

Vertical Midvastus Incision Enhances Early Recovery in Total Knee Arthroplasty

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ABSTRACT

Objective: The midvastus arthrotomy technique is commonly utilized in total knee arthroplasty (TKA) due to its potential to preserve quadriceps integrity and improve early post-operative outcomes. This retrospective cohort study evaluates the impact of incision orientation in the midvastus technique on pain, functional recovery, and surgical outcomes.

Materials and Methods: A total of 90 patients undergoing TKA were included, divided into three groups: standard midline, horizontally oriented, and vertically oriented midvastus incisions. All patients received the same implant and standardized perioperative care. Outcomes such as pain (VAS), function, blood transfusion rates, and numbness were assessed at 10 days, 1 month, and 3 months.

Results: The vertical incision group demonstrated significantly lower VAS scores and faster functional recovery. Blood transfusion rates and numbness incidence were also lowest in this group. Results are supported by p-values and descriptive statistics.

Conclusion: Vertical incision orientation in the midvastus approach appears to offer benefits in early post-operative outcomes. Following primary TKA, the vertical modified midvastus approach appears to be appropriate for enhancing early post-operative comfort.

Keywords: Arthroplasty, Knee, Quadriceps muscle

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INTRODUCTION

The choice of arthrotomy technique in total knee arthroplasty (TKA) plays a critical role in surgical outcomes, affecting both intraoperative exposure and post-operative recovery.^[1,2] The most commonly employed techniques include the medial parapatellar, subvastus, and midvastus arthrotomies.^[3] Each method has distinct advantages and limitations, and the selection is often determined by patient

anatomy, surgeon preference, and the specific procedural requirements.

The medial parapatellar approach remains the gold standard for many surgeons, providing excellent exposure to the knee joint by laterally displacing the patella.^[4] However, transection of the quadriceps tendon is required, which can lead to post-operative quadriceps weakness, delayed rehabilitation, and increased early post-operative pain.^[5]

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To minimize the impact on the quadriceps mechanism, less invasive techniques such as the subvastus and midvastus approaches have been developed.^[6,7] The subvastus approach, which retracts the vastus medialis without cutting the quadriceps tendon, preserves muscle integrity and has been associated with reduced post-operative pain and faster recovery.^[8] Nevertheless, it is technically demanding and may limit visualization, particularly in obese patients or those with complex deformities.

The midvastus approach was introduced to combine the exposure benefits of the medial parapatellar technique with the muscle-sparing advantages of the subvastus approach.^[9] In this method, the arthrotomy is performed through the fibers of the vastus medialis, preserving the quadriceps tendon while maintaining adequate exposure. Clinical studies have shown that the midvastus technique results in less post-operative pain, faster quadriceps strength recovery, and improved early functional outcomes compared with the medial parapatellar approach.^[10] Furthermore, patients often report higher satisfaction and a quicker return to daily activities.

Despite numerous publications on the midvastus approach, a standardized definition of the incision orientation is lacking. Most descriptions are vague, commonly referring only to an incision “parallel to the fibers.”^[11] This lack of precision may contribute to variability in surgical performance and outcomes. Therefore, the objective of this study is to define the optimal incision orientation for midvastus arthrotomy, with a focus on angles that enhance surgical performance and preci-

sion. The hypothesis is that a vertical incision modification of the midvastus technique provides superior clinical and functional outcomes compared to the conventional description.

MATERIALS AND METHODS

This retrospective study was approved by the institutional review board of Metin Sabancı Baltalimanı Bone Diseases Training and Research Hospital (approval number: 22-147, dated May 30, 2024) and was conducted in accordance with the ethical principles of the Declaration of Helsinki. All data were collected from hospital records following established ethical standards. The study population consisted of 90 patients who underwent TKA using the midvastus arthrotomy technique by the same surgical team at our institution between August 2022 and February 2024.

Inclusion criteria were patients aged 55–75 years with primary varus gonarthrosis and no prior surgery on the ipsilateral knee. Patients were excluded if they had rheumatologic diseases, previous ipsilateral knee surgery, vascular disorders or thrombotic events, did not receive general anesthesia, or had a tibiofemoral angle >30°. Only patients classified as the American Society of Anesthesiologists physical status I or II were included (Table 1).

All 90 patients (100%) completed the 3-month post-operative follow-up, with no losses to follow-up. Baseline demographic and clinical characteristics – including age, sex, body mass index, hypertension, and diabetes mellitus – were similar among the groups, with no statistically significant differences (all $p>0.05$; Table 2).

Patients were assigned to three groups ($n=30$ each) according to hospital admission order, each receiving a different midvastus arthrotomy incision orientation: vertical, midline, or horizontal. In all cases, the same type of cemented, posterior-stabilized knee prosthesis was implanted (Trausson, Stryker, USA). Standardized perioperative protocols – including general anesthesia, post-operative analgesia, and rehabilitation–were uniformly applied. All surgeries were performed under tourniquet control. Tranexamic acid was administered locally at wound closure to minimize bleeding.

Table 1. Study population	
Inclusion criteria	Exclusion criteria
Age 55–75	Rheumatologic diseases
No previous surgery on the same side	History of previous surgery on the ipsilateral knee
General anesthesia	Vascular disorders or history of thrombotic events
Bilateral cases	Tibiofemoral angle >30°

Table 2. Patient demographics					
Group	Age (mean±SD)	Male (%)	BMI (mean±SD)	Hypertension (%)	Diabetes (%)
Group 1	66.9±6.3	36.67	29.6±3.3	43.3	30
Group 2	67.2±6.1	40	29.8±3.5	43.3	30
Group 3	66.5±5.9	43.3	30.1±3.7	46.6	33.3
BMI: Body mass index; SD: Standard deviation.					

Patients were mobilized starting on the 1st post-operative day. Pain management during the early post-operative period consisted of intravenous paracetamol and tramadol as needed, with opioid-based intravenous analgesics available. Rehabilitation focused on quadriceps strengthening exercises supervised by a physiotherapist. Patients were encouraged to attend follow-up visits accompanied by their physiotherapist to ensure continuity of care.

The first group underwent TKA with a vertically oriented midvastus arthrotomy, involving a laterally placed incision at a steep angle (60–75°) to potentially improve joint access while preserving quadriceps integrity (Fig. 1). The second

group had a midline incision through approximately the midline fibers of the vastus medialis muscle at 30–45°, preserving the quadriceps tendon and providing sufficient exposure (Fig. 2). The third group received a more medial, transverse incision (10–20°) through the vastus medialis muscle belly, more horizontal than the midline approach but still intramuscular and distinct from the subvastus technique (Figs. 3 and 4).

The primary outcomes were post-operative pain, assessed with the Visual Analog Scale (VAS), and functional recovery, measured by the Oxford Knee Score (OKS) at 10 days, 1 month, and 3 months postoperatively during rest. All patients completed assessments at each time point, ensuring 100% follow-up compliance. Secondary outcomes included intra-operative blood loss, transfusion requirements, and wound complication rates. Outcome measures were independently evaluated by two blinded clinicians unaware of the arthroto-my incision type. The interobserver reliability was high, with an intraclass correlation coefficient of 0.95.

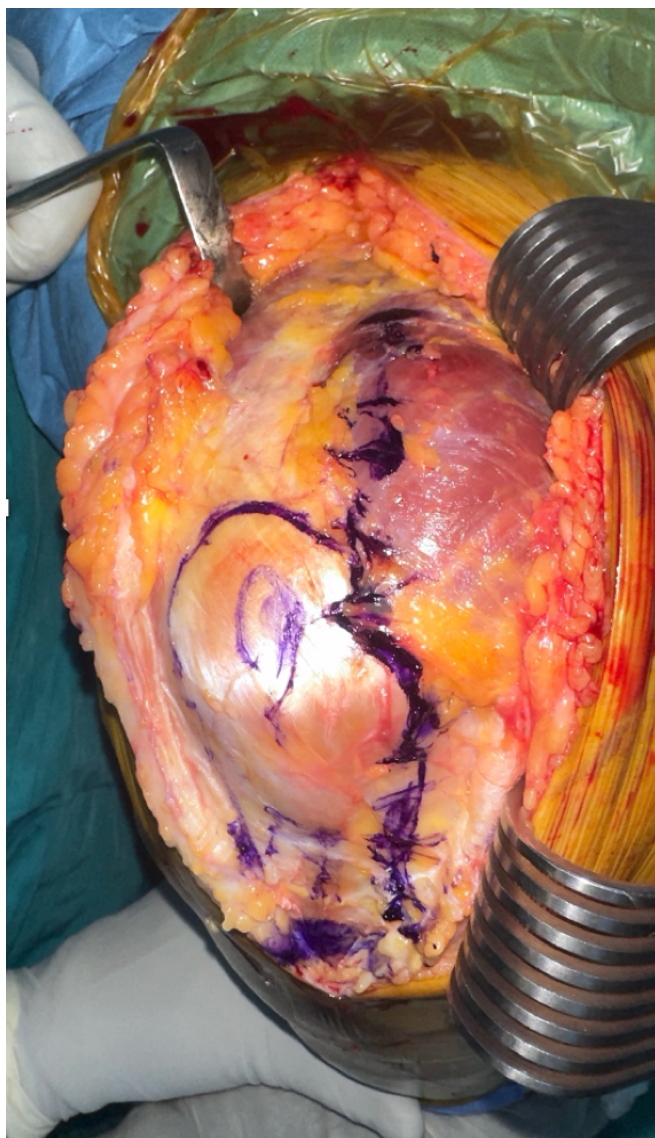


Figure 1. Vertically incised midvastus arthrotomy.



Figure 2. Midline incised midvastus arthrotomy.



Figure 3. Horizontally incised midvastus arthrotomy.

Statistical Analysis

Data analysis was performed using IBM Statistical Package for the Social Sciences (SPSS) Statistics version 24 (SPSS Inc., Chicago, IL, USA). Statistical significance was set at $p < 0.05$. A post hoc power analysis was conducted with G*Power software to confirm the adequacy of the sample size.^[12] For a one-way Analysis of Variance (ANOVA) with three groups, an alpha of 0.05, and desired power of 0.80, a sample size of 30 patients per group (total $n=90$) was sufficient to detect a medium effect size (Cohen's $f=0.24$), confirming the study's robustness. Comparisons of continuous variables among the three groups were made using one-way ANOVA, with Bonferroni correction applied for multiple pairwise comparisons. Categorical variables were compared using Chi-square tests.

RESULTS

The post-operative outcomes of the three patient groups were analyzed to identify significant differences in blood transfusion rates, OKSs, VAS pain scores, and incidence of numbness.

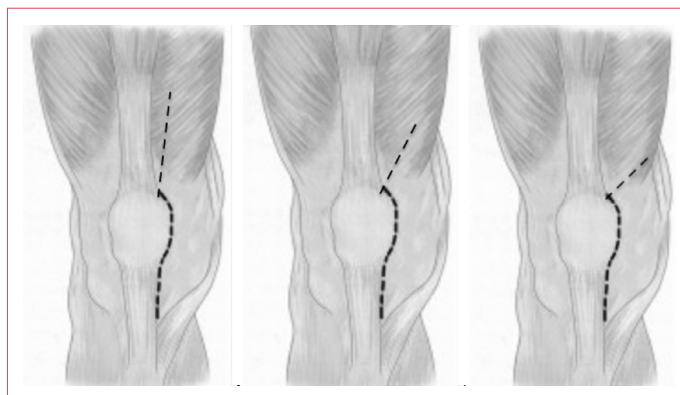


Figure 4. All 3 different incision angles demonstrated; vertical, midline and horizontal.

Functional outcomes (OKS): Significant intergroup differences were observed at all post-operative time points. On day 10, mean $\pm$ standard deviation (SD) OKS scores were 34.5 ± 5.4 for Group 1, 28.3 ± 4.6 for Group 2, and 32.1 ± 5.0 for Group 3 ($\eta^2=0.24$). The 95% confidence interval (CI) for the difference between Group 2 and Group 3 ranged from -5.9 to -1.4 , with a Cohen's d effect size of 0.88. This pattern persisted at 1 month (Group 1: 39.1 ± 5.6 , Group 2: 34.2 ± 5.1 , Group 3: 37.8 ± 5.3 ; $\eta^2=0.11$) and 3 months (Group 1: 43.0 ± 5.4 , Group 2: 38.9 ± 4.9 , Group 3: 41.5 ± 5.2 ; $\eta^2=0.10$), with Group 2 consistently showing lower scores (Table 2).

Post hoc analyses revealed significant differences in blood transfusion rates between Group 2 and Group 3 (mean difference= 0.50 , $p=0.013$) and between Group 1 and Group 2 (mean difference= 0.58 , $p=0.002$). No significant difference was found between Groups 1 and 3. Regarding OKS, significant differences were found at day 10 between Group 2 and Group 3 ($p=0.002$) and between Group 1 and Group 2 ($p<0.05$), while no significant difference was observed between Groups 1 and 3. At 1 and 3 months, significant differences persisted only between Group 2 and Group 3 ($p<0.05$), with no significant differences between other group comparisons (Table 2).

Post-operative pain (VAS scores): Significant differences were observed among groups at all evaluated time points. On day 10, mean $\pm$ SD VAS scores were 2.8 ± 0.9 (Group 1), 4.8 ± 1.1 (Group 2), and 3.6 ± 1.0 (Group 3) (one-way Analysis of Variance $\eta^2=0.38$). The 95% CI for the difference between Groups 1 and 2 was -2.4 to -1.2 , with a large effect size (Cohen's $d=1.94$). Similar trends were maintained at 1 month (2.1 ± 0.8 , 3.9 ± 1.2 , 2.9 ± 1.1 ; $\eta^2=0.29$, $d=1.66$ between Groups 1 and 2) and at 3 months (1.5 ± 0.7 , 2.7 ± 1.0 , 2.1 ± 0.9 ; $\eta^2=0.14$, $d=1.34$ between Groups 1 and 2) (Table 3).

Blood transfusion and numbness rates: Blood transfusions were required in 3/30 patients (10%) in Group 1, 9/30 (30%)

Table 3. Post-operative pain and functional outcome scores

Time point	Group 1 (mean±SD)	Group 2 (mean±SD)	Group 3 (mean±SD)	p
VAS 10 d	2.8±0.9	4.8±1.1	3.6±1.0	<0.01*
VAS 1 m	2.1±0.8	3.9±1.2	2.9±1.1	0.014*
VAS 3 m	1.5±0.7	2.7±1.0	2.1±0.9	0.048*
OKS 10 d	34.5±5.4	28.3±4.6	32.1±5.0	<0.01*
OKS 1 m	39.1±5.6	34.2±5.1	37.8±5.3	0.016*
OKS 3 m	43.0±5.4	38.9±4.9	41.5±5.2	0.012*

VAS: Visual analogue score; OKS: Oxford knee score; SD: Standard deviation.

in Group 2, and 6/30 (20%) in Group 3, showing a significant difference among groups ($p=0.007$, Cramér’s $V=0.33$). Post-operative numbness occurred in 2/30 (6.7%), 5/30 (16.6%), and 4/30 (13.3%) patients in Groups 1, 2, and 3, respectively ($p=0.002$, Cramér’s $V=0.31$) (Table 4).

In summary, Group 2 generally demonstrated worse functional outcomes, higher pain scores, and increased blood transfusion and numbness rates compared to Groups 1 and 3.

DISCUSSION

This study demonstrated that the vertically oriented midvastus arthrotomy technique offers significant advantages over both the classic midline approach and the horizontal modification, particularly regarding post-operative pain, functional outcomes, and the need for blood transfusion.

A key finding was the significant reduction in blood transfusion rates in Group 1. This technique likely reduces intraoperative trauma and bleeding, aligning with previous literature while adding new clinical insights into the benefits of the midvastus approach.^[13,14] Muscles are highly vascularized tissues—more so than tendons in the lower extremity—and the midvastus approach involves incision through the vastus medialis obliquus (VMO) muscle belly.^[15] Our results suggest that vertically oriented incisions may reduce bleeding, potentially due to anatomical factors such as the vascularization pattern of the medial superior genicular artery, a branch of the popliteal artery.^[14] Vertical incisions may therefore anatomically distance the incision from critical vascular structures, con-

tributing to lower perioperative blood transfusion rates.^[13] In addition, midline incisions often cause more extensive muscle disruption, whereas Group 1’s average incision length was shorter, particularly compared to Group 3, likely sparing more muscle tissue.

Regarding post-operative pain, Group 1 consistently exhibited significantly lower VAS scores at multiple time points, especially at day 10 and 1 month. These findings support previous evidence linking less invasive arthrotomy techniques to reduced post-operative pain.^[16] Although this study did not compare the midvastus approach with other arthrotomy techniques, all patients had intact patellar tendons, indicating that the improved outcomes in Group 1 may be attributable to decreased muscle damage and a shorter incision length. Furthermore, all patellae were everted for optimal joint visualization, and the vertically oriented technique seems to further enhance pain management, highlighting the importance of incision angle and muscle preservation.

The horizontal midvastus approach resembles the subvastus technique, while the vertical modification is more akin to the paramedian parapatellar approach. Our study integrated elements from both approaches in the midvastus technique to determine an optimal incision angle. Future research should compare these modifications directly to the original subvastus and paramedian parapatellar techniques for more definitive conclusions.

Functional recovery, measured by the OKS, was faster in Group 1, with statistically significant improvements at days 10, 1 month, and 3 months postoperatively. These results align with growing evidence that muscle-sparing techniques, especially those avoiding direct quadriceps tendon damage, facilitate quicker functional recovery.^[17,18] While the midvastus approach has been shown to improve early outcomes compared to the medial parapatellar technique, literature on the modified midvastus approach is scarce, and prior descriptions lack precision—typically noting only that the incision is “parallel to

Table 4. Post-operative blood loss and nerve injury rates

Group	Blood transfusion (%)	Reported numbness (%)
Group 1	10	6.67
Group 2	30	16.6
Group 3	20	13.3

the muscle fibers.” Our findings emphasize the significance of incision orientation and surgical technique modification for optimizing early recovery.

Long-term implications of early functional differences are also relevant. Although our follow-up was limited to 3 months, longer studies have shown that early functional gains often predict better long-term outcomes.^[3] Patients recovering faster initially tend to maintain improved function and satisfaction at 1- and 2-year follow-ups.^[19,20] This suggests the potential for sustained benefits from the vertically oriented technique, though further long-term studies are necessary. Notably, some reports demonstrate better early outcomes but similar long-term results among techniques.^[2,21,22]

Another secondary outcome was the incidence of post-operative numbness, which can affect patient satisfaction but is often underreported. We found a significantly lower rate of numbness in the vertically modified midvastus group. This finding is consistent with prior studies reporting fewer sensory deficits with quadriceps-sparing TKA techniques,^[23] further supporting the soft-tissue preservation benefits of refined midvastus modifications.

Despite standardized surgical and rehabilitation protocols, this study has limitations. The relatively short follow-up limits assessment of long-term outcomes and complications such as prosthetic loosening or wear. The single-center, retrospective design may restrict generalizability, warranting larger multicenter prospective studies. In addition, we did not account for individual anatomical variability in VMO fiber orientation, and no intraoperative imaging was performed to verify incision alignment with muscle fibers. Hemoglobin data indicated greater perioperative blood loss in Group 2, corroborating transfusion rates and suggesting that incision orientation influences tissue handling and bleeding. Functional assessments, such as quadriceps strength and patellar tracking, were not evaluated but are important for future research.

CONCLUSION

This retrospective study offers valuable insights into the comparative outcomes of three midvastus arthrotomy techniques in TKA. The vertically oriented incision was associated with reduced pain, lower transfusion rates, and faster functional recovery. These results highlight the importance of tailoring incision angles based on anatomical fiber direction. Prospective, anatomically guided studies with extended follow-up are needed to confirm and refine these preliminary findings.

DECLARATIONS

Ethics Committee Approval: The study was approved by Metin Sabancı Baltalimanı Bone Diseases Training and Research Hospital Ethics Committee (No: 22-147, Date: 30/05/2024).

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REFERENCES

1. Stubnya BG, Kocsis K, Váncsa S, Kovács K, Agócs G, Stubnya MP, et al. Subvastus approach supporting fast-track total knee arthroplasty over the medial parapatellar approach: a systematic review and network meta-analysis. *J Arthroplasty* 2023;38:2750–8.
2. C Katragadda B, Kumar S, Suresh A, Vk K. Midvastus versus medial parapatellar approach in simultaneous bilateral total knee arthroplasty. *J Arthroplasty* 2023;38:2301–6.
3. 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;36:1187–94.e1.
4. Harwin SF. The medial parapatellar approach to the knee. *J Knee Surg* 2003;16:43–7.
5. Khan MNH, Abbas K, Faraz A, Ilyas MW, Shafique H, Jamshed MH, et al. Total knee replacement: a comparison of the subvastus and medial parapatellar approaches. *Ann Med Surg (Lond)* 2021;68:102670.
6. Maestro A, Suarez MA, Rodriguez L, Guerra C, Murcia A. The midvastus surgical approach in total knee arthroplasty. *Int Orthop* 2000;24:104–7.
7. Geng L, Fu J, Xu C, Ren P, Wang YM, Ji QB, et al. The comparison between mini-subvastus approach and medial parapatellar approach in TKA: a prospective double-blinded randomized controlled trial. *Orthop Surg* 2022;14:2878–87.
8. Wu Y, Zeng Y, Bao X, Xiong H, Hu Q, Li M, et al. Comparison of mini-subvastus approach versus medial parapatellar approach in primary total knee arthroplasty. *Int J Surg* 2018;57:15–21.
9. Engh GA, Ammeen DJ. The midvastus approach to the knee. *J Knee Surg* 2003;16:48–51.
10. Liu HW, Gu WD, Xu NW, Sun JY. Surgical approaches in total knee arthroplasty: a meta-analysis comparing the midvastus and subvastus to the medial peripatellar approach. *J Arthroplasty* 2014;29:2298–304.

11. Engh GA, Parks NL. Surgical technique of the midvastus arthrotomy. *Clin Orthop Relat Res* 1998;270–4.
12. Kang H. Sample size determination and power analysis using the G*Power software. *J Educ Eval Health Prof* 2021;18:17.
13. Cooper RE Jr, Trinidad G, Buck WR. Midvastus approach in total knee arthroplasty: a description and a cadaveric study determining the distance of the popliteal artery from the patellar margin of the incision. *J Arthroplasty* 1999;14:505–8.
14. Björkström S, Goldie IF. A study of the arterial supply of the patella in the normal state, in chondromalacia patellae and in osteoarthritis. *Acta Orthop Scand* 1980;51:63–70.
15. Vasiliadis AV, Chatziravdeli V, Metaxiotis D, Beletsiotis A. A prospective randomized comparative study between midvastus and standard medial parapatellar approaches for total knee replacement regarding the peri-operative factors. *Cureus* 2022;14:e29889.
16. Haas SB, Cook S, Beksac B. Minimally invasive total knee replacement through a mini midvastus approach: a comparative study. *Clin Orthop Relat Res* 2004;68–73.
17. Karachalios T, Giotikas D, Roidis N, Poultides 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;90:584–91.
18. Nikodelis T, Grigoriadis S, Metaxiotis D, Mylonas V, Kellis E. Mid-vastus approach induces milder short-term effects on postural control compared to parapatellar approach in total knee arthroplasty. *Clin Biomech (Bristol)* 2024;120:106354.
19. Blom AW, Hunt LP, Matharu GS, Reed M, Whitehouse MR. The effect of surgical approach in total knee replacement on outcomes. An analysis of 875,166 elective operations from the National Joint Registry for England, Wales, Northern Ireland and the Isle of Man. *Knee* 2021;31:144–57.
20. 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.
21. 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.
22. Lechner R, Lazzeri M, Oberaigner W, Nardelli P, Roth T, Köglberger P, et al. Does the type of surgical approach affect the clinical outcome of total knee arthroplasty? *Orthopade* 2021;50:674–80.
23. Holt G, Nunn T, Allen RA, Forrester AW, Gregori A. Variation of the vastus medialis obliquus insertion and its relevance to minimally invasive total knee arthroplasty. *J Arthroplasty* 2008;23:600–4.