Case report

Tibial reference point in total knee arthroplasty in patient with proximal tibia vara: A case report

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ARTICLE INFO

Keywords:
Tibial reference point
Total knee arthroplasty
Tibia vara
Case report
Varus knee malignment

ABSTRACT

Introduction: Center of the intercondylar eminence at the proximal tibia had been widely used as a reference point for tibial bone cut in the Total Knee Arthroplasty (TKA) procedure. However, in the presence of preexisting tibia vara, the center of intercondylar eminence as tibial bone cut reference point often leads to varus malalignment after TKA procedure.

Case report: 75 years old male patient complained of worsening pain on the left knee. The patient has had a history of knee osteoarthritis for the past seven years. The radiograph on the right knee revealed osteoarthritis grade 3 and left knee osteoarthritis grade 4, both with tibia vara. We planned to perform total knee arthroplasty surgery on his left knee with a preoperative planning tibial reference point of 10 mm lateral to the center. Six months after the knee replacement, there was minimal pain on activity, and full ROM was achieved on his left knee. On the radiographic X-ray evaluation, the alignment between the tibial implant surface and mechanical axis is 0.43 degrees valgus.

Clinical discussion: In a varus knee malalignment, the mechanical axis passes through one-third of the medial side of the knee, which makes the medial side of the implant wear off faster, resulting in the collapse of the medial tibia, thus decreasing implant survival and increasing the need for revision for TKA.

Conclusion: In patients with preexisting tibia vara, tibial bone cut reference point planning before TKA procedure is important to provide longevity of implant survival and better quality of life.

1. Introduction

Total Knee Arthroplasty (TKA) is a common surgical procedure indicated for knee disorders, primarily osteoarthritis. TKA improves patients' quality of life by reducing pain and improving the function of knee disorders [1]. In TKA, normal coronal alignment and correct placement of the femoral and tibial implants perpendicular to the mechanical axis is important for patient quality of life and long-term implant survival. The correct alignment by bone cuts, prosthesis positioning, and soft tissue balancing will restore the neutral mechanical axis of the femur and tibia in the coronal plane [2–8]. McGrory, in his study, describes that restoring normal mechanical axis correlates with improved long-term implant survival [4]. Fang, in his study, also describes the coronal alignment as a predictor for TKA revision [9].

According to Saibaba's research, in patients with varus arthritic knees, an undetected, yet considerable, extra-articular varus angulation may exist at the proximal metaphyseo-diaphyseal junction of the tibia [7]. The center of the intercondylar eminence had been widely used as a reference point for tibial bone cut at the proximal tibia in TKA [2]. But in the presence of preexisting tibia vara, the center of intercondylar eminence as a tibial bone cut reference often leads to varus malalignment after TKA procedure [2,7,10]. The implant in TKA procedure will fail faster in varus knees primarily from medial tibial collapse because of implant wear and in varus knees from ligament instability [8,9]. In a study by Fang, varus knees after TKA increases the risk of failure 6,9 times compared with properly aligned knees [9]. Tibia vara deformity identified at the proximal part of the tibia, studies reported that the closer to the joint the deformity, the more it will affect articulation and alignment to the nearest joint, but the closer to the joint the deformity, the more it will be possible to correct the axis or the alignment through intra-articular bone cuts [5,6].

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https://doi.org/10.1016/j.ijscr.2022.106945
Received 26 January 2022; Received in revised form 12 March 2022; Accepted 13 March 2022
Available online 16 March 2022
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achieving coronal alignment during the TKA procedure, we need to position the implant properly, conserve bone as much as possible and pre-
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3. Discussion

In TKA procedure, the function and durability of the implant are determined by multiple factors, such as surgeon, patient, and implant factor. Among all that factors, proper implant positioning to achieve coronal alignment of the leg is one of the most important points [9]. To achieve coronal alignment during the TKA procedure, we need to position the implant properly, conserve bone as much as possible and pre-
serve the collateral ligaments and the extensors part of the knee [5].

The center of the intercondylar eminence at the proximal tibia had been widely used as a reference point for the tibial bone cut in the TKA procedure [2]. But in the presence of preexisting tibia vara, the center of intercondylar eminence as the tibial bone cut reference often leads to varus malalignment after TKA procedure [2,7,8,10]. In the varus malalignment, the lower leg mechanical axis of the leg will not be in line with the anatomical axis of the tibia and the mechanical axis will pass through one-third of the medial side of the knee instead of the central third of the knee [2,4,5]. When the mechanical axis passed through one-third the medial side of the knee, the medial side of the implant would be worn off faster, resulting in the collapse of the medial tibia, thus decreasing implant survival and increasing the need for revision of TKA [7–10]. Han, in his study, described that coronal alignment of the tibia...
could be achieved with a tibial bone cut that has to be made perpendicular to the tibia mechanical axis or within 3° in either varus or valgus alignment [8]. Moreover, in recent studies, implant survival improved when the mechanical axis of the lower leg after the TKA procedure passed through the central third of the knee [4].

The anthropometric of the bones in Asian populations differ markedly from western populations. A study reported that the lower leg alignment in young Chinese populations was more varus than Caucasians. Moreover, in a group of end-stage osteoarthritis (OA) of the knee among Asians, bowing of the leg is not uncommon [3]. In varus knees, there is 6.9 times increased risk of failure TKA compared with properly aligned knees. As described in a study by Fang, thirteen of the eighteen of the varus knee failures were due to medial tibial collapse [9]. Fang also described the best implant survival rate found in overall coronal alignment between 2.4° and 7.2° of valgus following the TKA procedure [9]. To achieve normal coronal alignment in preexisting tibia vara during TKA, the tibial bone cut reference should be calculated according to the degree of the tibia vara deformity.

Kim Sang-Min, in his study, used lateral intercondylar eminence as a fixed reference for the tibial bone cut in varus knees and then investigated the accuracy of coronal alignment after TKA procedure in anatomical replica sawbones [2]. The result of his study is that lateral intercondylar eminence can be used as a tibial bone cut reference to achieve proper coronal alignment in varus knees [2]. Thippana and Saibaba, in their study, also used lateral tibial bone cut reference in preexisting tibia vara [7,10]. However, Thippana et al. calculated the reference point based on the degree of tibia vara deformity rather than the fixed reference point at the lateral intercondylar eminence, and it can extend further lateral than the lateral intercondylar eminence [10]. The result of her study results show that TKA using the calculated lateral tibial bone cut reference point provides more satisfactory coronal alignment than using the center intercondylar imminence as a reference point in preexisting tibia vara deformity [10]. This study proved the importance of tibial bone cut planning prior to TKA procedure with preexisting tibia vara deformity to provide implant survival.

Weight-bearing (standing) long leg radiograph has been the gold standard for assessing leg alignment [5,9]. Standing long leg radiograph could be used for preoperative planning to identify bowing of the leg caused by femoral or tibial deformity, in this case, tibia vara [3,4]. In the preoperative planning, the degree of the tibia vara and the lateralization of tibial bone cut reference were measured to be used for the TKA procedure. Yau, in his study, recommends using an anteroposterior (AP) standing long leg radiograph instead of short films for preoperative TKA planning, especially in populations with a high incidence of varus deformity, for example, Asian populations [3]. If standing long-leg radiographs are not available, commonly due to unavailable long films,
conventional x-rays may be taken separately with the same magnification in full weight bearing (standing) manner and put together as a puzzle afterwards to assess the leg alignment [5,7].

The TKA procedure used extramedullary (EM) and intramedullary (IM) system alignment to navigate tibial bone cutting. Both systems are commonly used, and choosing between EM or IM alignment systems is based on the surgeon’s consideration and examination. However, in recent studies, an EM alignment system is preferred instead of an IM alignment system if bowing of the leg is found during the planning of TKA [3,4]. During TKA with IM alignment system, the IM rod has to be inserted parallel to the mechanical axis of the tibia to achieve optimal tibial bone cut. Therefore, the EM alignment system used in patients with bowing of the leg may result in a tibial bone cut perpendicular to the proximal tibia’s anatomical axis, but not perpendicular to the mechanical axis of the tibia. Therefore, the EM alignment system is preferred in patients with bowing of the leg to enhance the accuracy of the tibial bone cutting [4,5].

4. Conclusion

In patients with preexisting tibia vara, tibial bone cut reference point planning prior to TKA procedure is important to provide longevity of implant survival and better quality of life. In our case, the point is located lateral to the traditional reference point.

Source of funding

This study did not receive any specific grant from funding agencies, commercial, or not-for-profit sectors.

Ethical approval

This study has been reviewed and approved by the authors’ Institutional Review Board.

Consent

Written informed consent was obtained from the patient for publication of this case report and accompanying images. A copy of the written consent is available for review by the Editor-in-Chief of this journal on request.

Author contribution

John Christian Parsaoran Butarbutar: conceptualization, writing original draft preparation, final approval, writing the paper and editing, supervision.

Lasa Dhakka Siahaan: data collecting, data interpretation, writing original draft preparation, writing the paper and editing, final approval.

Prettyssia Suvarly: data collecting, data interpretation, writing original draft preparation, writing the paper and editing, final approval.

Muhammad Alwy Sugiarito: data collecting, data interpretation, writing original draft preparation, writing the paper and editing, final approval.

Registration of research studies

This Case report is not “First in Man” Study.

Guarantor

John Christian Parsaoran Butarbutar.

Provenance and peer review

Not commissioned, externally peer-reviewed.

Declaration of competing interest

We declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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