

# Intraoperative Assessment of Mid-Flexion Instability in Primary Total Knee Replacement

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## ABSTRACT

**Introduction:** Midflexion instability in primary total knee replacement (TKR) is an evolving concept. Successful treatment of instability requires an understanding of the different types of instability.

**Methods:** A literature review was performed using Pubmed, google and google scholar to identify information pertinent to midflexion instability in primary total knee replacement, utilising some guidelines.

**Results:** Three factors, i.e., elevated joint line, multiradii femoral component and medial collateral ligament (MCL) laxity, were identified to influence midflexion instability. Literature suggested mediolateral instability at 30–60° of flexion as diagnostic of midflexion instability. Literature search also revealed paucity in clinical studies analysing midflexion instability. Most of the evidence was obtained from cadaveric studies for elevated joint line and MCL laxity. Clinical studies on multiradii femoral component were limited by their small study size and early follow up period.

**Conclusion:** Elevated joint line, multiradii femoral component and MCL laxity have been suggested to cause midflexion laxity in primary TKR. Due to limitations in available evidence, this review was unable to raise the strength of overall evidence. Future well-designed clinical studies are essential to make definitive conclusions. This review serves as a baseline for future researchers and creates awareness for routine assessment of midflexion instability in primary total knee replacement.

**Keywords:** Knee, Midflexion instability, medial collateral ligament (MCL), total knee arthroplasty (TKR).

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## INTRODUCTION

Total knee arthroplasty has to address three types of instabilities. These include varus-valgus or flimsiness within the coronal plane; besides buckling within the sagittal plane or 'plane of knee movement'<sup>1-4</sup> and flexion instability<sup>5-7</sup>, where the femur moves too freely on the tibial articular surface, with the knee flexed up to 90°. All precariousness has to be caught on in terms of the balance between deforming forces and balancing out restrictions. Varus-valgus instability comes about from issues of appendage alignment and the energetic loads on the knee as resisted by the geometry of the arthroplasty and ligamentous judgment. Precariousness in the plane of development

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unavoidably includes the function of the extensor component. In case the extensor instrument has been disrupted<sup>8</sup> anywhere from the tibial tubercle to the quadriceps muscle, the knee will flex spontaneously. Similarly, on the off chance that the patella separates, the knee will buckle. Patients with extensor insufficiency often depend on locking the knee in extension or recurvatum to preserve soundness. In case that manoeuvre comes up short, they may drop. Flexion instability, first depicted by Pagnano<sup>7</sup> is usually caused by the flexion hole being bigger than the expansion crevice, independent of which one may be 'normal', where the arthroplasty has been built with a tibial articular polyethylene insert that grants full extension, thereby taking off the flexion crevice remiss.

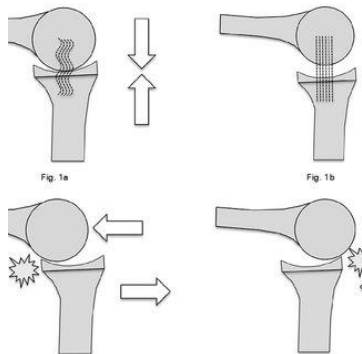
Patients with flexion insecurity don't like to bear weight on a flexed knee. They have difficulty rising from a chair and both climbing and descending stairs.

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Their knees flex unreservedly, often achieving amazing sums of flexion while still in healing center after surgery.<sup>7</sup> Laxity in flexion permits the femur to 'skate' on the proximal tibia until the limits to femoral trip are reached, when the ligamentous stabilizers are loaded suddenly. This clarifies persistent effusions and peri-articular delicacy. Flexion instability can too complicate back stabilised prostheses.<sup>6</sup> (Fig. 1).

The term mid-flexion precariousness entered the orthopaedic writing in 1990 with a laboratory investigation of the impacts of joint line position in TKA. Components were introduced into ten cadaver knees and the kinematics measured utilizing an Instron servo-pressure driven testing machine (Instron, Norwood, Massachusetts).<sup>10</sup> Examples with prove of joint pain or deformity were disposed of. This is often a essential condition but a different situation from the obsessive knees that are treated with TKA, where soft-tissue pathology, within the frame of plastic deformation from constant extending and contractures from limited development, will be experienced. The specimens were tried at first without an embed. Average and then lateral powers were applied to the joint in arrange to simulate varus and valgus stacking within the isolated positions of 0°, 30°, 45°, 60° and 90° of flexion. In partitioned parts of the study, anteroposterior relocations and turn were also assessed. The example was at that point evacuated from the testing fix so that a rotationally unconstrained posterior cruciate ligament-retaining condylar prosthesis, with a decreasing sweep from distal to back femoral surface, could be embedded.

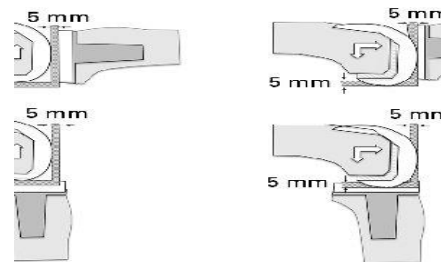


**Figure 1:** Flexion insecurity may be a well-described<sup>7</sup> and easily perceived sign for revision arthroplasty. The comes about from surgery will be predictably great. The address emerges whether a isolated clinical substance exists, which we can legitimately portray as mid-flexion instability; where the knee is steady at 90o of flexion and in extension, but unsteady some place mid-way between the two. The terms

flexion and midflexion instability ought to not be utilized interchangeably. Studies<sup>6,7,9</sup> have detailed revisions for flexion insecurity, but none for mid-flexion instability.

The femur was re-emerged with a dedicated measured resection procedure, where the average and lateral, distal and back surfaces were imitated to within 1 mm of the local life systems. A tibial embed thickness was chosen to settle the joint. The introductory tests were repeated to compare the comes about for a knee arthroplasty with the discoveries from the preparatory cadaver examinations. The prostheses were at that point repositioned. In half of the knees, the femoral component was re-positioned 5 mm more proximally and anteriorly (i.e., more bone was removed from the distal and back femur expanding the flexion and expansion holes symmetrically by 5 mm). Within the other five examples, the talk was done, with the femoral component uprooted 5 mm more distally and posteriorly to tighten both holes similarly.

Within the to begin with occurrence, the level of the verbalization was displaced proximally and anteriorly and within the moment it was displaced distally and posteriorly. The primary situation replicates selection of an undersized femoral component with additional distal femoral resection, and the moment scenario replicates a larger than usual component, with under-resection of the distal femur. In four knees within the moment bunch, the posterior cruciate tendon got to be tight and was resected. The authors did not specify if diverse tibial components were selected after the re-positioning, but in case a thicker component was not utilized within the to begin with bunch, improbable recurvatum with generalised laxity would happen. Additionally, in the event that a slender one was not utilized within the moment circumstance, it would be expected that summed up snugness would be display. Viably, the absences of these changes might have discredited the think about.



**Figure 2:** Schematic sees of the knee, which portray circumstances that were considered by Martin and Whiteside in 1990;<sup>10</sup> the cadaver work that embroiled joint line height as a cause of 'mid-flexion' flimsiness. Each match of graphs

delineates one exploratory or theoretical circumstance seen from the side, with the knee completely amplified in one picture and flexed to 90° within the other:

The common clinical situation of redressing a flexion contracture, where the expansion crevice is littler or tighter than the ordinary flexion hole after measured resection cuts, by expelling extra distal femoral bone to move the femoral articular surface proximally, will not have been modelled with this think about, nor will the impact of contracted or stretched collaterals. In this consider, the distal and back interpretation actually improved the varus-valgus soundness of examples, however, this technique has never been suggested for arthroplasty surgery. The oft-quoted result<sup>10</sup> is that proximal migration of the joint line leads to an increment in varus-valgus excursion in flexion between 30° and 60°, whereas maintaining stability in full expansion and 90° of flexion. This conclusion is for the most part cited in reference to clinical conditions where suitably measured femoral component is purposefully placed more proximally, (e.g., when adjusting a flexion contracture) ignoring the suggestions of anterior translation. The Martin and Whiteside study<sup>10</sup> in fact describes the circumstance where an undersized component is implanted and the crevice is at that point adjusted by resection of the distal femur.

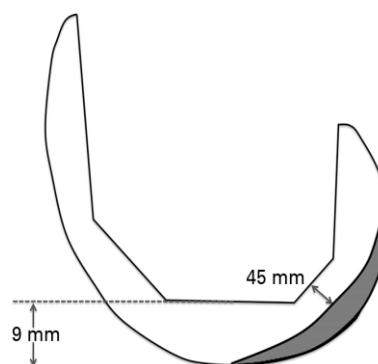
There were comparable discoveries of expanded anteroposterior displacements in reaction to loads connected in those directions. Again, one might expect that tibial embed thickness was balanced after each repositioning, in spite of the fact that this was not stated.<sup>10</sup> Disappointment to utilize thicker or more slender tibial components would cruel that resection of 5 mm on distal and posterior femoral condyle would be anticipated to make unstable knees and the inverse activity, exceptionally tight ones. The observation that two of the knees may well be totally dislocated at 45° of flexion in case quadriceps pressure was sufficiently reduced, portrays a shocking sum of insecurity after resection of as it were 5 mm of femoral bone in case that had been at slightest mostly compensated for employing a thicker tibial component.

The conclusions made by Martin and Whiteside<sup>10</sup> were that in a typical knee joint, an undersized femoral component that has been embedded more proximally, giving equivalent flexion and expansion crevices, comes about in laxity to varus-valgus loads between full expansion and 90 degree of flexion, with steadiness at the extremes. The clinical situation of correcting a

flexion contracture, by utilizing an anatomically proportioned femoral component that has been implanted with extra distal femoral resection to extend the size of the expansion crevice to coordinate the flexion crevice, was not evaluated (Fig. 2).

Modern computer demonstrating of the tallness of the joint line by König<sup>11</sup> in Berlin, did not bolster the idea that joint line height could be a major supporter to midflexion instability. In differentiate, later suggestions for surgical adjustment of flexion precariousness underwrite joint line elevation as implies of extending the extension crevice to match the flexion hole and, thus, kill flexion instability.<sup>9</sup> McPherson, Cuckler and Lombardi<sup>12</sup> proposed a interesting sort of rotational flimsiness emerging in certain constrained prostheses amid modification arthroplasty in a paper entitled "Mid-flexion flimsiness in Amendment TKA." They concentrated on highlights of prosthetic plan and rotational constraint but depicted a marvel, which was different from that depicted by Martin and Whiteside<sup>10</sup> with proximal situating of the femoral component not mentioned as a causative figure for insecurity.

One may make an embed with recessed forms (Fig. 3) such that laxity happened specifically between full extension and 90° of flexion, but it is far-fetched that this characterises any modern plan of TKA.

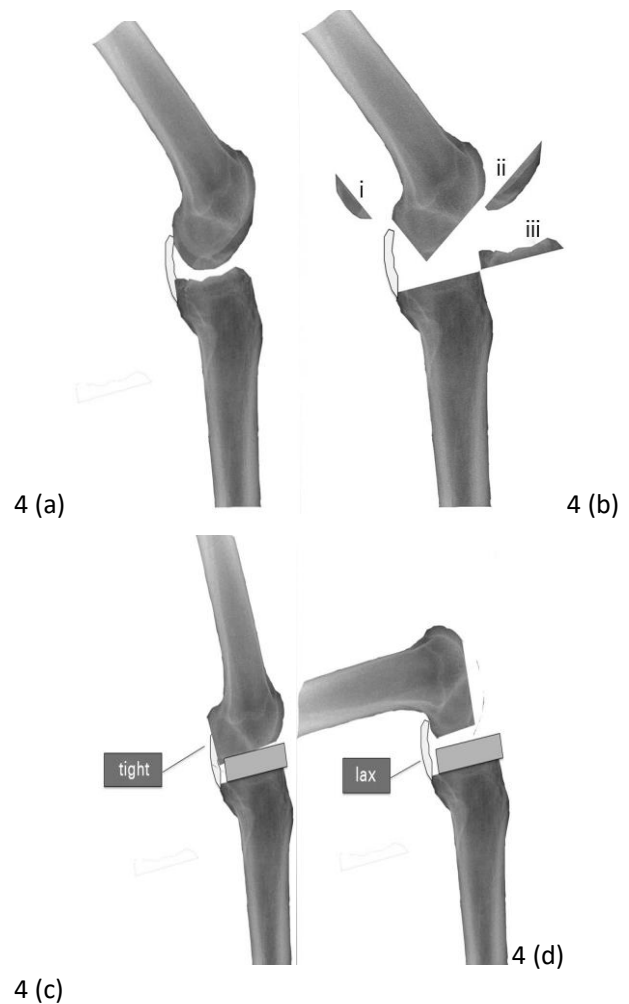


**Figure 3:** Sidelong see of a hypothetical femoral component where mid-flexion insecurity would be anticipated as a result of the plan. Expecting that the thickness of the metal of most femoral components is around 9 mm, it would be fundamental to expel or change the form of the midflexion division of the prosthesis by approximately half to approximate the impact examined by Martin and Whiteside<sup>10</sup> (5 mm). The stippled region appears the amount of fabric that would have to be evacuated. This reduction, or the talk expansion of 5 mm of metal to most inserts would be unconventional and it is profoundly unlikely that femoral component forms are dependable for mid-flexion precariousness

The standards required to develop a steady and mobile TKA without distortions, counting settled flexion contractures, are clear and straightforward. The understanding whose TKA is stable to varus-valgus stresses in full extension, but who has laxity once the knee is flexed marginally, may be befuddling. This is not, be that as it may, likely to be an unused substance that merits the label mid-flexion insecurity. It is conceivable that collateral laxity could be conceal by the auxiliary settling impact of posterior structures that gotten to be tight when the knee is fully extended.<sup>13</sup> This marvel is recognized when examining for average collateral tendon damage. The knee should be flexed to unwind the auxiliary restrictions, specifically the back capsule.<sup>14</sup>

The TKA with unequal flexion and expansion gaps, where the previous is more remiss, will show a few instabilities, even within the early extend of flexion. That would account for patients with this clinical issue disdaining stairs, where ascent and plummet stack the flexed knee.<sup>7</sup> They may not experience comparable challenges with strolling on level ground in the event that they compensate with a stiff-legged walk.

In the event that a joint knee with a settled flexion distortion is replaced employing a measured resection procedure, without appropriate soft-tissue adjustment of the contracture, the flexion hole will be of typical measurements, but the extension gap will be littler and more tightly. This discrepancy may be relatively subtle, within the arrange of a few millimeters. It has been reported that 4° of contracture can be accounted for by each millimeter of resection of bone.<sup>15</sup> In this setting, in the event that a modular polyethylene component is chosen to allow full extension, the flexion hole will be lopsided, making a knee generally remiss in flexion. An uncorrected flexion contracture likely causes most cases of flexion instability (Fig. 4).



**Figure 4:** A more likely clarification for what patients might endure, and surgeons might watch as mid flexion precariousness, is the much more mundane, uncorrected settled flexion deformation. (a) Horizontal see of a knee with a fixed flexion distortion. The back structures are tight and contracted. (b) On the off chance that a normal measured resection procedure or ‘kinematic alignment’ method is utilized, an sum of bone will be expelled from the back (i), and distal (ii) femoral condyles, break even with to the thickness of the embed. A standard sum of proximal tibia (iii) will too be resected. (c) The knee can presently be completely amplified and settled in extension with a spacer of thickness less than the combined thickness of distal femoral (ii) and tibial resections (ii). The contracted posterior structures stay tight. (d) In the event that the same spacer is embedded in flexion, the flexed knee will be remiss. This may be more inconspicuous than has been depicted here, but the circumstance will be replicated with the implantation of component

The terms flexion flimsiness and mid-flexion instability should not be utilized traded. On the off chance that mid-flexion instability exists, it ought to be

particular from both varus-valgus instability and flexion precariousness, both of which have been described precisely.

Appropriately, a circumstance might conceivably exist where a TKA was steady in expansion and at 90° of flexion, but was unsteady between the two positions. That substance has been portrayed in a cadaver study<sup>10</sup> but has not been completely affirmed in clinical hone. The common circumstance where a TKA shows up steady in expansion, however unsteady with a small flexion, is superior clarified by more basic principles. The part of the back structures in varus-valgus stability highlights the significance of picturing all four sides of the knee joint, average, sidelong, back and front when performing a TKA. We tend to think in two measurements: the collateral tendons as envisioned on the anteroposterior radiograph and the extensor and back capsule as envisioned on the sidelong see. Failure to render the knee joint conceptually in three measurements leads to foggy vision and woolly thinking.

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## Authorship and Contribution Declaration

**Dr. Ranjeet Kumar**, Conception and design of the study

**Dr. Muhammad Imran Haider Qaisrani**, Drafted the manuscript

**Dr. Raja Muhammad Shahzad**, Revised the manuscript critically for important intellectual content

**Prof. Mohd Umar**, Final approval of the version for publication