



Intraoperative fracture fixation during primary total knee arthroplasty

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ABSTRACT

Introduction: Intraoperative fracture is a rare complication of total knee arthroplasty (TKA) with no clear consensus on the treatment plan due to limited literature on the subject. We studied different articles to further understand this complication and how to manage it.

Methods: Multiple Databases were searched using specific keywords, and after further scanning and exclusion process, we limited the work to 10 articles.

Results: The reported incidence varied from 0.2% to 4.4% according to different studies with a higher incidence in female (male to female ratio of 0.4). Posterior stabilized (PS) TKA was among the risk factors associated with higher incidence of intra-operative femoral fractures, along with Rheumatoid arthritis and osteoporosis. Timing of occurrence and location of the intra-operative fractures can vary widely, with femoral fractures being the most frequent (60%) and fractures occurring more commonly during bone preparation and trialing. Management of these fractures has no clear consensus but is based on the basic principles of fracture fixation, with a multitude of options made available like screw and plate fixation and stemmed implants.

Conclusion: Intraoperative fracture during primary TKA is a rare underestimated complication with good prognosis after fracture fixation and little to no long term implications.

RESUME

Introduction : Les fractures peropératoires lors d'une PTG de première intention sont des complications rares, sans plan de prise en charge bien codifié à cause du nombre limité d'articles qui portent sur ce sujet encore mal étudié. Nous avons sélectionné les articles pertinents pour mieux comprendre cette complication et comment la prendre en charge.

Méthodes : Plusieurs bases de données ont été analysées et la recherche a été faite en se basant sur des mots clés sous-mentionnés. Après la filtration et l'exclusion, on a retenu finalement 10 articles.

Résultats : L'incidence rapporté varie de 0.2% à 4.4% selon les différentes études avec une prédominance féminine (sex ratio = 0.4). Les prothèses postéro-stabilisées, ainsi que l'arthrite rhumatoïde et l'ostéoporose, font partie des facteurs de risques de ces fractures. Le temps et la localisation préférentielle de ces fractures varient beaucoup avec une prédominance nette de la localisation fémorale à 60%. La phase la plus pourvoyeuse de fractures est en général la phase de coupes osseuses, suivie par la mise en place de prothèse d'essai. La prise en charge de cette complication n'a pas de consensus mais suit les règles de base de l'ostéosynthèse avec plusieurs options qui sont disponibles au chirurgien (plaques, vis, prothèse à quille longue...).

Conclusion : Les fractures peropératoires lors d'une PTG de première intention sont des complications rares et sous-estimées, avec un bon pronostic après l'ostéosynthèse sans conséquences à long terme dans la vaste majorité des cas.

I- INTRODUCTION

Even though TKA is one of the most commonly performed surgeries, intraoperative fracture is one of the rare complications. It's sometimes underestimated and there's no clear consensus on the treatment plan. While intraoperative fracture during revision knee arthroplasty has been well documented, there is limited literature on fractures occurring during primary knee arthroplasty. The purpose of this work, after going through the different studies included, is to clearly define the predisposing factors, incidence, and characteristics of the fracture itself and to arrive at a consensus on the management and prevention of intra-operative fractures during primary knee arthroplasty.

II- METHODS

The PubMed/Medline, Cochrane, Scopus and Embase databases were searched using keywords : Intra-operative fracture, Distal femoral fracture, Tibial fracture, Primary total knee arthroplasty.

A- Eligibility criteria

We included in our work articles that studied femoral and tibial fractures during or immediately after primary total knee arthroplasty. We didn't include articles that studied post-operative fractures in TKA or patella fractures. We also excluded articles that studied revision TKA.

A total of 158 articles were retrieved and after further filtration and exclusion processing, 10 articles that evaluated intra-operative fractures in primary total knee arthroplasty were included for the review (Fig 1).

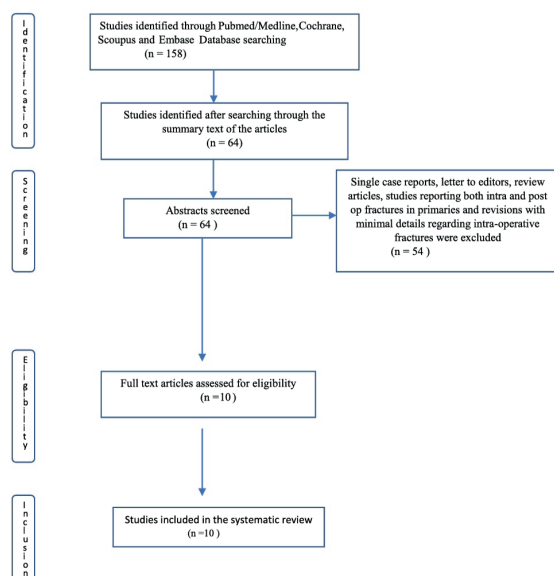


Figure 1: Flowchart of the search strategy

III- RESULTS

The reported incidence of intra-operative fractures varied from 0.2% to 4.4%. A higher incidence in female patients with a male to female ratio of 0.4 was reported. The mean age of the patients is 60 years with a range of 45.5-73.3 years. The most common indication for TKA was

primary osteoarthritis (57.4%). Posterior stabilized (PS) total knee arthroplasty was associated with higher risk of intra-operative femoral fractures by many authors. Other risk factors included Rheumatoid arthritis, osteoporosis, advanced age and chronic steroid use. Felix et al [1] classified periprosthetic fractures of the tibia into 4 types based on their location and subdivided into type A, B and C with the last one being intraoperative fractures. However, we didn't find any particular classification for femoral fractures. Timing of occurrence and location of the intra-operative fractures can vary widely, with femoral fractures occurring more commonly during bone preparation (39%), trialing (30%) and impaction of the final implant and tibial fractures occurring during preparation for the tibial keel (37%) and impaction of the tibial component (53%). Overall, 60% of fractures were femoral.

There was no consensus among authors on the treatment plan and management of fractures, but overall a multitude of fracture fixation options was exercised, and treatments went from no further intervention in non displaced intercondylar fractures to a distal femoral replacement in highly comminuted fractures.

There was a variation in post-op protocol among the different studies, as 4 authors opted for a non weight bearing period of 6 to 8 weeks, and 3 others allowing full weight bearing and ROM with crutches or a walking frame. Long term, there was no statistically significant difference in comparison with patients who had no intraoperative complications, all the authors reported radiological healing except for one complex tibial fracture, and they all reported clinical score improvements similar to that of the series of patients with no fractures.

IV- DISCUSSION

Intra-operative fracture during primary total knee arthroplasty is uncommon and there is limited literature on this topic. We identified incidence ranging from 0.2% to 4.4% but this may be underestimated (some fractures that had no clinical significance went unnoticed) [2].

Similar to revision knee arthroplasty surgery, osteoporosis, rheumatoid arthritis, advanced age, female gender, severe pre-operative bone deformities, chronic steroid use, posterior-stabilized knee arthroplasty and metabolic bone disorders have been identified to be important risk factors for intra-operative fractures during primary knee arthroplasty [3-6]. The intercondylar notch cut acts as a stress riser by decreasing the strength of the femoral condylar bone thus leading to fractures. Similarly, if the implant or the trial are inserted or extracted in a slight varus or valgus angulation it results in stresses applied to either condyles, this may lead to fractures [6].

Intra-operative fractures can occur at any stage of a knee arthroplasty procedure. Exposure and bone preparation have been identified to be particularly risky [3,4] as is trialing and impaction of the implant [6-8]. Huang et al [9] were of the opinion that the micro fractures that might have occurred

during exposure and bone preparation would become visible on trialing of the implants due to the mechanical forces created by reducing the tibia on to the femur.

A- Management of intraoperative fractures

There's no consensus on the treatment strategy of these fractures, due to multiple options and variable fracture patterns, as well as the rarity and lack of literature. However, as a general rule, fracture fixation and arthroplasty principles should be followed to achieve stable internal fixation and any unstable fracture site should be bypassed with the utilization of long intramedullary stems^[3,4].

a) Femoral fractures

Non-displaced intercondylar femoral fractures that do not extend into the medial or the lateral cortex are considered to be stable and they do not need any further intervention like Lombardi et al^[6] reported, with no change in post-op protocol (unrestricted ROM and full weight-bearing).

Non-displaced fractures of the medial or the lateral femoral condyles extending into the respective cortices can be treated with partially threaded cancellous screws^[8-10]. Plate and screw fixation or screw with a stemmed femoral implant^[3,6] should be available as options in displaced unstable femoral condylar fractures.

Epicondylar fractures are uncommon and can be safely addressed using screw fixation^[3,4].

Highly comminuted femoral condylar fractures and supracondylar fractures might need to be treated using distal femoral replacement^[3].

b) Tibial fractures

Small vertical crack fractures involving the anterior, posterior, medial or the lateral cortex of the proximal tibia can be managed with compression screws and a standard tibial implant^[4,10]. Tibial plateau fractures should be addressed using a stemmed tibial implant and compression screw fixation of the fracture to gain stable fixation^[1,3,4]. Fractures involving the metaphyseal-diaphyseal region of the tibia should be addressed using a stemmed tibial component with or without plate and screw fixation as needed^[1,7].

B- Recommendations for prevention of intra-operative fractures:

Preoperative planning is necessary in case of severe bone deformity. Bone loss should be located with a CT scan if needed, and prosthesis choice should be made according to the deformity.

While operating, the surgeon should be careful not to perforate the lateral tibial cortex, to evert the patella with too much force or to perforate the anterior femoral cortex with intramedullary instruments.

arthritis, advanced age, female gender, chronic steroid use, metabolic bone disorders, PS type of femoral implant and difficult exposure of the joint due to severe deformities. Patients with risk factors warrant careful pre-operative planning with a full medical history, evaluation of bone stock and availability of appropriate instruments and implants. Exposure, bone preparation and trialing, final femoral implant placement, preparation for the tibial keel and impaction of the tibial component are associated with higher incidence of these fractures. A plethora of management options have been utilized according to surgeon preference. Standard principles of fracture fixation and arthroplasty principles should be followed to achieve stable internal fixation and any unstable fracture site should be bypassed with the utilization of stemmed components. Satisfactory radiographic and functional outcome can be expected with appropriate treatment.

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V- CONCLUSION

Intra-operative fractures during primary TKA are rare with higher risk associated with osteoporosis, rheumatoid