ORIGINAL ARTICLE

Is patient self-assessment of flexion after TKR able to identify risk of manipulation under anaesthesia?

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KEYWORDS
Total knee arthroplasty; Clinical audit; Knee flexion; Patient self-assessment; Risk identification tool; Manipulation under anaesthesia; Arthrofibrosis

Summary

Background: Patient self-assessment of postoperative knee flexion following knee replacement was introduced at our institution. This protocol had a dual objective: improve follow-up and act as an early indicator to identify patients at risk of requiring a manipulation under anaesthesia. The aim of our study was to audit the use of this patient self-assessment tool and evaluate whether these outcomes were being achieved.

Materials and methods: A prospective audit of patients admitted for total knee replacements under the care of one orthopaedic consultant between April and October 2009. Participants were asked to measure and record daily maximum knee flexion whilst sitting, from discharge through to six-week follow-up. Patients were advised to contact the arthroplasty team if flexion reduced by 10° or more for three consecutive days. Patient’s documented knee flexion was compared to that measured on discharge and at six weeks postoperatively by clinicians.

Results: Seventy-nine participants (82 knees) were included with 61 participants (64 knees) returning data for analysis (78% compliance rate). Comparison of patient and clinician measurements showed a mean difference of +2° with limits of agreements from −12° to +15°. At a mean follow-up of six weeks maximum flexion (measured by clinician) was 99° (95%CI 97°, 102°) and 92% had a 90° flexion or greater. During the audit period, six patients met the criteria to contact the arthroplasty team, however none of them followed this instruction.

Discussion: Patient self-assessment of knee flexion at home with a simple goniometer was accurate enough to be useful and 92% of patients reached 90° maximum flexion at six weeks. However this self-assessment method was not successful as an early indicator to identify patients at risk of requiring a manipulation under anaesthesia. Future studies into alternative identifiers are required.

Level of evidence: Level III. Investigating a diagnostic test.

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Introduction

Total knee replacement (TKR) is a common surgical treatment option for the pain and disabling effects of osteoarthritis. Postoperative knee flexion is one of the outcome measures used to evaluate the success of this surgical intervention [1,2].

It is generally accepted that a period of rehabilitation is required to optimise success following surgery. Rehabilitation programmes vary in delivery and frequency, [3–6] and numerous studies have looked at the benefits and differences of these. A Cochrane review in 2009 suggested that the quality of evidence in this area was relatively low [7]. Compliance with any postoperative exercise programme is variable and can be dependent on a number of factors including patient motivation, pain and time [8]. Non-compliance with exercise prescription can be a contributory factor in a patient’s failure to achieve outcomes and in some cases results in residual stiffness.

Where postoperative knee flexion is restricted to less than 80°, this impacts the patient's ability to perform normal daily activities [9,10]. In these cases, the treatment of choice would be to perform a manipulation under anaesthetic (MUA) [11] shown to be most effective in the early stages post surgery, normally within the first six weeks [12–14] or earlier. After this time, there is an increased risk of complications which also supports early manipulation [11,14,15]. Mauerhan et al. reported that the more rapidly patients were able to achieve and maintain 90° of knee flexion the less likely they were to require an MUA [16].

MUA prevalence within our institution from a previous period highlighted concern that the success of this procedure was negatively influenced with failure to identify appropriate candidates prior to six-week follow-up. The absence of professional intervention within this initial post discharge period supports the need for a method of patient directed monitoring to identify those at risk of developing a poor range of motion (RoM) postoperatively.

This resulted in patient self-assessment of knee flexion being introduced and the following audit established to evaluate potential benefits. The aim of the study was to audit the use of this tool to improve follow-up and act as an early indicator to identify patients at risk of requiring an MUA.

Methods

This study was carried out under the clinical governance procedures of our institution as an audit. Between April 2009 and February 2010, patients admitted for TKR under the care of a single orthopaedic consultant at our institution were invited to participate in the audit. Patients were excluded from the audit if they did not wish to participate, presented with postoperative confusion or any other significant previous medical history, which would have prevented compliance with the audit, or were discharged home by staff not familiar with the audit process.

All participants were provided with a universal long-handled goniometer and written instruction on how to self-measure knee flexion in sitting. Written instructions were screened and approved by patient information officer for the hospital, for appropriate language and ease with which it could be followed. Prior to discharge from hospital, a qualified physiotherapist noted maximum knee flexion achieved. Participants were asked to continue with the standard prescribed daily exercise programme, which included range of movement and quadriceps strengthening exercises, but in addition to measure and document knee flexion angles on a daily basis using the goniometer provided. Patients were also asked to note the time of day the measurement was taken and to standardise this whenever possible to reduce the potential for variance based on time of day and activity levels. Furthermore, patients were advised to monitor knee flexion angles and to contact the arthroplasty clinic if there was a reduction of 10° or more in knee flexion that persisted for three consecutive days.

Participants were invited back to arthroplasty clinic six weeks after initial surgery, as per standard care for our institution, where a further measure of knee flexion was noted by the clinician, is a "specialist Arthroplasty practitioner" and audit forms collected.

To assess whether the angles measured by the patients were accurate enough to be useful, the first measurement of knee flexion taken by the patient was compared to the knee flexion at discharge as measured by a physiotherapist and then the final measurement taken by the patient was compared to that measured by an arthroplasty practitioner at the six week follow-up appointment. The two sets of data were compared together using Bland Altman plots and limits of agreement calculated [17] with negative numbers indicating the patient measuring higher flexion and positive numbers indicating the physiotherapist measuring higher flexion.

In order to minimise the impact of odd missing days in the recorded audit data, the audit period was divided into five-day intervals. If three or more measurements had been taken during the interval the data were included, with a median value taken from the available readings to represent the flexion in that time period.

Results

Over the period of audit, 129 patients (133 knees) were eligible to participate with a total of 79 patients (82 knees) being included. Of the exclusions two patient declined to take part in the audit, one patient presented with postoperative confusion, one patient was excluded due to visual impairment, 18 patients were discharged home by staff not familiar with the audit, three patients were referred on for outpatient physiotherapy as they were struggling with exercises, four had significant medical issues which would have impaired their ability to complete the audit and 21 patients were unable to participate due to a lack of available goniometers. Sixty-one patients with a combined total of 64 knee replacements completed and returned audit forms for analysis, an 78% return rate (based on knees). The demographics of this group were 31 females (one patient had right and left knee replacement on separate occasion over course of audit) and 30 males (one patient had right and left knee replacement on separate occasion over course of audit, one patient had simultaneous bilateral knees), mean age 67.7 (SD 8.2) and mean BMI 31.9 (SD 5.3). Of the 50 patients
initially excluded and the 18 that did not return audit forms 36 were female and 32 male with a mean age of 69.2 (SD 9.1) and mean BMI of 31.6 (SD 4.9).

Of the 64 knees included compliance reduced over the time period of the audit to 61% by the end (Table 1). In general, no reason for lack of compliance was given however one patient was hospitalised for other medical complications so ceased the audit after only four days.

The Bland Altman plot showed that the mean difference between the physiotherapist and patient measurements was +2° with limits of agreement being −12° to +15° (Fig. 1).

At six weeks, the mean maximum flexion measured at follow-up was 99° (95%CI 97°, 102°) and 92% had flexion of 90° or greater. Plotting the data for each time period showed how the mean maximum flexion had increased from discharge to the six-week follow-up appointment and that the upper three quartiles had clearly increased their maximum flexion from that measured on discharge from hospital.

![Figure 1](image1.png)

**Figure 1** Bland Altman plot showing agreement of clinician recorded goniometer measurements compared to patient self-assessment both for initial discharge at the beginning of the assessment period and at six-week follow-up at the end of the self-assessment period.

<table>
<thead>
<tr>
<th>Time interval</th>
<th>Number of knees</th>
<th>% compliance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Returned audit form</td>
<td>64</td>
<td>100</td>
</tr>
<tr>
<td>Day 5</td>
<td>63</td>
<td>98</td>
</tr>
<tr>
<td>Day 10</td>
<td>62</td>
<td>97</td>
</tr>
<tr>
<td>Day 15</td>
<td>58</td>
<td>91</td>
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<td>Day 20</td>
<td>60</td>
<td>94</td>
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<td>Day 25</td>
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<tr>
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<td>45</td>
<td>74</td>
</tr>
<tr>
<td>Day 40</td>
<td>39</td>
<td>61</td>
</tr>
</tbody>
</table>

![Figure 2](image2.png)

**Figure 2** Change in knee flexion measured by patient from discharge up to six-week follow-up. Data presented for intervals of five days.

(Fig. 2). For the 68 patients (69 knees), either excluded or non-compliant with the audit mean maximum flexion at follow-up was 95° (95%CI 93°, 98°) with 80% having a flexion of 90° or greater.

Some patients did not show this increase with six patients meeting the criteria to call arthroplasty within the first two weeks post discharge, but none of them followed this instruction. At the six-weeks follow-up, four of these six patients had achieved the target of 90° knee flexion but two had not, with one of these requiring a MUA. In addition to this, a further three patients who had not met the call criteria failed to achieve 90° knee flexion at six weeks. Of these two patients had failed to comply with the instruction of the audit to measure knee flexion daily. The remaining patient who failed to achieve the target of 90° flexion did...
comply with the audit however only managed to show a small increase in knee flexion from initial hospital discharge to that at six-week follow-up.

Discussion

The primary aim of this audit was to evaluate whether patients’ self-assessment of maximum knee flexion angles at home resulted in the early identification of those developing problems with flexion and therefore identified patients at risk of requiring an MUA.

As expected, the data showed variation in knee flexion angles documented by patients compared to that noted on initial discharge from hospital and again at six-week follow-up. Lenssen et al. [18] suggested that differences of up to 8° in recorded values, taken using a long arm goniometer, could represent measurement error and this value supported the use of a 10° reduction in knee flexion as the trigger for patients to contact arthroplasty. The mean difference reported in knee flexion over the audit period was +2° where therapist measured flexion to be greater than the patient, which supported the theory that patients could reasonably measure their own progress at home. The majority of patients documented a steady increase in knee flexion from discharge, with an improvement in flexion of between 10° and 20°. The amount of flexion achieved at six weeks was very similar when compared to previously published data from the same surgeon with the same implant at one-year follow-up, which showed mean maximum flexion of 101° [19]. Achieving the same levels of flexion at an earlier point in the rehabilitation may indicate an improved outcome but further work would be necessary to confirm this. Throughout the period of audit compliance with data collection also varied amongst patients. Of those who submitted data collection forms the initial compliance remained high for the first 20 to 25 days however decreased thereafter. By the end of the audit period, only 61% of those who commenced the audit continued to collect data on a daily basis. Although this indicates compliance with audit was variable no conclusive comparisons can be made with respect to compliance with daily exercise regimes prescribed.

Comparison of demographics between those patients completing the audit and those eligible but non-compliant showed no large differences. The mean maximum flexion at six weeks post-operation was slightly lower for those not completing the audit, with less of them achieving 90° of flexion. This may indicate that those completing the audit had slightly better rehabilitation but it cannot be discerned whether those who were more motivated and therefore would do better anyway took part in the audit or whether taking part in the audit did have a small positive effect on outcome. Early identification of patients at risk of requiring MUA is more cost effective and has a greater potential for long-term success [11]. For this reason, patient self-assessment was introduced to try and highlight as early as possible in the immediate post discharge period that a patient was not gaining the required knee flexion. However, this audit indicated that the self-assessment of knee flexion angles by patients failed to give early detection of lack of knee flexion. Some patients did not measure knee flexion daily so were not alerted to the lack of progress. Others observed stagnation of knee flexion angles but failed to inform the arthroplasty service. During the period of audit, in no cases were earlier reviews at the surgeon’s clinic initiated therefore this method was deemed to be an ineffective early identification tool. A more robust and reliable method of highlighting those patients at risk is therefore still required.

This audit had some limitations. Although all clinicians responsible for taking goniometry readings throughout the audit were experienced in the use of the long handed goniometer a different clinician measured knee flexion on discharge from hospital to that at six weeks. In addition to this was the expectation of the patient to self-assess knee flexion in a seated position. Patients were unfamiliar with the goniometer and the seated position in which to use this to measure knee flexion, which may have affected the reliability of the data obtained. In an attempt to limit variance between measurements patients were provided with written instruction along with a photographic reminder of correct positioning of goniometer arms and encouraged wherever possible to have a family member read the angle of flexion. As such this was still deemed to be a useful comparison to give an indication of whether the patient’s measurements gave an approximation of the flexion achieved. This study showed that in general patients were capable of measuring knee flexion using a goniometer to a level of accuracy that meant the results were useful.

An easier method of self-assessment for patients, as demonstrated by Piriyaprasarth et al. [20] with a flexible, lightweight electrogoniometer, may address some of the compliance issues and encourage those patients at greater risk of developing complications to participate. However, this would not address the issue of patients failing to report a reduction in knee flexion. By introducing a device with the capacity to store or remotely forward this information, this issue of non-reporting could be overcome and early identification of lack of flexion may be achieved. There would be an initial cost implication for any technology-based system; however, a cost analysis could determine whether this was more cost effective than further surgery.

Conclusion

Although patient self-assessment of knee flexion at home with a simple goniometer was accurate enough to be useful and 92% of patients reached 90° maximum flexion at six weeks, unfortunately it was not successful as an early indicator to identify patients at risk of requiring an MUA. Future studies into alternative identifiers or more robust systems are required.

Disclosure of interest

The authors declare that they have no conflicts of interest concerning this article.

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References


