Editorial

Alignment in TKA: An Unresolved Controversy

Alineación en PTR: Una controversia en evolución aun no resuelta

Rafael Calvo Rodríguez[1] Javier González Almonacid[1]

[1] Clínica Alemana – Universidad del Desarrollo

Rev Chil Ortop Traumatol 2021;62(2):e75–e76.

The problem

At 15 years, the survival of these implants is greater than 96% and at 25 years they exceed 82%[1] however, this good survival is obscured by a high percentage of patients, around 20%, who continue with pain and other discomfort nonspecific in the knee over time.[2]

Dissatisfaction after a Total Knee Arthroplasty (TKA) is a phenomenon well documented in the literature.[3]

Based on a review of the Swedish Registry, Dunbar et al reported that 17% of patients were dissatisfied with the TKA result.[4] Baker et al. re-evaluated data from the National Register of England and Wales: 71% of patients reported improvement in knee symptoms, but only 22% rated the results as "excellent"[5].

In the search for solutions to improve these results, new assistive technologies for the implant have been proposed (from navigation to robotics). Although this is a multifactorial problem, lately an emphasis has been placed on alignment as a modifiable cause of this problem.[6]

There is controversy regarding the most appropriate type of alignment in TKA.[6]

The balanced knee concept has no clear definition and can be achieved in more than one way. There are 2 classic techniques described for this: The measured resection (MR) and the gap balancing of the femur and tibia.[7]

In MR, anatomical references are used to place the implant. Bone cuts are made regardless of the ligamentous situation and are based on the transepicodyle axis, the anteroposterior femoral axis or Whiteside axis and the posterior axis of the condyles. The surgeon follows the guidelines of the instruments, trying to make the distal and posterior femoral bone resections similar; ligaments later adapt through soft tissue releases.

In the gap balancing (GB), distraction systems are used to define the best position of the arthroplasty and subsequently bone cuts and ligamentous releases are adapted to it.

But regardless of the technique used, the goal for decades has been the same, to obtain a mechanically aligned knee.[8]

The classic is still mechanical alignment, but this approach ignores the anatomy of the native joint and the relationship between the origin and insertion of the soft tissues.

What's new: kinematic, functional, anatomical alignment etc.

The mechanical alignment looks for a knee that respects the mechanical axis of the lower limb, in which the mechanical axles of the femur and tibia form an angle of 180° between them.[8] The problem is that this axis is natively neutral in only a certain percentage of the population, which is why it has been questioned as a parameter to be followed. Constitutional varus has been described in up to 30% of men and 17% of women.[9]

There is no doubt about the excellent results that have been achieved with mechanically aligned TKA.[8] But new studies have generated more interest in a new concept of alignment; kinematic alignment. Two randomized clinical trials and other multicenter studies showed that patients treated with kinematic alignment reported a significantly better difference from mechanical alignment in pain relief, function, flexion, and more normal knee sensation, with implant survival of about 2, 3 and 6 years.[10–12]

The kinematic alignment seeks to reconstruct the axis of the limb prior to the implantation of the Arthroplasty (pre-arthrosic axis),[8] and has 3 objectives[7]: Restore the native tibiofemoral articular surface, restore the native alignment of the lower limb and restore the native laxity of the knee.

Riviere et al defined 5 implant alignment methods[13]: Mechanical, tight mechanical, anatomical, kinematic, and

Address for correspondence Rafael Calvo, MD, Clínica Alemana de Santiago SA, Vitacura, Región Metropolitana, Chile (e-mail: rcalvo61@gmail.com).

DOI https://doi.org/10.1055/s-0041-1735514.
ISSN 0716-4548.

Thieme Revinter Publicações Ltda., Rua do Matoso 170, Rio de Janeiro, RJ, CEP 20270-135, Brazil

restricted kinematics. Recently Oussedick et al also defined functional alignment.[14] In their study, they argue that mechanical alignment ignores the importance of soft tissue. Kinematic alignment, on the other hand, respects the soft tissues, but ignores the mechanical environment, which is why it proposes functional alignment as a hybrid technique that respects the soft tissue tension, but at the same time the mechanical environment of the limb.

In our opinion, it is in this line that the further development and evolution of alignment in knee prosthesis will be considered.

Functionally aligned TKA shows a way to achieve specific patient kinematics, manipulating bone resections and slightly modifying the position of components to limit the need for periarticular soft tissue release.[15] This is accomplished with advanced technical aids, such as robotic surgery or navigation. The additional precision achieved with these techniques allows a non-neutral lower extremity alignment to be achieved more reproducibly.[16] With functional alignment by robotic surgery, the gaps can be balanced by changing the direction of the components in all 3 planes. This positioning can be individualized to the patient's knee, maintaining safe alignment limits, which considers a safe range of $0 \pm 3°$ of coronal alignment.[14]

This hybrid model that provides a balanced knee but remains within the safe limits of mechanical alignment could have promising results,[14] reducing the morbidity associated with the great release of soft tissues that sometimes requires mechanical alignment and being able to achieve better patient satisfaction without compromising the longevity of the implant.[15]

The literature published so far comparing mechanical versus kinematic alignment shows similar results in the short term, with some studies describing a positive difference for kinematic alignment.[8] It is possible that functional alignment is the method that leads to the best results, but the literature is still scarce, so the optimal goal of alignment remains an open question, whose answer should continue to be investigated.

Conflict of Interest

The authors have no conflict of interests to declare.

Bibliografia

1 National Joint Registry. 16th Annual report 2019. https://reports.njrcentre.ORG.UK/PORTALS/0/PDFDOWNLOADS/NJR%2016TH%20ANNUAL%20REPORT%202019.PDF Date accessed 22 Jan 2020

2 Baker PN, van der Meulen JH, Lewsey J, Gregg PJNational Joint Registry for England and Wales Data from the National Joint Registry for England and Wales. The role of pain and function in determining patient satisfaction after total knee replacement. J Bone Joint Surg Br 2007;89(07):893–900

3 Nam D, Nunley RM, Barrack RL. Patient dissatisfaction following total knee replacement: a growing concern? Bone Joint J 2014;96-B(11, Supple A)96–100

4 Dunbar MJ, Richardson G, Robertsson O. I can't get no satisfaction after my total knee replacement: rhymes and reasons. Bone Joint J 2013;95-B(11, Suppl A)148–152

5 Baker PN, Rushton S, Jameson SS, Reed M, Gregg P, Deehan DJ. Patient satisfaction with total knee replacement cannot be predicted from pre-operative variables alone: A cohort study from the National Joint Registry for England and Wales. Bone Joint J 2013;95-B(10):1359–1365

6 Clement ND, Deehan DJ. Minimum reporting criteria for robotic assisted total knee arthroplasty studies. Alignment and balancing techniques should both be defined. Bone Joint Res. 2020;9:279–81

7 Howell SM. Kinematically Aligned Total Knee Arthroplasty. En Insall and Scott Surgery of the Knee. 6th edition New York: Elsevier; 2018:1784–1796

8 The alignment of the knee replacement. Old myths and new controversies. Rev Esp Cir Ortop Traumatol (Engl Ed). 2021 Apr 22; S18888-4415(21)52-7

9 Bellemans J, Colyn W, Vandenneucker H, Victor J. The Chitranjan Ranawat award: Is neutral mechanical alignment normal for all patients? The concept of constitutional varus. Clin Orthop Relat Res. 2012;470:45–53

10 Calliess T, Bauer K, Stukenborg-Colsman C, et al. PSI kinematic versusnon-PSI mechanical alignment in total knee arthroplasty: a prospective, randomized study. Knee Surg Sports Traumatol Arthrosc 2016;27:1–6

11 Dossett HG, Estrada NA, Swartz GJ, LeFevre GW, Kwasman BG. A randomised controlled trial of kinematically and mechanically aligned total knee replacements: two-year clinical results. Bone Joint J 2014;96-B(07):907–913

12 Howell SM, Papadopoulos S, Kuznik K, Ghaly LR, Hull ML. Does varus alignment adversely affect implant survival and function six years after kinematically aligned total knee arthroplasty? Int Orthop 2015;39(11):2117–2124

13 Rivière C, Iranpour F, Auvinet E, et al. Alignment options for total knee arthroplasty: A systematic review. Orthop Traumatol Surg Res 2017;103(07):1047–1056

14 Oussedik S, Abdel MP, Victor J, Pagnano MW, Haddad FS. Alignment in total knee arthroplasty. Bone Joint J 2020;102-B(03):276–279

15 Kayani B, Konan S, Tahmassebi J, Oussedik S, Moriarty PD, Haddad FS. A prospective double-blinded randomised control trial comparing robotic arm-assisted functionally aligned total knee arthroplasty versus robotic arm-assisted mechanically aligned total knee arthroplasty. Trials 2020;21(01):194

16 Kayani B, Konan S, Pietrzak JRT, Huq SS, Tahmassebi J, Haddad FS. The learning curve associated with robotic-arm assisted unicompartmental knee arthroplasty: a prospective cohort study. Bone Joint J 2018;100-B(08):1033–1042

