig. 1). This technique has not previously been investigated in the context of improving knee flexion and ROM. We wished to investigate this concept and tested the hypothesis that posterior capsular stripping (PCS) improves post-operative flexion and ROM.

2. Patients and methods

This study was a prospective randomised controlled trial. Ethical approval for the study was granted by the Local Research Ethics Committee. The primary outcome measures were the difference in the flexion and ROM after wound closure, 3 months post-operatively and 1 year post-operatively compared to pre-operative measurements.

* Corresponding author. Orthopaedic Outcomes Assessment Unit, Musgrave Park Hospital, Stockman's Lane, Belfast, Northern Ireland, BT9 7JB, United Kingdom. Tel.: +44 7766740104; fax: +44 2890683530.
E-mail address: bmhanratty@yahoo.co.uk (B. Hanratty).

0968-0160/$ – see front matter.
doi:10.1016/j.knee.2010.10.002

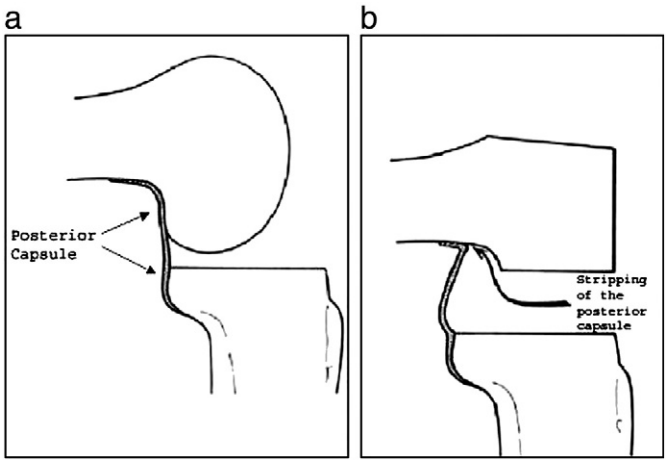

Fig. 1. (a) and (b). Schematic showing (a) posterior capsule and (b) stripping of the posterior capsule.

Secondary outcome measures were the absolute values of knee flexion, extension and range of motion at the different time points and post-operative complications.

The study was carried out between August 2000 and January 2001. During this period consecutive patients admitted under the care of the senior author (DEB) undergoing TKA were recruited. 128 consecutive patients were recruited. Patients were randomised either to undergo posterior capsular stripping (PCS group) or not (non-PCS group) (Fig. 2). Randomisation was carried out by an independent statistician using a computerised random number generator. A permuted block length of 10 was used to generate the treatment options. Sealed envelopes were opened in sequence at time of surgery.

The following pre-operative data was collected for each patient — age, gender and the direction and magnitude of the pre-operative axial deformity. The magnitude of the axial deformity was measured from the pre-operative long-leg radiographs. Inclusion criteria were patients undergoing primary total knee replacement under the care of the senior author during the study period. Exclusion criteria were previous knee surgery with the exception of open or closed meniscectomy and an inability of the patient to give informed consent. Fixed flexion deformity was not an exclusion.

The operating surgeon was blinded until the time of surgery to the selected treatment option. Patients were blinded as to which group they were assigned to. All operations were performed by the senior author (DEB) using a standard surgical technique. A bi-cruciate sacrificing mobile bearing prosthesis (Low Contact Stress (LCS) rotating platform prosthesis (DePuy International, Leeds, UK) was used in all cases. Soft tissue balancing was achieved in all cases, with the posterior capsule being cut under direct vision as per the senior authors technique [15]. Patients received either uncemented femoral and tibial components, or an uncemented femoral component and a cemented tibial component, or both components cemented. Stripping of the posterior capsule was performed as follows: after making the chamfer cuts on the distal femur and prior to insertion of the implants, the knee was placed in maximal flexion. The distal femur was elevated using a retractor to tension the posterior capsule (Fig. 3) which was then stripped from the posterior aspect of the distal femur for a distance of approximately 4–5 cm proximal to the level of the posterior femoral condyles using a periosteal elevator.

Knee extension and flexion were measured at four time points: pre-operatively (before anaesthesia), after wound closure at the end of the procedure and at 3 months and 1 year post-operatively. All participants were blinded as to whether they experienced PCS or no-PCS at all stages of the study. The participants were enrolled by NWT and were assigned groups on disclosure of the treatment option at the time of operation. The person administering intervention (DEB) was

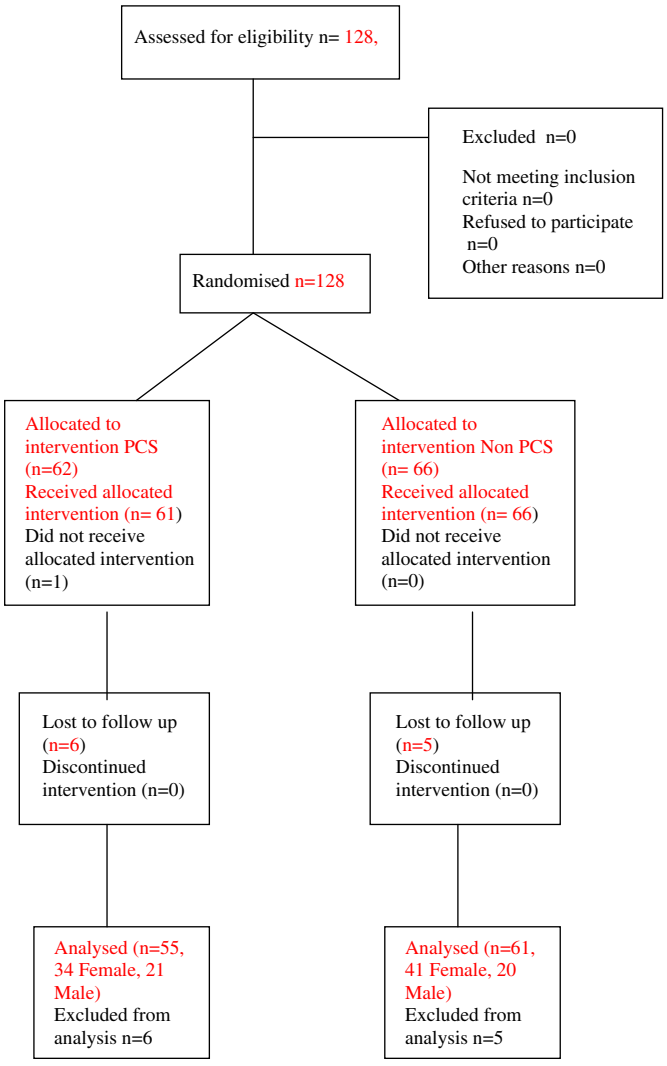

Fig. 2. Flow chart.

blinded up until the point of administration. The study member performing flexion and extension measurements (NWT) was blinded as to whether or not the patient had undergone stripping of their posterior capsule or not. Change in knee flexion and ROM measured following wound closure, 3 months post-operatively, and 1 year post-operatively relative to pre-operative measurements were analysed between PCS and non-PCS groups. The absolute values of knee flexion, extension and ROM between the groups were also analysed at each time-point.

To measure passive knee flexion and extension a standardised digital image of the patient's limb during knee flexion and extension was recorded at the various time points (Figs. 4 and 5). The limb was moved by the operating surgeon (DEB). Flexion and extension measurements were made by a single study member (NWT) using image analysis software (Rhinoceros, Seattle, WA, USA) (Fig. 6). This measurement method has previously been shown to have good inter-observer reliability and intra-observer repeatability [16].

3. Statistical analysis

Statistical power analysis indicated that to detect a difference of 10° in knee ROM between the two groups, a minimum of 55 patients in each group was required to give the study a power of 90% at $\alpha = 0.05$. This power calculation is based on a standard deviation of knee ROM of 16°.