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## The Knee



## Review

## Factors affecting the incidence and management of fixed flexion deformity in total knee arthroplasty: A systematic review

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## ABSTRACT

**Purpose:** This study aimed to systematically review the literature and identify factors which would contribute to the intraoperative correction of FFD to frame a potential surgical algorithm or predictive model to guide intraoperative decision-making.

**Methods:** Electronic searches of six databases were undertaken in April 2016 according to the PRISMA guidelines, and the reference lists of studies searched. Quality of studies was assessed using the STROBE checklist, and the Downs and Black Scores.

**Results:** Twenty-five studies investigating 10, 679 knees were found to satisfy the inclusion and exclusion criteria. These studies described a variety of pre-operative and intra-operative factors which contribute to the development or correction of post-operative FFD. The only patient predictor of post-operative FFD was pre-operative FFD. The intra-operative steps described to correct FFD were: distal femoral resection, soft-tissue balancing (in the posterior and medial compartments), sagittal component flexion and posterior condylar offset. However, no studies investigated these in an integrated model.

**Conclusion:** This review has identified various pre-, intra- and post-operative factors predictive of post-operative FFD. In practice, these factors are likely to interact, and therefore further investigation in an integrated model is crucial to developing a statistically sound and reliable intraoperative algorithm for surgeons to follow when correcting fixed flexion deformity.

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## 1. Introduction

In traditional mechanically aligned (MA) total knee arthroplasty (TKA), a key objective is to restore the mechanical axis (MA) of the knee in extension in both coronal and sagittal planes. A maximally extended knee that remains in considerable flexion (fixed flexion deformity or FFD) is observed in up to 17% of knees following TKA [1]. Post-operative FFD is associated with abnormal gait requiring excessive energy expenditure and quadriceps loading [2], with an increased risk of anterior knee pain, reduced function and a reduction in patient reported outcome scores [3]. Post-operative extension has been correlated with intraoperative range of motion [4], therefore the intraoperative correction of FFD in TKA is a key surgical outcome.

Historically, FFD has been managed in an empirical manner via surgical algorithms which revolve around ligament balancing, releases and further distal resection if necessary. For example, Bellemans et al. proposed a four-step algorithm comprising osteophyte removal and ligament balancing, followed by transverse posterior capsular release, then distal femoral over-resection and finally tenotomy of the knee flexors [5], progressing to each successive step only if FFD was remaining. Although the success of published surgical algorithms is well-described [5–11], they involve a subsequent re-resection of the distal femur, which prolongs operative duration whilst resetting the cutting guides, increasing the risk of excessive bleeding, infection [12] and deep vein thrombosis [13]. Femoral recuts can be difficult to make accurately with all systems, and they result in a change in the joint line. The combination of a delayed surgical work flow, and concerns around accuracy, makes it desirable to be able to predict the distal femoral resection to achieve full extension in all deformities, prior to making the first femoral cut.

A predictive model able to dictate the appropriate surgical steps to be undertaken to correct FFD in any given patient with the least number of operative steps would aid the pre-operative surgical planning process, leading to streamlined intraoperative decision making and reduced operative time. To develop such a model, a detailed understanding of all the factors involved in the development and intraoperative prevention of post-TKR FFD is required. The pre-operative characteristics which predispose patients to developing post-operative FFD should be identified and the contribution of each individual operative step to correcting FFD needs to be quantified. Once determined, these factors can be subject to multivariate regression analysis to develop an accurate and validated predictive model for achieving full extension [14]. This data-driven approach is a considerable departure from the previous empirical approach to FFD correction.

The purpose of this systematic review was to identify those factors predisposing patients to post-operative FFD, as well as factors involved in the intraoperative correction of FFD, with the intention of proposing a predictive model to guide intraoperative decision-making.

## 2. Methods

### 2.1. Literature search

This review was registered on the PROSPERO database (CRD42016037207). A systematic review of the literature was conducted in accordance with Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines [15]. Electronic searches were performed in the Ovid MEDLINE, PubMed, Cochrane Central Register of Controlled Trials, Cochrane Database of Systematic Reviews, ACP Journal Club, and Database of Abstracts of Review of Effectiveness during April 2016. To achieve maximum sensitivity, the terms (“flexion contracture” OR “flexion deformity”) AND (“knee arthroplasty” OR “knee replacement”) were combined as keywords. The reference lists of retrieved articles were reviewed to identify any additional relevant studies as per the inclusion and exclusion criteria as listed below.

### 2.2. Selection criteria

Studies eligible for this systematic review included English-language studies published at any time that addressed or reported pre-operative or intra-operative factors in total knee arthroplasty for osteoarthritis that affect post-operative fixed flexion deformity. Specifically, studies investigating pre-operative and intra-operative factors were included. Studies investigating rheumatoid arthritis or haemophilic arthropathy were excluded. Case reports, abstracts and conference proceedings were also excluded.

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