

Surgical Approaches in Primary and Revision Total Knee Arthroplasty: A Contemporary Narrative Review

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Abstract: ***Background:** Surgical exposure in total knee arthroplasty (TKA) must reconcile preservation of the extensor mechanism with visualization, ligament balancing, accurate implantation, and reliable closure. Numerous standard, muscle-sparing, lateral, and extensile approaches are available, but terminology and evidence quality vary considerably. **Methods:** This narrative review used targeted web-assisted searches of PubMed-indexed publications, PubMed Central, and journal websites, supplemented by reference tracing. Landmark technical and comparative studies were considered alongside publications available through 7 October 2026. Primary and revision procedures were assessed separately. No exhaustive database screening, formal risk-of-bias assessment, or quantitative pooling was performed. **Findings:** Medial parapatellar exposure remains a versatile reference approach. Subvastus and midvastus techniques can improve selected early recovery outcomes, although sustained functional advantages are inconsistent. Restricted quadriceps-sparing exposure has a distinct learning curve and historical concerns about component-position outliers. Lateral parapatellar exposure is anatomically attractive in selected valgus knees; lateral subvastus variants remain less extensively validated. A 2026 review of 27 randomized trials found no approach consistently superior across range of motion, patient-reported outcomes, and reoperation. Recent observational studies support early subvastus recovery benefits but cannot establish causal superiority. In revision TKA, quadriceps snip and tibial tubercle osteotomy provide different solutions to restricted exposure; V-Y quadricepsplasty and other salvage exposures require more selective use and repair-specific rehabilitation. **Conclusions:** Approach selection should follow deformity, tissue mobility, previous surgery, required reconstruction, and surgeon expertise. A limited exposure should be enlarged whenever visualization or tissue safety becomes inadequate. Contemporary evidence supports individualized selection rather than a universal preferred approach. Future trials should separate exposure from perioperative care and robotic technology, measure clinically important early function, and capture uncommon complications and long-term revision.*

Keywords: total knee arthroplasty; surgical approach; subvastus; midvastus; lateral approach; quadriceps snip; tibial tubercle osteotomy; revision arthroplasty

1. Introduction

The approach to TKA is more than a route to the joint. It determines how the extensor mechanism is mobilized, which structures are divided or retracted, how the contracted side of a deformity is accessed, and what must heal after implantation. Its value therefore depends on the entire operation: a technically elegant arthrotomy is unsuccessful if it impairs component placement, leaves residual instability, or creates a closure that cannot tolerate rehabilitation.

Debate has often been framed around conventional versus minimally invasive surgery. This distinction is imprecise. A shorter skin incision, less quadriceps-tendon division, preservation of vastus medialis, avoidance of patellar eversion, and reduced collateral dissection are different interventions. Studies frequently combine several of them with different instruments, analgesic pathways, implants, or rehabilitation schedules. Apparent differences in recovery may consequently reflect an operative package rather than the deep approach alone. The 2026 randomized-trial review and network meta-analysis illustrate both the breadth of investigation and the continuing uncertainty about durable superiority. [1, 2]

The question changes further in revision TKA. The priorities become atraumatic implant removal, management of bone loss, restoration of joint line and stability, and protection of a

scarred extensor mechanism. Here, an extensile exposure can prevent injury even though it introduces an additional repair. Comparisons with routine primary TKA are therefore inappropriate. The literature on revision exposure contains useful technical experience but comparatively few controlled studies.[3]

This review examines the principal recognized approaches for primary and revision TKA, including standard medial and lateral arthrotomies, muscle-sparing variants, less common alternative exposures, and extensile techniques. It integrates recent findings with the anatomical and reconstructive considerations that make those findings clinically interpretable. The central argument is that tissue preservation and adequate exposure are complementary objectives; either becomes counterproductive when pursued without the other.

2. Review Methods and Scope

Targeted searches were conducted using combinations of “total knee arthroplasty” or “total knee replacement” with medial parapatellar, midvastus, subvastus, quadriceps-sparing, intervastus, trivector, lateral parapatellar, lateral subvastus, revision exposure, quadriceps snip, tibial tubercle osteotomy, femoral peel, banana peel, epicondylar osteotomy, and V-Y quadricepsplasty. Additional searches addressed randomized trials, registry analyses, robotic

assistance, and publications dated 2025–2026. The final literature check was 7 October 2026.

The search accessed public PubMed records, accessible full texts, publisher pages, and linked references. It was not an exhaustive search of subscription bibliographic databases. Selection emphasized anatomical descriptions, comparative clinical studies, randomized trials, large observational analyses, and recent evidence syntheses. Technical reports were included to describe emerging approaches but were not treated as proof of comparative effectiveness. Promotional material and patent information were not used to establish clinical efficacy.

Primary and revision TKA were interpreted separately. Skin-incision studies, patellar-management choices, and robotic workflows were considered as related modifiers rather than independent deep approaches. Study design, comparator, follow-up, and major confounding were considered qualitatively. No protocol was registered, no PRISMA study-flow count was generated, and no independent duplicate screening or formal certainty grading was undertaken. Accordingly, this is a critical narrative review, not a systematic review or clinical practice guideline. Its coverage is broad but cannot exclude every local modification or unpublished technique.

3. Anatomical framework and terminology

Three levels should be specified when reporting an approach: the cutaneous incision; the deep capsular or retinacular arthrotomy and its relationship to the quadriceps; and any additional release or osteotomy. Descriptions such as “mini,” “quadriceps-sparing,” and “muscle-sparing” are inadequate unless the divided structures and conversion rules are stated. In particular, a subvastus approach that preserves the quadriceps tendon should not automatically be grouped with the historically restricted quadriceps-sparing instrumentation technique.

“Quadriceps-splitting” is another classification used in comparative literature.[2] It requires an operative definition: the name alone does not distinguish longitudinal tendon division in a conventional anterior exposure from a muscle-splitting variant. These categories should not be treated as interchangeable anatomical interventions.

Extensor preservation has several dimensions. Continuity of the tendon is one, but retraction pressure, muscle injury, perfusion, patellar-tendon traction, and postoperative activation also matter. A tendon-preserving route can still cause tissue injury when exposure is forced. Conversely, a securely repaired tendon incision may permit reliable recovery. The clinically useful comparison is the total burden of injury, repair, and rehabilitation rather than the length of the incision alone.

Skin perfusion deserves particular attention in revision surgery. Previous scars and local tissue quality influence flap design, while patellar mobility and scar tethering influence the deep exposure. Planning should integrate both rather than applying an isolated numerical rule for skin bridges. Full-thickness handling and avoidance of

unnecessary undermining are practical principles, but the final incision must account for the actual scar pattern and vascular condition.[3]

Patellar eversion and lateral subluxation are exposure choices, not interchangeable synonyms for an approach. Similarly, lateral retinacular release is an adjunct performed for a specific indication; it does not convert a medial arthrotomy into a lateral approach. Robotic assistance, navigation, alignment philosophy, cruciate retention, and patellar resurfacing can interact with exposure but do not define the anatomical route. This terminology is essential when interpreting comparative studies or counseling patients.

4. Medial approaches for primary TKA

4.1 Standard medial parapatellar approach

The medial parapatellar approach provides access through the quadriceps tendon and medial retinacular-capsular tissues, continuing beside the patella and patellar tendon. Its principal strengths are familiarity, broad visualization, and extensibility. The proximal arthrotomy can be increased, and recognized revision extensions can be added when required. These features make it a useful reference exposure across a wide range of deformities and reconstructive demands.

The trade-off is a repair within the extensor apparatus and disruption of medial peripatellar tissues. Nevertheless, this anatomical difference does not establish a clinically important disadvantage in every patient. In a double-blind randomized trial comparing contemporary subvastus and medial parapatellar techniques, early outcomes did not show a consistent advantage for the tendon-preserving route when other elements of care were controlled.[4] This supports separating anatomical plausibility from measured clinical benefit.

The medial approach should not be equated with extensive dissection, obligatory patellar eversion, or unnecessarily long tendon division. Tissue handling can be conservative within a conventional arthrotomy. Its versatility is especially valuable when obesity, substantial stiffness, difficult tibial access, or anticipated complex reconstruction makes a narrow working window unreliable. The relevant choice is whether the exposure permits a precise, controlled procedure in that knee, rather than whether its name carries a minimally invasive label.

The large National Joint Registry analysis of 875,166 operations found that conventional medial parapatellar exposure accounted for 91.9% of procedures. Conventional midvastus exposure was associated with a lower adjusted revision risk, but patient-reported differences were not clinically important. Residual confounding by surgeon expertise, case selection, and practice patterns prevents interpreting this association as proof that changing the arthrotomy reduces revision.[5]

4.2 Mini-medial parapatellar approach

The mini-medial parapatellar approach restricts the conventional arthrotomy and usually combines it with a smaller incision and altered instrument handling. It preserves the same fundamental route while reducing the intended extent of dissection. Its practical attraction is the ability to increase exposure along a familiar line if the restricted window becomes inadequate.

However, “mini” is not a standardized dose of tissue preservation. Studies differ in incision length, proximal tendon division, patellar handling, instrumentation, and perioperative care. Consequently, comparison with standard medial parapatellar exposure may test several interventions simultaneously. The randomized-trial synthesis found favorable results for mini-medial parapatellar exposure in some studies, but no reproducible dominance across the outcomes assessed. [1]

The safety boundary is functional: visualization of landmarks, control of cutting instruments, and protection of adjacent tissues must remain adequate. Extension should occur before restricted access produces uncertainty about component rotation, resection quality, or ligament balance. Conversion is best reported as part of the operative strategy, including its timing and reason, rather than hidden as a technical failure.

4.3 Midvastus and mini-midvastus approaches

Midvastus exposure enters through the vastus medialis muscle while preserving the quadriceps tendon. Mini-midvastus techniques limit the proximal muscle split and working window. The approach represents a compromise between tendon preservation and access, although it still requires healing of divided muscle fibers. The split length and direction should be described explicitly rather than assumed from the label.

Early pain, quadriceps activation, and functional recovery can favor midvastus techniques in individual studies, but the overall randomized evidence does not establish sustained superiority. The 2026 review included trials favoring midvastus on selected outcomes alongside many trials showing no difference. The registry association with lower revision after conventional midvastus exposure is supportive observational information rather than confirmation of causality. [1, 5]

The low mini-midvastus technique reported in 2025 limits the split to a small cuff at the inferomedial muscle margin, intending to preserve more muscle bulk. This is a technical development; its proposed recovery advantages require independent comparative testing. A description of feasible exposure cannot establish better patient-reported function or a lower complication rate.[6]

For clinical selection, muscle bulk and extensibility deserve as much attention as body mass index. The operative window must accommodate the planned instruments without excessive traction. When extension is needed, the surgeon should identify what additional muscle or tendon division

will be required and how it will be repaired. Studies should distinguish standard midvastus, mini-midvastus, and low mini-midvastus rather than pooling them under one name.

4.4 Subvastus and modified under-vastus approaches

The medial subvastus approach mobilizes vastus medialis from its underlying plane and opens the capsule beneath it, preserving the quadriceps tendon and avoiding a direct muscle split. Its rationale is to preserve active extension and medial patellar mechanics. Exposure can nevertheless be demanding when the muscle is bulky, the knee is stiff, or patellar mobility is limited. Tendon continuity should not justify forceful retraction.

The 2026 study in patients older than 75 years compared 30 subvastus with 30 medial parapatellar procedures. Straight-leg raise returned at 1.7 versus 3.4 days and one-week motion was 94° versus 79°, favoring subvastus, but the six-week Knee Society Score did not differ significantly. Retrospective selection and a single-surgeon pathway limit generalizability. In particular, the nonsignificant complication difference does not demonstrate reduced thromboembolism or other uncommon harm.[7]

An August 2026 retrospective study compared modified subvastus with limited medial parapatellar exposure in 90 patients. Quadriceps recovery was earlier (1.56 versus 2.07 days), while later outcomes converged. Comparing two limited approaches is useful, but treatment allocation remained nonrandomized. The publisher identified the available article as accepted research subject to editing before the version of record.[8]

The modified under-vastus approach incorporates attention to anatomical soft-tissue repair. Such modifications should be described separately because capsular handling and closure may influence recovery independently of the route beneath the muscle.[9] Branded terminology, including Jiffy Knee, should likewise be replaced in research by an explicit anatomical description and operative protocol. Evidence for the subvastus family cannot automatically validate every proprietary retractor, incision, or perioperative package.

4.5 Restricted quadriceps-sparing approach

In its historical minimally invasive usage, quadriceps-sparing TKA employs a restricted medial working window and specialized instruments to minimize proximal extensor division. This is distinct from using “quadriceps-sparing” as a broad description of any tendon-preserving exposure. The restricted technique can make direct landmark visualization and conventional instrumentation more difficult.

A 2017 meta-analysis reported greater malalignment and component-position concerns with quadriceps-sparing exposure than with medial parapatellar exposure.[10] These findings arose from older techniques and should not be translated into a universal prediction for every experienced modern surgeon. Nonetheless, they identify a credible mechanism of harm: a smaller operative window may compromise the accuracy it is intended to preserve.

Comparative studies and contemporary syntheses have not established a sufficiently consistent long-term functional advantage to disregard that concern. [4, 2] Suitable implementation therefore requires specific training, appropriate case selection, and low tolerance for inadequate visualization. Navigation or robotics may assist execution, but neither can compensate for unsafe soft-tissue access or inability to introduce instruments without excessive force. Future studies should measure both the intended biological advantage and technical outliers.

4.6 Modified intervastus approach

The modified intervastus approach seeks to preserve vastus medialis and the quadriceps tendon while retaining an extensile route. Its description uses the relationship between vastus medialis, the underlying capsule, and a proximal interval toward vastus intermedius. The original report and subsequent retrospective analysis support technical feasibility, but the evidentiary base is substantially smaller than that for medial parapatellar, midvastus, or subvastus exposure. [11, 12]

Claims of rapid active-extension recovery should therefore be regarded as preliminary. The main unresolved questions are independent reproducibility, the tissue effects of retraction and closure, and comparative performance in difficult knees. Its anatomical preservation is a reasonable hypothesis for investigation rather than an established reason to prefer it across routine primary TKA.

4.7 Trivector and mini-trivector approaches

Trivector terminology refers to alternative handling of the extensor apparatus intended to preserve useful force transmission while creating a working window. The mini-trivector technical description includes limited snips rather than an entirely incision-free quadriceps route. It should therefore not be classified automatically with techniques that leave both tendon and muscle undivided.[13]

The proposed advantage is greater exposure than the most restricted minimally invasive routes, particularly where stiffness makes patellar mobilization difficult. Published technical experience is insufficient to establish durable superiority, rare-complication safety, or broad applicability. The informative reporting variables are the exact snips, their repair, patellar handling, and any subsequent extension. Grouping all trivector modifications together obscures those differences.

5. Lateral Approaches

5.1 Lateral parapatellar approach

Lateral parapatellar exposure opens the lateral retinacular-capsular structures and mobilizes the patella medially. Keblish's landmark description addressed the valgus knee, where the contracted tissues are lateral and the medial stabilizers may already be attenuated.[14] This gives the approach a deformity-specific rationale: direct access to the contracted side can facilitate controlled balancing while limiting unnecessary medial dissection.

Access does not determine which structures must be released. Fixed valgus, reducible valgus, flexion instability, and medial incompetence are different problems. Correction requires reassessment of stability through the arc of motion, with preservation of useful stabilizers whenever possible. The approach also does not remove the risk associated with correcting a substantial valgus deformity, including traction-related nerve injury.

A small randomized study in valgus osteoarthritis reported less postoperative lateral patellar tilt with Keblish's approach than with medial exposure. This is a plausible patellofemoral benefit, but the study's size and narrow endpoint do not establish a general advantage in patient satisfaction, revision, or all valgus phenotypes.[15] The lateral arthrotomy itself creates closure considerations after correction; lengthening or reconstructive modifications may be required when the formerly contracted lateral envelope cannot close appropriately.

Recent technical publications demonstrate lateral exposure within robotic workflows for valgus knees.[16] Their contribution is procedural feasibility and adaptation of instrumentation. They do not prove that the combination is superior to a well-performed medial procedure or that robot-assisted balancing neutralizes the consequences of a deficient medial collateral ligament.

5.2 Lateral subvastus and subvastus lateralis approaches

Lateral subvastus approaches aim to preserve the quadriceps tendon and vastus lateralis while accessing the joint laterally. The terminology encompasses different capsulotomies and mobilization strategies, so reports should be interpreted by their operative details rather than their shared name. These approaches are not simply medial subvastus surgery performed on the opposite side.

A cadaveric study demonstrated the feasibility of lateral subvastus exposure without a longer incision than medial parapatellar exposure.[17] Such work helps establish anatomical plausibility but cannot predict pain, functional recovery, vascular healing, or uncommon complications in living patients. A subsequent clinical and kinematic comparison supplies comparative information, although the overall clinical literature remains limited.[18]

Nguyen and colleagues described a lateral subvastus technique and reviewed 931 consecutive cases. This large retrospective series establishes that the technique can be implemented at substantial volume, but its absence of a contemporaneous comparator prevents attribution of outcomes to the approach. The distinctive capsulotomy and tibia-first workflow also limit pooling with other lateral techniques.[19]

The 2025 Keblish lateral subvastus technical note combines a tendon-preserving route with a Z-plasty strategy for valgus correction and closure.[20] This addresses an important mechanical problem, but the report remains technical evidence. Independent multicenter comparisons, standardized definitions, and longer follow-up are needed

before lateral subvastus exposure can be assigned the same evidentiary status as established medial approaches.

Lateral subvastus exposure combined with tibial tubercle osteotomy is a further distinct variant. In a two-year randomized trial, its clinical outcome was comparable with medial parapatellar exposure, but increased surgical time and technique-specific complications argued against routine use.[21] Results from this combined approach should not be attributed to a tendon-preserving lateral capsulotomy without osteotomy: the additional bone procedure changes both exposure and recovery.

5.3 Skin incision and sensory outcomes

Anterior knee numbness depends partly on cutaneous nerve anatomy and partly on incision placement. It should not be treated as a direct measure of quadriceps preservation. A randomized trial comparing lateral and medial parapatellar exposure found less early numbness with the lateral route but no difference at mid-term follow-up.[22] A separate randomized study of a lateralized distal skin incision addressed persistent numbness without making skin placement synonymous with deep arthrotomy.[23]

These findings support reporting skin and deep exposure separately. Numbness, kneeling discomfort, and anterior pain should also be measured independently: they are related patient experiences but not interchangeable endpoints. An approach that improves a sensory map need not improve strength, implant survival, or global knee function.

A 2026 meta-analysis of randomized skin-incision trials associated anterolateral incision with less hypoesthesia at one year.[24] This extends the sensory evidence but does not establish superiority of lateral deep arthrotomy. For valgus TKA itself, a comparative-study meta-analysis found broadly comparable functional, alignment, and complication outcomes between lateral and medial approaches.[25] The anatomical appeal of lateral access should therefore be distinguished from proof of universal clinical superiority.

6. Extensile approaches in complex primary and revision TKA

6.1 Escalation principles

In revision TKA, restricted motion may reflect scarred gutters, patella baja, extensor shortening, distorted bone anatomy, or a bulky implant-spacer construct. The exposure should be planned around the limiting structure and the intended reconstruction. Initial scar mobilization may be sufficient; otherwise, extension should precede uncontrolled traction on the patellar tendon or forceful flexion of the knee.

Extensile options are not arranged in a universal mandatory sequence. A modest proximal restriction may be solved by a quadriceps snip, whereas severe distal tethering or the need to access the proximal tibia may favor tibial tubercle osteotomy. A shortened extensor mechanism may require lengthening. The repair and postoperative protection should

be anticipated before the exposure is performed, including interaction with stems, augments, cones, and bone quality.

6.2 Quadriceps snip

The quadriceps snip extends the proximal medial arthrotomy obliquely through the quadriceps apparatus to increase patellar mobilization. It adds proximal excursion without creating a formal tibial osteotomy or a deliberate tendon-lengthening construct. Its value is a relatively straightforward extension when the standard exposure is nearly sufficient.

Abdel and colleagues compared 321 revision TKAs using a quadriceps snip with a matched standard-exposure cohort. They found no significant difference in major extensor or overall clinical outcomes, supporting the technique's use within their practice.[26] Matching improves interpretation but cannot remove all differences in scar severity or operative indication. Rehabilitation should follow the security of the repaired snip and the entire revision construct; the label alone is insufficient to prescribe unrestricted activity.

A snip may be inadequate when distal tethering is dominant. Repeatedly increasing retraction after a modest proximal release defeats its protective purpose. The intraoperative criterion for further extension is whether the planned work can be completed under direct control without threatening the extensor insertion.

6.3 Tibial tubercle osteotomy

Tibial tubercle osteotomy mobilizes the extensor mechanism with a bone fragment that retains its tendon attachment. It can provide substantial distal exposure and facilitate access to the tibial component or canal. Its success depends on fragment viability, bone geometry, stable fixation, and compatibility with the revision tibial reconstruction.

A 2020 systematic review reported a 98.1% union rate across the included revision literature.[27] This is encouraging, but pooled technical series are subject to selection, publication bias, and differences in fixation and postoperative care. High average union does not eliminate the risks of migration, nonunion, fracture, hardware symptoms, or additional surgery in an individual patient.

The randomized trial by Bruni and colleagues compared tibial tubercle osteotomy with quadriceps snip during reimplantation for chronic prosthetic infection. At long-term follow-up, osteotomy was associated with better Knee Society scores and flexion, with no detected difference in reinfection.[28] This is important comparative evidence in a specific two-stage revision population. It does not establish osteotomy as the preferred exposure for every aseptic revision or complex primary knee.

Fixation and rehabilitation must be individualized. A stable arthroplasty implant does not automatically imply a healed osteotomy, and weight bearing, active extension, and flexion restrictions address different loading problems. Studies

should report these separately, including fixation-related reoperations and the time to union.

6.4 V–Y quadricepsplasty and patellar turndown

V–Y quadricepsplasty creates broad proximal exposure and permits lengthening when the extensor mechanism is shortened. Patellar turndown describes the associated reflection of the patella and extensor tissues; historical Coonse–Adams and modified Scott–Siliski exposures should not be assumed anatomically identical. Their practical trade-off is a larger repair with potential loss of extensor efficiency.

The historical clinical series by Trousdale and colleagues included 16 primary or revision knees and documented postoperative weakness despite useful exposure.[29] Contemporary repair and rehabilitation may differ, but this experience explains why a broad lengthening exposure is usually reserved for a compelling indication rather than chosen solely to simplify access.

A February 2026 retrospective study compared 12 modified V–Y procedures with 19 medial parapatellar revision procedures. Clinical scores, motion, and isokinetic strength did not differ significantly. The authors explicitly cautioned that the findings were not evidence of equivalence.[30] Conversion to V–Y occurred when medial exposure was inadequate, making confounding by indication unavoidable; the sample was also too small to establish uncommon-complication safety.

The reasonable interpretation is that satisfactory function can follow carefully selected modified V–Y exposure. It does not justify unrestricted use or a uniform accelerated rehabilitation schedule. Closure length, tension, intraoperative flexion tolerance, and repair quality should guide postoperative protection.

6.5 Femoral Peel

Femoral peel exposure releases a soft-tissue sleeve from the distal femur to gain access in a severely stiff or ankylosed knee. A modified peel series describes the possibility of extending medial, posterior, and lateral release according to the exposure required.[31] This is a major escalation because collateral attachment release can alter coronal stability and the necessary level of implant constraint.

The technique should therefore be considered together with reconstruction planning. Obtaining visualization is only one objective; the residual soft-tissue envelope must support the selected implant or be reconstructed appropriately. Posterior dissection also demands direct anatomical control. Its evidentiary base is predominantly technical and observational, and it should not be compared uncritically with routine exposures in mobile primary knees.

6.6 Banana Peel Exposure

The banana peel technique mobilizes a tibial soft-tissue sleeve around the patellar-tendon insertion while retaining important distal and lateral attachments; it is commonly

combined with a proximal snip. The original report described revision use rather than a standard primary arthrotomy.[32] Its attraction is increased distal mobility without creating a formal tubercle osteotomy.

Preserved attachment does not mean that no tissue requires healing. The insertional sleeve has been mobilized and needs protection appropriate to its integrity. Technical series support feasibility, but comparative clinical evidence is limited. It should not be described as proven equivalent to osteotomy merely because both can expose the tibia.

6.7 Medial epicondylar osteotomy and wandering resident exposure

Medial epicondylar osteotomy mobilizes a bone wafer carrying the medial collateral attachment to improve exposure and, in selected cases, permit correction of a severe varus envelope. The original description emphasizes its combined exposure and balancing role.[33] Because ligament function and fragment fixation are involved, this is a reconstructive decision rather than a benign enlargement of the incision. Failure of fixation or persistent instability may affect protection and implant constraint.

The wandering resident exposure uses a substantial oblique proximal quadriceps extension for a very stiff revision knee. Hendel and colleagues reported an 18-patient retrospective series, including septic and aseptic revisions.[34] Its historical name adds little to clinical comparison; the meaningful features are the tissues divided, repair performed, and subsequent restrictions. It remains a less common salvage option with limited comparative evidence.

7. What the latest evidence changes

7.1 Randomized evidence remains heterogeneous

The August 2026 review by Rainey and colleagues included 27 randomized-trial manuscripts, with a search covering January 2010 through December 2024. Most studies reported no difference in motion or patient-reported outcomes, and no approach was consistently superior.[1] The result supports caution about universal superiority claims, but it is not proof of equivalence: trial sizes, outcome definitions, and follow-up differed, and uncommon reoperations were difficult to evaluate.

The March 2026 network meta-analysis by Huh and colleagues included 42 randomized trials across nine approach categories, but its evidence search ended in December 2022. Rankings favored different techniques for pain, motion, or adverse events.[2] These rankings should not be read as an absolute clinical hierarchy. Network estimates depend on comparable populations and treatment definitions, while ranking probabilities do not disclose whether an advantage exceeds a clinically important threshold.

Direct and indirect estimates were inconsistent for pain and motion, further limiting interpretation of the rankings.[2] Publication year must therefore be distinguished from evidence currency. A review published in 2026 may largely

summarize earlier perioperative practice and omit later technical developments. Conversely, a very recent retrospective report may be timely but less reliable for causal inference than an older, well-controlled trial.

7.2 Early benefits deserve appropriate endpoints

The newer subvastus comparisons reinforce the possibility of faster initial activation, lower early pain, and better short-term motion. [7, 8] These outcomes can matter to patients and services even when later scores converge. However, the benefit should be expressed in interpretable units and assessed against the recovery pathway: an earlier straight-leg raise does not necessarily establish better independent walking, discharge readiness, or return to usual activity.

Comparative research should prioritize repeated early functional measurements alongside later patient-reported outcomes. Analgesia, tourniquet use, tranexamic acid, nerve blocks, rehabilitation intensity, and discharge criteria require control or transparent adjustment. Otherwise, a statistically significant difference may reflect contextual care rather than the exposure. Complications should be analyzed with adequate denominators and confidence intervals; absence of events in a small cohort is not confirmation of safety.

7.3 Robotics and approach should be separated analytically

A January 2026 retrospective cohort compared robot-assisted modified subvastus, manual modified subvastus, and medial parapatellar groups in 275 patients.[35] The three-group design is useful because it begins to separate technology and exposure, but it remains nonrandomized. Surgeon selection, chronology, baseline anatomy, and differences in perioperative care can still influence the result.

Robotic lateral technical reports similarly show that an alternative route can be integrated with platform-specific registration and instrumentation.[16] Clinical comparisons should specify whether the robot, approach, alignment target, implant, and rehabilitation changed together. Factorial designs or carefully controlled pragmatic trials would be more informative than comparing two bundled packages and attributing all differences to muscle preservation.

8. Clinical selection and reporting

Selection begins with the required operation. For an uncomplicated, mobile knee, a familiar medial approach or a practiced muscle-sparing variant can both be reasonable. For a fixed valgus knee, direct lateral access may be attractive when the surgeon can manage balancing and closure. For marked stiffness, previous extensor surgery, or revision bone loss, a planned extensile strategy may protect tissues more effectively than a forced limited exposure.

A useful preoperative discussion identifies the intended anatomical route, anticipated difficulty, and circumstances requiring extension. It should avoid guaranteed recovery timelines based solely on a branded name. Patients may

value early mobility, kneeling, or sensory preservation differently, but those preferences should be matched to evidence relevant to the specific outcome.

Operative and research reports should document skin placement, capsular route, proximal muscle or tendon division, patellar handling, releases, osteotomies, closure, conversion, surgeon experience, and rehabilitation restrictions. Outcomes should include component-position outliers, extensor lag, objective strength, manipulation, wound problems, instability, infection, and reoperation. This detail enables meaningful comparison across modifications that otherwise share an imprecise label.

9. Limitations and Research Priorities

This narrative review is limited by selective retrieval, uneven full-text access, English-language emphasis, and the absence of formal risk-of-bias or certainty assessment. Some newer techniques are represented mainly by technical notes or institutional series. The review cannot establish the completeness of the published literature, and its clinical synthesis should be regarded as reasoned interpretation rather than a formally graded recommendation.

The evidence also has structural limitations. Definitions of minimally invasive exposure vary, learning curves are inconsistently reported, and difficult knees are commonly excluded from primary trials. Rare complications require larger samples than early recovery outcomes. Registry analyses provide scale but may misclassify modifications and cannot fully account for expertise or deformity. Revision series have especially strong confounding by indication because the most extensive approach is often used in the most difficult knee.

Future studies should standardize anatomical reporting and prospectively record conversion. Expertise-based randomization may help compare approaches fairly, while common enhanced-recovery pathways would reduce contextual confounding. Early endpoints should include independent ambulation and validated recovery measures; later endpoints should include satisfaction, strength, kneeling, instability, and revision. New lateral and modified medial techniques need independent multicenter replication. Revision trials should stratify infection, stiffness, bone loss, and extensor condition, then link functional results to repair-specific rehabilitation.

10. Conclusions

No surgical approach has demonstrated universal superiority in TKA. Medial parapatellar exposure offers dependable versatility, while subvastus and midvastus techniques may improve selected early recovery outcomes. Restricted quadriceps-sparing exposure requires particular attention to visualization and technical accuracy. Lateral parapatellar exposure has a clear anatomical rationale in selected valgus knees, whereas lateral subvastus variants require further comparative validation.

In complex primary and revision TKA, exposure should address the restriction and planned reconstruction.

Quadriceps snip, tibial tubercle osteotomy, V-Y quadricepsplasty, and salvage releases differ in repair and rehabilitation requirements. Select the least disruptive

reliable exposure, and extend it promptly when tissue safety or technical control is threatened.

Table 1: Primary approach taxonomy and practical trade-offs

Approach	Extensor relationship	Practical attraction	Main limitation
Medial parapatellar	Quadriceps tendon and medial capsule opened	Familiar, broad, extensile access	Extensor repair; tissue handling remains important
Mini-medial parapatellar	Restricted conventional arthrotomy	Familiar conversion route	Variable definition; restricted visualization
Midvastus / mini-midvastus	Vastus medialis split; tendon retained	Compromise between access and preservation	Muscle injury; split extent matters
Low mini-midvastus [6]	Small inferomedial muscle cuff split	Proposed reduction in divided muscle bulk	Technique report; comparative benefit unproven
Subvastus / modified under-vastus	Plane beneath vastus medialis	Tendon and muscle continuity	Retraction and patellar mobility may limit access
Restricted quadriceps-sparing [10]	Limited medial window; special instruments	Intended minimal proximal disruption	Learning curve and historical positioning outliers
Modified intervalvastus [11]	Preservation-oriented medial interval	Intended extensibility with tissue preservation	Limited independent comparative validation
Trivector / mini-trivector [13]	Variant-specific limited extensor snips	Additional working space	Not an entirely undivided extensor route
Lateral parapatellar [14]	Lateral capsule and retinaculum opened	Direct contracted-side access in valgus	Closure and balancing require specific expertise
Lateral subvastus [19]	Lateral capsulotomy preserving proximal extensor	Alternative tendon-preserving route	Different techniques; comparative evidence limited
Lateral subvastus plus TTO [21]	Additional distal bony mobilization	Greater distal excursion	Osteotomy morbidity limits routine primary use

TTO, tibial tubercle osteotomy. Table is a qualitative anatomical synthesis; it is not a ranked recommendation. Detailed evidence and citations appear in the corresponding text sections.

Table 2: Extensile exposure: benefit and reconstructive cost

Technique	Exposure problem addressed	Principal cost / caution	Evidence anchor
Quadriceps snip	Proximal restriction on patellar mobilization	Repair required; may not solve distal tethering	Matched revision cohort [26]
Tibial tubercle osteotomy	Distal tethering; access to tibial reconstruction	Fixation, union, migration, hardware symptoms	Systematic review and infection-revision RCT [27] [28]
V-Y / patellar turndown	Severe extensor shortening or stiffness	Lengthening repair; weakness or lag; tailored protection	Historical series and small 2026 cohort [29] [30]
Femoral peel	Severe ankylosis and periarticular contracture	Collateral release can change implant constraint	Observational modified-peel series [31]
Banana peel	Distal soft-tissue restriction	Mobilized insertional sleeve requires healing	Technical revision report [32]
Medial epicondylar osteotomy	Exposure plus selected severe varus correction	Fragment fixation and ligament stability	Original technique description [33]
Wandering resident	Very stiff revision knee	Substantial proximal extensor incision and repair	Small historical series [34]

Rehabilitation must reflect repair integrity, fixation, and the complete reconstruction. These techniques are alternatives selected for specific restrictions, not a universal escalation sequence. RCT, randomized controlled trial.

Table 3: Selected recent findings, 2025–2026

Publication	Design / population	Finding or contribution	Interpretation
Rainey et al., August 2026 [1]	27 randomized-trial manuscripts; search to December 2024	No consistently superior approach	Publication date exceeds evidence cutoff; no equivalence inference
Huh et al., March 2026 [2]	Network meta-analysis; 42 RCTs; search to December 2022	Different outcome-specific rankings	Rankings are not a clinical hierarchy
Pang et al., August 2026 [8]	Retrospective; 90 patients; limited medial comparator	Early recovery benefit; later convergence	Nonrandomized; accepted-research status
Gürbüz et al., May 2026 [7]	Retrospective; 60 patients older than 75	Early subvastus recovery advantage	Selected cases; rare-harm claims unsupported
Fan et al., January 2026 [35]	Retrospective; 275 patients; three groups	Robotic subvastus group had better early recovery and alignment	Bundled intervention; residual confounding
Asoglu et al., February 2026 [30]	Retrospective revision cohort; 12 V-Y / 19 medial	No significant functional or strength differences	Small sample; not evidence of equivalence

Low mini-midvastus, 2025 [6]	Technical report	Smaller muscle-cuff split	Hypothesis-generating
Micicoi et al., 2025 [20]	Technical note; valgus knees	Lateral subvastus plus Z-plasty	Feasibility; superiority unproven
Andriollo et al., 2025 [16]	Robotic lateral technique	Workflow for valgus exposure	Technical adaptation, not efficacy trial
Skin-incision meta-analysis, 2026 [24]	Randomized-trial synthesis	Lower one-year hypoesthesia with anterolateral incision	Skin result cannot establish deep-approach superiority

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