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# Do Functional Outcomes Differ Among Total Knee Arthroplasty Approaches at six, 12, and Beyond 18 Months of Follow-Up?

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**Do Functional Outcomes Differ Among Total Knee Arthroplasty Approaches at six, 12, and Beyond 18 Months of follow-up?**

**Response/Recommendation:** Current literature indicates no clinically relevant or statistical differences in early functional outcomes (within 6 months post-surgery) when comparing various surgical approaches to the medial parapatellar approach. However, in more extended follow-up (beyond 18 months), both the quadriceps-sparing and mid-vastus approaches showed clinically relevant and statistically significant improvements in functional outcomes compared to the medial parapatellar approach, with the mid-vastus approach exhibiting superior results at beyond 18 months of follow-up.

**Level of Evidence:** high

**Expert Vote:** Agree 57.2%, Disagree 32.8%, and Abstain 9.8%.

## Rationale

Various total knee arthroplasty (TKA) approaches, including the medial parapatellar (MP), mini-MP, sub-vastus (SV), mini-SV, mid-vastus (MV), mini-MV, and quadriceps-sparing (QS), exhibit differences in incision configuration and intraoperative factors such as blood loss and tourniquet time. Due to similarities in incision techniques, the mini-SV approach was grouped with the QS approach [1]. Likewise, the mini-MV and MV approaches were combined due to their similar techniques and the limited number of studies reporting outcomes specifically for the MV approach. The MP approach was selected as the reference group, as it represents the traditional and most commonly used technique in most randomized controlled trials (RCTs) [2,3]. This methodology allowed for a comprehensive comparison of four different approaches (SV, MV, QS, and mini-MP) against the MP approach.

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**Table 1**
Comparing Different TKA Approaches With Medial Parapatellar Approach.

| PROMs | 6 months | 1 year | >1.5 years |
|---|---|---|---|
| KSS knee | No differences | **QS > MP** (MD = 3.94, CI: 95% [0.68 to 7.20], $P = 0.01$) | No differences |
| KSS function | No differences | **MV > MP** (MD = 3.60, CI: 95% [1.67 to 5.54], $P = 0.00$)<br>**QS > MP** (MD = 2.32, CI: 95% [0.61 to 4.02], $P = 0.00$) | **MV > MP** (MD = 8.28, CI: 95% [3.37 to 13.19], $P = 0.00$)<br>**QS > MP** (MD = 5.13, CI: 95% [1.88 to 8.38], $P = 0.00$) |
| ROM | No differences | No differences | **mini-MP > MP** (MD = 6.21, CI: 95% [4.42 to 8.01], $P = 0.00$)<br>**MV > MP** (MD = 5.46, CI: 95% [3.08 to 7.83], $P = 0.00$)<br>**QS > MP** (MD = 4.78, CI: 95% [2.71 to 6.85], $P = 0.00$) |
| OKS | No differences | **MV > MP** (MD = 4.40, CI to 95% [0.61; 8.19], $P = 0.02$) | No differences |
| WOMAC | No differences | No differences | Not enough data |

KSS, Knee Society Score; OKS, Oxford Knee Score; ROM, range of motion; WOMAC, Western Ontario and McMaster Universities Osteoarthritis Index; MP, medial parapatellar; MD, mean differences; CI, confidence interval; SV, sub-vastus; MV, mid-vastus; QS, quadriceps-sparing.

The minimum clinically important difference was set at 5 to 6 for the Knee Society Score (KSS), 4 to 5 for the Oxford Knee Score (OKS), and more than five degrees for the range of motion (ROM) [4,5]. Previous studies were often limited by their focus on endpoint scores without accounting for baseline variations, potentially obscuring treatment effects. In this analysis, we addressed these limitations by comparing the improvement (delta) in functional outcomes between approaches at the endpoint, providing a more accurate assessment of treatment effects.

A comprehensive network meta-analysis (NMA) was conducted, encompassing all RCTs from 2000 onwards that reported patient-reported outcomes (PROMs) at least six months after surgery. The analysis included 51 RCTs [1–3],[6–40],[41–53] that reported on KSS, Western Ontario and McMaster Universities Osteoarthritis Index, OKS, and ROM. The findings indicate that there were no significant variations in PROMs between different TKA approaches at the 6-month mark compared to the MP approach (Table 1). However, at the 1-year follow-up, both the QS and MV approaches showed superior PROMs compared to the MP approach. The QS approach led to greater improvement in the KSS knee, while both QS and MV improved regarding KSS function. However, these differences did not exceed the minimum clinically important difference of approximately 5 points. The MV approach also demonstrated meaningful clinical improvement in the OKS compared to MP. In the final analysis of data beyond 18 months, the QS, MV, and mini-MP approaches showed superior outcomes over MP. Both QS and MV achieved significantly and clinically better KSS function results. Also, mini-MP, MV, and QS provided greater ROM enhancement, with clinically meaningful differences observed for mini-MP and MV.

An evaluation of a recent 5-year meta-analysis of RCTs was performed. Yang et al. reported no significant differences in the PROMs at 6-month and 1-year follow-ups between the MP and MV approaches; however, the PROMs were superior in the MV group at the early follow-up (three months) [54]. Bouché et al., in their NMA, found that all approaches exhibited comparable PROMs during early follow-up (six months), except for ROM, where the SV approach demonstrated superior results [55]. They further reported no significant differences between approaches at one and two years postoperatively for PROMs, except for KSS, where the mini-MP approach showed superior outcomes [55]. An NMA conducted by Zhang et al. also found no significant differences in KSS among different approaches during the short-term follow-up [56]. Additionally, a meta-analysis by Yuan et al. indicated that the QS approach led to a more significant improvement in KSS compared to the MP approach at mean follow-up of two years [57]. Furthermore, Berstock et al., in their meta-analysis evaluating KSS at six weeks and 12 months of follow-up, found no significant differences between the MP, mini-SV, and mini-SV approaches [58]. However, statistically significant advantages were observed only in the mini-MP group for functional KSS compared to the conventional MP approach.

A possible explanation for the similarity in early outcomes and the divergence in extended follow-ups may be attributable to the initial postoperative recovery phase. During this period, improvements in pain relief and joint function are generally consistent across different surgical techniques due to factors such as pain management, soft tissue healing, and standardized rehabilitation protocols. In contrast, extended follow-ups highlight the advantages of less invasive approaches, such as QS, MV, and mini-MP techniques, which demonstrate superior functional outcomes, particularly in KSS function and ROM. The prolonged period permits the manifestation of the mid-term benefits of these approaches, as they may better preserve muscle function, minimize soft tissue trauma, and promote more natural joint mechanics, leading to enhanced functional recovery over time.

## CRediT authorship contribution statement

**Seyed Mohammad Javad Mortazavi:** Writing – review & editing, Writing – original draft, Project administration, Investigation. **Ali Soltani Farsani:** Writing – original draft, Formal analysis, Data curation, Conceptualization. **George Babis:** Writing – review & editing, Supervision. **Julio Cesar Palacio:** Validation, Supervision. **David Mateu-Vicent:** Writing – review & editing, Validation, Supervision. **Joao Mauricio Barretto:** Writing – review & editing, Supervision. **Mohammad Razi:** Supervision. **Parag Sancheti:** Writing – review & editing, Validation, Supervision. **Mohammad Saeed:** Investigation. **Eleftherios Tsiridis:** Validation, Supervision. **Seyed Hadi Kalantar:** Writing – original draft, Validation, Investigation.

## References

[1] Mehta N, Bhat MS, Goyal A, Mishra P, Joshi D, Chaudhary D. Quadriceps sparing (subvastus/midvastus) approach versus the conventional medial parapatellar approach in primary knee arthroplasty. J Arthrosc Joint Surg 2017;4:15–20. https://doi.org/10.1016/j.jajs.2017.02.004.
[2] Cho KY, Kim KI, Umrani S, Kim SH. Better quadriceps recovery after minimally invasive total knee arthroplasty. Knee Surg Sports Traumatol Arthrosc 2014;22:1759–64. https://doi.org/10.1007/s00167-013-2556-2.
[3] Zhu M, Ang CL, Yeo SJ, Lo NN, Chia SL, Chong HC. Minimally invasive computer-assisted total knee arthroplasty compared with conventional total knee arthroplasty: a prospective 9-year follow-up. J Arthroplasty 2016;31:1000–4. https://doi.org/10.1016/j.arth.2015.11.023.
[4] Lee WC, Kwan YH, Chong HC, Yeo SJ. The minimal clinically important difference for knee society clinical rating system after total knee arthroplasty for primary osteoarthritis. Knee Surg Sports Traumatol Arthrosc 2017;25:3354–9. https://doi.org/10.1007/s00167-016-4208-9.
[5] Murray DW, Fitzpatrick R, Rogers K, Pandit H, Beard DJ, Carr AJ, et al. The use of the oxford hip and knee scores. J Bone Joint Surg Br 2007;89:1010–4. https://doi.org/10.1302/0301-620x.89b8.19424.
[6] Aglietti P, Baldini A, Sensi L. Quadriceps-sparing versus mini-subvastus approach in total knee arthroplasty. Clin Orthop Relat Res 2006;452:106–11. https://doi.org/10.1097/01.blo.0000238789.51972.16.
[7] Kelly MJ, Rumi MN, Kothari M, Parentis MA, Bailey KJ, Parrish WM, et al. Comparison of the vastus-splitting and median parapatellar approaches for primary total knee arthroplasty: a prospective, randomized study. J Bone Jt Surg Am Vol 2006;88A:715–20. https://doi.org/10.2106/JBJS.E.00107.

[8] Kim YH, Kim JS, Kim DY. Clinical outcome and rate of complications after primary total knee replacement performed with quadriceps-sparing or standard arthrotomy. J Bone J Surg Br 2007;89:467–70. https://doi.org/10.1302/0301-620X.89B4.18663.
[9] Seon JK, Song EK, Yoon TR, Park SJ, Bae BH, Cho SG. Comparison of functional results with navigation-assisted minimally invasive and conventional techniques in bilateral total knee arthroplasty. Comput Aided Surg 2007;12:189–93. https://doi.org/10.3109/10929080701311861.
[10] Tashiro Y, Miura H, Matsuda S, Okazaki K, Iwamoto Y. Minimally invasive versus standard approach in total knee arthroplasty. Clin Orthop Relat Res 2007;463:144–50.
[11] Karachalios T, Giotikas D, Roidis N, Poultsides L, Bargiotas K, Malizos KN. Total knee replacement performed with either a mini-midvastus or a standard approach - a prospective randomised clinical and radiological trial. J Bone Joint Surg Br 2008;90B:584–91. https://doi.org/10.1302/0301-620X.90B5.20122.
[12] Kashyap SN, van Ommeren JW. Clinical experience with less invasive surgery techniques in total knee arthroplasty: a comparative study. Knee Surg Sports Traumatol Arthrosc 2008;16:544–8. https://doi.org/10.1007/s00167-008-0523-0.
[13] Bridgman SA, Walley G, MacKenzie G, Clement D, Griffiths D, Maffulli N. Subvastus approach is more effective than a medial parapatellar approach in primary total knee arthroplasty: a randomized controlled trial. Knee 2009;16:216–22. https://doi.org/10.1016/j.knee.2008.11.012.
[14] Jung YB, Lee YS, Lee EY, Jung HJ, Nam CH. Comparison of the modified subvastus and medial parapatellar approaches in total knee arthroplasty. Int Orthop 2009;33:419–23. https://doi.org/10.1007/s00264-007-0510-y.
[15] Karpman RR, Smith HL. Comparison of the early results of minimally invasive vs standard approaches to total knee arthroplasty: a prospective, randomized study. J Arthroplasty 2009;24:681–8. https://doi.org/10.1016/j.arth.2008.03.011.
[16] Watanabe T, Muneta T, Ishizuki M. Is a minimally invasive approach superior to a conventional approach for total knee arthroplasty? Early outcome and 2- to 4-year follow-up. J Orthop Sci 2009;14:589–95. https://doi.org/10.1007/s00776-009-1383-2.
[17] Bonutti PM, Zywiel MG, Ulrich SD, Stroh DA, Seyler TM, Mont MA. A comparison of subvastus and midvastus approaches in minimally invasive total knee arthroplasty. J Bone Joint Surg 2010;92:575–82. https://doi.org/10.2106/JBJS.I.00268.
[18] Hay GC, Kampshoff J, Kuster MS. Lateral subvastus approach with osteotomy of the tibial tubercle for total knee replacement a two-year prospective, randomised, blinded controlled trial. J Bone Joint Surg Br 2010;92B:862–6. https://doi.org/10.1302/0301-620X.92B6.24027.
[19] Hernandez-Vaquero D, Noriega-Fernandez A, Suarez-Vazquez A. Total knee arthroplasties performed with a mini-incision or a standard incision. Similar results at six months follow-up. BMC Musculoskelet Disord 2010;11:27. https://doi.org/10.1186/1471-2474-11-27.
[20] Pan WM, Li XG, Tang TS, Qian ZL, Zhang Q, Zhang CM. Mini-subvastus versus a standard approach in total knee arthroplasty: a prospective, randomized, controlled study. J Int Med Res 2010;38:890–900. https://doi.org/10.1177/147323001003800315.
[21] Varela-Egocheaga JR, Suárez-Suárez MA, Fernández-Villán M, González-Sastre V, Varela-Gómez JR, Rodríguez-Merchán C. Minimally invasive subvastus approach: improving the results of total knee arthroplasty: a prospective, randomized trial. Clin Orthop Relat Res 2010;468:1200–8. https://doi.org/10.1007/s11999-009-1160-8.
[22] Dutka J, Skowronek M, Sosin P, Skowronek P. Subvastus and medial parapatellar approaches in tka: comparison of functional results. Orthopedics 2011;34:6. https://doi.org/10.3928/01477447-20110427-05.
[23] Kim JG, Lee SW, Ha JK, Choi HJ, Yang SJ, Lee MY. The effectiveness of minimally invasive total knee arthroplasty to preserve quadriceps strength: a randomized controlled trial. Knee 2011;18:443–7. https://doi.org/10.1016/j.knee.2010.08.008.
[24] Lee DH, Choi J, Nha KW, Kim HJ, Han SB. No difference in early functional outcomes for mini-midvastus and limited medial parapatellar approaches in navigation-assisted total knee arthroplasty: a prospective randomized clinical trial. Knee Surg Sports Traumatol Arthrosc 2011;19:66–73. https://doi.org/10.1007/s00167-010-1130-4.
[25] Bourke MG, Jull GA, Buttrum PJ, FitzPatrick PL, Dalton PA, Russell TG. Comparing outcomes of medial parapatellar and subvastus approaches in total knee arthroplasty. A randomized controlled trial. J Arthroplasty 2012;27:347–353.e1. https://doi.org/10.1016/j.arth.2011.06.005.
[26] Chiang H, Lee CC, Lin WP, Jiang CC. Comparison of quadriceps-sparing minimally invasive and medial parapatellar total knee arthroplasty: a 2-year follow-up study. J Formos Med Assoc 2012;111:698–704. https://doi.org/10.1016/j.jfma.2011.11.025.
[27] Essving P, Axelsson K, Otterborg L, Spännar H, Gupta A, Magnuson A, et al. Minimally invasive surgery did not improve outcome compared to conventional surgery following unicompartmental knee arthroplasty using local infiltration analgesia: a randomized controlled trial with 40 patients. Acta Orthop 2012;83:634–41. https://doi.org/10.3109/17453674.2012.736169.
[28] Guy SP, Farndon MA, Conroy JL, Bennett C, Grainger AJ, London NJ. A prospective randomised study of minimally invasive midvastus total knee arthroplasty compared with standard total knee arthroplasty. Knee 2012;19:866–71. https://doi.org/10.1016/j.knee.2012.04.009.
[29] Masjudin T, Kamari ZH. A comparison between subvastus and midvastus approaches for staged bilateral total knee arthroplasty: a prospective, randomised study. Malaysian Orthop J 2012;6:31–6.
[30] Avci CC, Gülabi D, Erdem M, Kurnaz R, Güneş T, Bostan B. Minimal invasive midvastus versus standard parapatellar approach in total knee arthroplasty. Acta Orthop Traumatol Turc 2013;47:1–7. https://doi.org/10.3944/aott.2013.2801.
[31] Lin SY, Chen CH, Fu YC, Huang PJ, Lu CC, Su JY, et al. Comparison of the clinical and radiological outcomes of three minimally invasive techniques for total knee replacement at two years. Bone Joint J 2013;95-b:906–10. https://doi.org/10.1302/0301-620x.95b7.29694.
[32] Pongcharoen B, Yakampor T, Charoencholvanish K. Patellar tracking and anterior knee pain are similar after medial parapatellar and midvastus approaches in minimally invasive tka knee. Clin Orthop Relat Res 2013;471:1654–60. https://doi.org/10.1007/s11999-012-2778-5.
[33] Thienpont E. Faster recovery after minimally invasive surgery in total knee arthroplasty. Knee Surg Sports Traumatol Arthrosc 2013;21:2412–7. https://doi.org/10.1007/s00167-012-1978-6.
[34] Zhang Z, Zhu W, Gu B, Zhu L, Chen C. Mini-midvastus versus mini-medial parapatellar approach in total knee arthroplasty: a prospective, randomized study. Arch Orthop Trauma Surg 2013;133:389–95. https://doi.org/10.1007/s00402-012-1645-x.
[35] Heekin RD, Fokin AA. Mini-midvastus versus mini-medial parapatellar approach for minimally invasive total knee arthroplasty: outcomes pendulum is at equilibrium. J Arthroplasty 2014;29:339–42. https://doi.org/10.1016/j.arth.2013.05.016.
[36] Nutton RW, Wade FA, Coutts FJ, Van Der Linden ML. Short term recovery of function following total knee arthroplasty: a randomised study of the medial parapatellar and midvastus approaches. Arthritis 2014;2014:1737857. https://doi.org/10.1155/2014/173857.
[37] Tasker A, Hassaballa M, Murray J, Lancaster S, Artz N, Harries W, et al. Minimally invasive total knee arthroplasty; a pragmatic randomised controlled trial reporting outcomes up to 2year follow up. Knee 2014;21:189–93. https://doi.org/10.1016/j.knee.2013.07.010.
[38] Zhou C, Peng W, Si ZP. Effect of total knee arthroplasty via different approaches on extensor mechanism. Chinese J Tissue Eng Res 2014;18:1337–42. https://doi.org/10.3969/j.issn.2095-4344.2014.09.005.
[39] Huang AB, Wang HJ, Yu JK, Yang B, Ma D, Zhang JY. Are there any clinical and radiographic differences between quadriceps-sparing and mini-medial parapatellar approaches in total knee arthroplasty after a minimum 5 years of follow-up? Chin Med J (Engl) 2015;128:1898–904. https://doi.org/10.4103/0366-6999.160521.
[40] Liu H, Mei X, Zhang Z, Sun J. Mini-midvastus versus mini-medial parapatellar approach in simultaneous bilateral total knee arthroplasty with 24-month follow-up. Acta Orthop Traumatol Turcica 2015;49:586–92. https://doi.org/10.3944/AOTT.2015.15.0078.
[41] Feczko P, Engelmann L, Arts JJ, Campbell D. Computer-assisted total knee arthroplasty using mini midvastus or medial parapatellar approach technique a prospective, randomized, international multicentre trial. BMC Muscoskel Disord 2016;17:19. https://doi.org/10.1186/s12891-016-0872-7.
[42] Huang AB, Wang HJ, Yu JK, Yang B, Ma D, Zhang JY. Optimal patellar alignment with minimally invasive approaches in total knee arthroplasty after a minimum five year follow-up. Int Orthop 2016;40:487–92. https://doi.org/10.1007/s00264-015-2896-2.
[43] Koh IJ, Kim MW, Kim MS, Jang SW, Park DC, In Y. The patient's perception does not differ following subvastus and medial parapatellar approaches in total knee arthroplasty: a simultaneous bilateral randomized study. J Arthroplasty 2016;31:112–7. https://doi.org/10.1016/j.arth.2015.08.004.
[44] Verburg H, Mathijssen NMC, Niesten DD, Verhaar JAN, Pilot P. Comparison of mini-midvastus and conventional total knee arthroplasty with clinical and radiographic evaluation a prospective randomized clinical trial with 5-year follow-up. J Bone Joint Surg Am 2016;98:1014–22. https://doi.org/10.2106/JBJS.15.00654.
[45] Aslam MA, Sabir AB, Tiwari V, Abbas S, Tiwari A, Singh P. Approach to total knee replacement: a randomized double blind study between medial parapatellar and midvastus approach in the early postoperative period in asian population. J Knee Surg 2017;30:793–7. https://doi.org/10.1055/s-0036-1597978.
[46] Shukla R, Mahajan P, Singh M, Jain RK, Kumar R. Outcome of total knee replacement via two approaches in indian scenario. J Knee Surg 2017;30:174–8. https://doi.org/10.1055/s-0036-1584192.
[47] Unwin O, Hassaballa M, Murray J, Harries W, Porteous A. Minimally invasive surgery (mis) for total knee replacement; medium term results with minimum five year follow-up. Knee 2017;24:454–9. https://doi.org/10.1016/j.knee.2017.01.010.
[48] Li Z, Cheng W, Sun L, Yao Y, Cao Q, Ye S, et al. Mini-subvastus versus medial parapatellar approach for total knee arthroplasty: a prospective randomized controlled study. Int Orthop 2018;42:543–9. https://doi.org/10.1007/s00264-017-3703-z.
[49] Jhurani A, Agarwal P, Aswal M, Rasquinha C, Srivastava M. Subvastus exposure compared to parapatellar approach in navigated sequential bilateral total knee arthroplasty (sbtka): a prospective randomized study. J Knee Surg 2021;34:635–43. https://doi.org/10.1055/s-0039-1700496.
[50] Madadi F, Osias E, Washington III ER, Shamie AN, Yazdanshenas H. Comparison of effects of medial parapatellar and subvastus bilateral simultaneous

approaches in total knee arthroplasty. J Arthrosc Joint Surg 2021;8:350–3. https://doi.org/10.1016/j.jajs.2021.06.001.
[51] Sogbein OA, Zomar BO, Bryant DM, Howard JL, Marsh JD, Lanting BA. Effects of surgical approach and tourniquet use on patient-reported outcomes following total knee arthroplasty: a pilot randomized clinical trial. Orthop Res Rev 2022;14:407–17. https://doi.org/10.2147/ORR.S381894.
[52] Phruetthiphat OA, Mokmongkolkul K, Apinyankul R. Total knee arthroplasty with lateral parapatellar approach results in less early postoperative skin numbness than medial approach, but no difference at mid-term follow-up: a randomized control trial. Arthroplast Today 2024;27:101365. https://doi.org/10.1016/j.artd.2024.101365.
[53] Berth A, Urbach D, Neumann W, Awiszus F. Strength and voluntary activation of quadriceps femoris muscle in total knee arthroplasty with midvastus and subvastus approaches. J Arthroplasty 2007;22:83–8. https://doi.org/10.1016/j.arth.2006.02.161.
[54] Yang X, Cheng QH, Yang YZ, Zhang AR, Fan H, Guo HZ. Minimally invasive medial femoral approach to total knee arthroplasty improves short-term outcomes compared to the standard medial parapatellar approach: a systematic review and meta-analysis. J Orthop Surg Res 2023;18:657. https://doi.org/10.1186/s13018-023-04136-2.
[55] Bouché PA, Corsia S, Nizard R, Resche-Rigon M. Comparative efficacy of the different surgical approaches in total knee arthroplasty: a systematic-review and network meta-analysis. J Arthroplasty 2021;36:1187–11894.e1. https://doi.org/10.1016/j.arth.2020.09.052.
[56] Zhang L, Li X, Rüwald JM, Welle K, Schildberg FA, Kabir K. Comparison of minimally invasive approaches and standard median parapatellar approach for total knee arthroplasty: a systematic review and network meta-analysis of randomized controlled trials. Technol Health Care 2021;29:557–74. https://doi.org/10.3233/thc-192078.
[57] Yuan FZ, Zhang JY, Jiang D, Yu JK. Quadriceps-sparing versus traditional medial parapatellar approaches for total knee arthroplasty: a meta-analysis. BMC Musculoskelet Disord 2019;20:117. https://doi.org/10.1186/s12891-019-2482-7.
[58] Berstock JR, Murray JR, Whitehouse MR, Blom AW, Beswick AD. Medial subvastus versus the medial parapatellar approach for total knee replacement: a systematic review and meta-analysis of randomized controlled trials. EFORT Open Rev 2018;3:78–84. https://doi.org/10.1302/2058-5241.3.170030.