



# 32. BÖLÜM

## ROBOT YARDIMLI TOTAL DİZ ARTROPLASTİSİ

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### GİRİŞ

Unikompartmantal diz artroplastisi (UDA) ve total diz artroplastisi (TDA), primer osteoartritli hastalar için güvenilir tedavi seçenekleridir. Bu cerrahilerin sonuçlarını etkileyen en önemli faktörlerin başında ise implant sağ kalımı olup gevşeme halen günümüzde de en önemli problemlerin başında gelmektedir. İmplant sağ kalımı oranlarını iyileştirmek için intraoperatif olarak ortopedi cerrahları tarafından kontrol edilebilen cerrahi değişkenler değerlendirilmiş ve bu değişkenler arasında alt ekstremite dizilimi (alignment), yumuşak doku dengesi, eklem hattının dengesi ve tibial/femoral komponentlerin hizalanması, uygun komponent boyutunun ayarlanması ve implant fiksasyonu bulunmaktadır. Son yirmi yılda, bu faktörlerin daha doğru ve güvenilir şekilde kontrol edilmesi ve dolayısıyla diz artroplastisinin sonuçlarının iyileştirilmesi amacıyla birkaç bilgisayar destekli cerrahi sistem geliştirilmiştir. Bu sistemler, kontrol ettikleri değişkenlerin sayısına ve türüne göre farklılık gösterir. Bilgisayar navigasyon sistemleri, bu cerrahi değişkenlerden bir veya daha fazlasını kontrol etmeyi amaçlar. Bu robotik destekli sistemler genel olarak cerrahi değişkenleri kontrol etmeyi amaçlar; ek olarak, cerrahi prosedürün hassasiyetini artırmayı hedefler.

Her ne kadar yapılan çalışmaların sonuçları ümit verici olsa da diz artroplastisinde robotik cerrahinin tam rolü belirsizliğini halen korumaktadır. Bu yazımızda, robotik cerrahinin kısa tarihçesini, robot yardımcı diz artroplastisinin mevcut durumunu ve farklı robotik yardımcı diz artroplasti sistemlerini literatür ışığında tartışmayı planlamaktayız.

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## KAYNAKLAR

1. Kwoh YS, Hou J, Jonckheere EA, Hayati S. A robot with improved absolute positioning accuracy for CT guided stereotactic brain surgery. *IEEE Trans Biomed Eng* 1988;35:153-160.
2. Loulmet D, Carpentier A, d'Attellis N, et al. Endoscopic coronary artery bypass grafting with the aid of robotic assisted instruments. *J Thorac Cardiovasc Surg* 1999;118:4-10.
3. Linsky P, Wei B. Robotic lobectomy. *J Vis Surg* 2017;3:132.
4. Soto E, Lo Y, Friedman K, et al. Total laparoscopic hysterectomy versus da Vinci robotic hysterectomy: is using the robot beneficial? *J Gynecol Oncol* 2011;22:253-259.
5. El-Hakim A, Tewari A. Robotic prostatectomy - a review. *MedGenMed* 2004;6:20.
6. Jakopec M, Harris SJ, Rodriguez y, Baena F, et al. The first clinical application of a "hands-on" robotic knee surgery system. *Comput Aided Surg* 2001;6:329-339.
7. Petrie JR, Haidukewych GJ. Instability in total knee arthroplasty : assessment and solutions. *Bone Joint J* 2016;98-B(Suppl A):116-119.
8. Allen MM, Pagnano MW. Neutral mechanical alignment: is it necessary? *Bone Joint J* 2016;98-B(Suppl A):81-83.
9. Huang T, Long Y, George D, Wang W. Meta-analysis of gap balancing versus measured resection techniques in total knee arthroplasty. *Bone Joint J* 2017;99-B:151-158.
10. Khan M, Osman K, Green G, Haddad FS. The epidemiology of failure in total knee arthroplasty: avoiding your next revision. *Bone Joint J* 2016;98-B(Suppl A):105-112.
11. Bassetot F, Gicquel T, Common H, et al. Are ligament-tensioning devices interchangeable? A study of femoral rotation. *Orthop Traumatol Surg Res* 2016;102(Suppl):S213-S219.
12. Teter KE, Bregman D, Colwell CW., Jr Accuracy of intramedullary versus extramedullary tibial alignment cutting systems in total knee arthroplasty. *Clin Orthop Relat Res* 1995;321:106-110.
13. Song EK, Seon JK, Park SJ, et al. Simultaneous bilateral total knee arthroplasty with robotic and conventional techniques: a prospective, randomized study. *Knee Surg Sports Traumatol Arthrosc* 2011;19:1069-1076.
14. Song EK, Seon JK, Yim JH, Netravali NA, Bargar WL. Robotic-assisted TKA reduces postoperative alignment outliers and improves gap balance compared to conventional TKA. *Clin Orthop Relat Res* 2013;471:118-126.
15. Bellemans J, Vandenuecker H, Vanlauwe J. Robot-assisted total knee arthroplasty. *Clin Orthop Relat Res* 2007;464:111-116.
16. Hampp EL, Chughtai M, Scholl LY, et al. Robotic-arm assisted total knee arthroplasty demonstrated greater accuracy and precision to plan compared with manual techniques. *J Knee Surg* 2019;32:239-250.
17. Moon YW, Ha CW, Do KH, et al. Comparison of robot-assisted and conventional total knee arthroplasty: a controlled cadaver study using multiparameter quantitative three-dimensional CT assessment of alignment. *Comput Aided Surg* 2012;17:86-95.
18. Abdel MP, Ledford CK, Kobic A, Taunton MJ, Hanssen AD. Contemporary failure aetiologies of the primary, posterior-stabilised total knee arthroplasty. *Bone Joint J* 2017;99-B:647-652.
19. Kutzner I, Bender A, Dymke J, et al. Mediolateral force distribution at the knee joint shifts across activities and is driven by tibiofemoral alignment. *Bone Joint J* 2017;99-B:779-787.
20. DiGioia AM 3rd, Jaramaz B, Colgan BD. Computer assisted orthopaedic surgery. Image guided and robotic assistive technologies. *Clin Orthop Relat Res.* 1998(354):8-16
21. No authors listed. THINK Surgical Inc. <https://thinksurgical.com> (date last accessed 23 September 2019).
22. Schulz AP, Seide K, Queitsch C, et al. Results of total hip replacement using the Robodoc surgical assistant system: clinical outcome and evaluation of complications for 97 procedures. *Int J Med Robot.* 2007;3(4):301-306.

23. Liow MH, Xia Z, Wong MK, Tay KJ, Yeo SJ, Chin PL. Robot-assisted total knee arthroplasty accurately restores the joint line and mechanical axis. A prospective randomised study. *J Arthroplasty*. 2014;29(12):2373-2377
24. Siebert W, Mai S, Kober R, Heeckt PF. Technique and first clinical results of robot-assisted total knee replacement. *Knee*. 2002;9(3):173-180
25. Kim SM, Park YS, Ha CW, Lim SJ, Moon YW. Robot-assisted implantation improves the precision of component position in minimally invasive TKA. *Orthopedics*. 2012;35(9):e1334-e1339.
26. Moon YW, Ha CW, Do KH, et al. Comparison of robot-assisted and conventional total knee arthroplasty: a controlled cadaver study using multiparameter quantitative three-dimensional CT assessment of alignment. *Comput Aided Surg*. 2012;17(2):86-95.
27. Park SE, Lee CT. Comparison of robotic-assisted and conventional manual implantation of a primary total knee arthroplasty. *J Arthroplasty*. 2007;22(7):1054-1059.
28. Song EK, Seon JK, Park SJ, Jung WB, Park HW, Lee GW. Simultaneous bilateral total knee arthroplasty with robotic and conventional techniques: a prospective, randomized study. *Knee Surg Sports Traumatol Arthrosc*. 2011;19(7):1069-1076.
29. Song EK, Seon JK, Yim JH, Netravali NA, Bargar WL. Robotic-assisted TKA reduces postoperative alignment outliers and improves gap balance compared to conventional TKA. *Clin Orthop Relat Res*. 2013;471(1):118-126.
30. No authors listed. NAVIO. Smith & Nephew. <http://www.smith-nephew.com/professional/microsites/navio> (date last accessed 23 September 2019).
31. No authors listed. Mako Robotic-Arm Assisted Surgery. Stryker. <https://www.stryker.com/us/en/portfolios/orthopaedics/joint-replacement/mako-robotic-arm-assisted-surgery.html> (date last accessed 23 September 2019).
32. Koenig JA, Suero EM, Plaskos C. Surgical accuracy and efficiency of computer-navigated TKA with a robotic cutting guide—report on the first 100 cases. *J Bone Joint Surg Br*. 2012;94-B(SUPP XLIV):103. Available at: [http://www.bjjprocs.boneandjoint.org.uk/content/94-B/SUPP\\_XLIV/103](http://www.bjjprocs.boneandjoint.org.uk/content/94-B/SUPP_XLIV/103). Accessed April 6, 2016.
33. Cobb J, Henckel J, Gomes P, et al. Hands-on robotic unicompartmental knee replacement: a prospective, randomised controlled study of the acrobot system. *J Bone Joint Surg Br*. 2006;88(2):188-197.
34. Sodhi N, Khlopas A, Piuze NS, et al. The learning curve associated with robotic total knee arthroplasty. *J Knee Surg* 2018;31:17-21.
35. Jones GG, Kotti M, Wiik AV, et al. Gait comparison of unicompartmental and total knee arthroplasties with healthy controls. *Bone Joint J* 2016;98-B(Suppl B):16-21.
36. Huijbregts HJ, Khan RJ, Fick DP, et al. Component alignment and clinical outcome following total knee arthroplasty: a randomised controlled trial comparing an intramedullary alignment system with patient-specific instrumentation. *Bone Joint J* 2016;98-B:1043-1049.
37. Kayani B, Konan S, Pietrzak JRT, Haddad FS. Iatrogenic bone and soft tissue trauma in robotic-arm assisted total knee arthroplasty compared with conventional jig-based total knee arthroplasty: a prospective cohort study and validation of a new classification system. *J Arthroplasty* 2018;33:2496-2501.
38. Yang HY, Seon JK, Shin YJ, Lim HA, Song EK. Robotic total knee arthroplasty with a cruciate-retaining implant: a 10-year follow-up study. *Clin Orthop Surg* 2017;9:169-176.
39. Marchand RC, Sodhi N, Khlopas A, et al. Patient satisfaction outcomes after robotic arm-assisted total knee arthroplasty: a short-term evaluation. *J Knee Surg* 2017;30:849-853.
40. Kayani B, Konan S, Tahmassebi J, Rowan FE, Haddad FS. An assessment of early functional rehabilitation and hospital discharge in conventional versus robotic-arm assisted unicompartmental knee arthroplasty: a prospective cohort study. *Bone Joint J* 2019;101-B:24-33.
41. Liow MHL, Goh GS, Wong MK, et al. Robotic-assisted total knee arthroplasty may lead to improvement in quality-of-life measures: a 2-year follow-up of a prospective randomized trial. *Knee Surg Sports Traumatol Arthrosc* 2017;25:2942-2951.

42. Koulalis D, O'Loughlin PF, Plaskos C, Kendoff D, Cross MB, Pearle AD. Sequential versus automated cutting guides in computer-assisted total knee arthroplasty. *Knee*. 2011;18(6):436-442.
43. Clark TC, Schmidt FH. Robot-assisted navigation versus computer-assisted navigation in primary total knee arthroplasty: efficiency and accuracy. *ISRN Orthop*. 2013;2013:794827.
44. Bauwens K, Matthes G, Wich M, et al. Navigated total knee replacement. A meta-analysis. *J Bone Joint Surg Am*. 2007;89(2):261-269.
45. Brin YS, Nikolaou VS, Joseph L, Zukor DJ, Antoniou J. Imageless computer assisted versus conventional total knee replacement. A Bayesian meta-analysis of 23 comparative studies. *Int Orthop*. 2011;35(3):331-339.
46. Cheng T, Zhang G, Zhang X. Imageless navigation system does not improve component rotational alignment in total knee arthroplasty. *J Surg Res*. 2011;171(2):590-600.
47. Conteduca F, Iorio R, Mazza D, Ferretti A. Patient-specific instruments in total knee arthroplasty. *Int Orthop*. 2014;38(2):259-265.
48. Fu Y, Wang M, Liu Y, Fu Q. Alignment outcomes in navigated total knee arthroplasty: a meta-analysis. *Knee Surg Sports Traumatol Arthrosc*. 2012;20(6):1075-1082.
49. Hetaimish BM, Khan MM, Simunovic N, Al-Harbi HH, Bhandari M, Zalzal PK. Meta-analysis of navigation vs conventional total knee arthroplasty. *J Arthroplasty*. 2012;27(6):1177-1182.
50. Mason JB, Fehring TK, Estok R, Banel D, Fahrback K. Meta-analysis of alignment outcomes in computer-assisted total knee arthroplasty surgery. *J Arthroplasty*. 2007;22(8):1097-1106.
51. Moskal JT, Capps SG, Mann JW, Scanelli JA. Navigated versus conventional total knee arthroplasty. *J Knee Surg*. 2014;27(3):235-248.
52. Shi J, Wei Y, Wang S, et al. Computer navigation and total knee arthroplasty. *Orthopedics*. 2014;37(1):e39-e43.