Lateral Parapatellar Approach Without Tibial Tubercle Osteotomy for Fixed Valgus Deformity Correction in Total Knee Arthroplasty

Bhava R.J. Satish, MS, DNB, Jutty C. Ganesan, DNB, MCh, Prakash Chandran, MS, FRCS,
Praveen L. Basanagoudar, MS, FRCS, and Damodarasamy Balachandar, MS

Based on an original article: *J Arthroplasty*. 2013 May 20. <http://dx.doi.org/10.1016/j.arth.2013.04.037>

Introduction

The lateral parapatellar approach provides direct access to the pathological area in a valgus knee deformity and allows sequential titrated release of contracted lateral soft tissues during total knee arthroplasty.

Valgus deformity is less commonly encountered but more technically challenging than varus deformity¹⁻³. Typically, the intraoperative challenge is to obtain optimal tibiofemoral gap balancing that corrects the deformity without producing instability and to achieve optimal patellofemoral balancing. The standard technique is medial arthrotomy and lateral release with the inside out “pie-crusting” technique, which is suitable for “clinical valgus” deformities of <20°^{2,4}. Experimental and clinical studies have shown that major deformity correction obtained with the pie-crusting technique was achieved through effective release of the lateral collateral ligament^{4,5}.

Achieving gap balance in moderate to severe fixed valgus deformity with satisfactory access and release of tight lateral or posterolateral soft-tissue structures is difficult through a medial approach. Even with well-balanced flexion-extension gaps and properly aligned implants, patellar maltracking is a substantial problem. Lateral retinacular release has been reported in 30% to 76% of knees with “clinical valgus” undergoing primary total knee arthroplasty^{1,3,5}. This was our primary reason for shifting from medial to lateral arthrotomy for valgus knees. The tibial external rotation deformity that often accompanies moderate to severe fixed valgus deformity is not optimally corrected with a medial approach¹.

While several authors have reported good efficacy and long-term functional results with a lateral approach^{1,6-9}, that technique is generally not preferred because of the need for tibial tubercle osteotomy, be-

cause of presumed difficulty with lateral closure of the prosthetic joint, and because it is considered a technically demanding procedure². To address these problems, Keblish¹⁰ later modified his own approach by replacing the tibial tubercle osteotomy with a quadriceps snip and replacing the longitudinal lateral arthrotomy with a coronal z-plasty of the lateral retinaculum and capsule complex. The “expanded lateral structures,” which included the lateral retinaculum and lateral fat pad meniscal flap, were utilized for lateral joint closure. This technique eliminates the need for tibial tubercle osteotomy and associated concerns but retains the efficacy and advantages of the lateral approach for valgus deformities. We routinely perform this approach for all arthritic valgus knees that require total knee arthroplasty and found it to be highly effective.

The technique is performed in the following steps.

Step 1: Preoperative Planning

Differentiate the flexible and fixed components of the valgus deformity by clinical and radiographic examination.

- Measure the amount of valgus on a standard weight-bearing long anteroposterior knee radiograph. This is termed *clinical valgus*; the deformity is the sum of flexible and fixed components. The flexible component is contributed by a lax medial collateral ligament, tight but stretchable lateral soft tissues, and lateral femoral or tibial condyle bone loss. The fixed component is contributed by tight and unyielding (contracted) lateral or posterolateral soft tissues.
- With the patient lying supine and the knee in full extension, apply a varus strain to the knee. The residual deformity is termed *clinical fixed valgus*, where most of the flexible components have

been eliminated.

- After proper anesthesia has been administered in the operating room, apply varus strain to the knee; the deformity that persists is termed *surgical fixed valgus* (Fig. 1). An anteroposterior radiograph covering the maximum limb length is made for measurement of the femorotibial angle. Surgical fixed valgus, which will be termed simply *surgical valgus* in this report, determines the amount of lateral soft-tissue release required in a given knee. A patient with clinical valgus of 20° can have surgical valgus of 0° to 20°.
- Note any associated flexion deformity or hyperextension deformity of the knee.

Step 2: Expansile Lateral Arthrotomy

Open the knee joint from the lateral side by coronal z-plasty of the lateral retinaculum, oblique lateral tenotomy of the quadriceps tendon, and iliotibial band release.

- With a tourniquet in place and the knee in 90° of flexion, make an anterior longitudinal skin incision centered over the lateral third of the patella. Elevate a full-thickness lateral skin flap.
- Incise the lateral retinaculum 3 to 7 cm lateral to the lateral margin of the patella. Keep the incision superficial and perform undermining dissection toward the patella, separating the lateral retinaculum and capsule complex into two layers, superficial-anterior-medial and deep-posterior-lateral. Release the deep layer from the lateral margin of the patella, completing the coronal z-plasty (Figs. 2-A and 2-B; Video 1).
- Inferiorly, include the retropatellar fat with portions of the lateral meniscus in the lateral flap (Fig. 2-C). Release the iliotibial band from the midpart of the Gerdy tubercle, extending the incision to the anterior compartment fascia if necessary (Fig. 2-D). Release the capsule adherent to the lateral tibial margin. This proximal-lateral tibial release is done as a sleeve up to the middle of the lateral condyle. If there is an associated flexion deformity, extend the sleeve dissection posteriorly.
- Superiorly, incise the rectus tendon obliquely along its lateral margin, completing the lateral arthrotomy.

Step 3: Quadriceps Snip and Joint Exposure

Perform a quadriceps snip and expose the knee joint.

- With the knee in extension, perform a quadriceps snip in the distal-lateral to proximal-medial direction after placing stay sutures in the proxi-

mal portion for later easy identification.

- Clear the adhesions between the patellar tendon and the proximal-anterior aspect of the tibia.
- Evert the patella, flex the knee, and expose the joint (Fig. 3-A).
- Further release adherent lateral capsule from the proximal-anterior aspect of the tibia and resect lateral osteophytes (Fig. 3-B).
- Release both cruciate ligaments. Subluxate the tibia anterior to the femur by hyperflexing the knee and internally rotating the leg and by placing a Hohmann lever just behind the posterior margin of the tibial intercondylar area (Fig. 3-C).
- Quadriceps snip may not be necessary in patients with surgical valgus of <5°. However, if there is a tendency for tibial tubercle avulsion at the time of tibial subluxation, perform a quadriceps snip.

Step 4: Tibial and Distal Femoral Cuts

Make proximal tibial and distal femoral cuts in appropriate alignment.

- Perform measured bone cuts ranging from 8 to 10 mm with reference to the intact medial femoral and tibial condyles.
- If sizeable correction has been achieved with manipulation while the patient is under anesthesia, reduce the proximal tibial and distal femoral bone resections by 2 to 4 mm each to adjust for the joint laxity.
- Cut the proximal part of the tibia perpendicular to the long axis of the tibia. If a posterior stabilized implant is used, give the cut an appropriate posterior slope. If a side-specific tibial cutting block is used, use a contralateral side block (Fig. 4-A).
- With an intramedullary jig, perform the distal femoral cut in 3° to 5° of valgus in relation to the anatomical axis, as opposed to the usual 5° to 7° valgus cut. The cut typically removes thinner lateral condyle than medial condyle; in severe cases, none of the distal part of the lateral condyle is removed (Fig. 4-B).

Step 5: Extension Gap Balancing

A rectangular extension gap is the goal.

- With the knee in extension, assess the gap with a spacer block. In most cases, release of the iliotibial band, anterolateral aspect of the capsule, and posterolateral aspect of the capsule along with appropriate bone cuts will provide a symmetric extension gap (Fig. 5).
- If the extension gap is trapezoidal, with a spacer

block or distractor on the medial side, visualize and palpate the soft tissues on the lateral side to identify the tight structures.

- Look for tightness of the iliotibial band at the suprapatellar level; if it is taut, make a transverse incision from the lateral to the posterior aspect of the fascia.
- Flex the knee and release the posterolateral aspect of the capsule from its tibial attachment with cautery in small steps, assessing the extension gap every time.
- A balanced extension gap allows 1 to 2 mm of “give” on the medial and lateral sides with the spacer block in place with valgus and varus stress, respectively. If more “give” is available, try the next size spacer block. If the extension gap is symmetrical but does not allow a spacer block, make more of a bone cut.

Step 6: Flexion Gap Balancing

Determine the femoral component size and femoral rotation, and balance the flexion gap.

- Bring the knee into 90° of flexion. Select the appropriate size of femoral component by using the anterior or posterior referencing system. The distal femoral anterior condylar anatomy is highly variable in valgus knees, ranging from a nearly normal height to a flat lateral condyle anteriorly. Assess the most prominent part of the distal-anterior aspect of the femur (lateral or medial) and keep the sizing stylus there to avoid notching of the anterior cortex.
- Fix the femoral anteroposterior jig after confirming rotational alignment with the epicondylar axis and proximal tibial cut surface (Fig. 6-A). Make the anterior and posterior femoral cuts. The posterior cut typically removes a thin portion or none of the lateral femoral condyle.
- Assess the flexion gap. If it is trapezoidal, with a spacer block or distractor on the medial side, visualize and palpate the soft tissues on the lateral side to identify the tight structures.
- Release either the tendon of the popliteus or the lateral collateral ligament, whichever is tighter.
- After achieving a symmetric flexion gap (Fig. 6-B), make chamfer and box cuts.

Step 7: Component Fixation

Confirm tibial rotational alignment, fix the components, and assess patellar tracking.

- Insert the trial femoral and tibial components and assess the stability in extension and in 45° and 90° of flexion.

- Take the knee into several cycles of flexion and extension. Mark the tibial rotation after confirming alignment to the femoral trial component center and ankle joint center (Fig. 7-A).
- Fix the femoral and tibial components. Repair the quadriceps snip in full extension. Flex the knee to 90° and assess the quadriceps snip repair and patellar tracking (Figs. 7-B, 7-C, and 7-D).

Step 8: Prosthetic Joint Closure

Perform closure of the prosthetic joint with expanded lateral structures.

- Flex the knee to 70° to 90° and start lateral closure. There will be a “defect” on the lateral side; the extent of this defect is proportionate to the severity of the preoperative fixed valgus deformity and external rotation deformity and the intraoperative correction achieved.
- At the femoral component and joint line level, perform closure with coronal z-plasty layers of the lateral retinaculum and capsule complex (Figs. 8-A through 8-E).
- At the level of the tibial component and below it, the lateral soft-tissue sleeve closes the arthrotomy. In patients with mild deformity, suture back the lateral sleeve along with the iliotibial band partly or fully to the patellar tendon (Fig. 8-F). In those with severe deformity, suture the infrapatellar fat pad meniscal flap to the iliotibial band sleeve laterally and to the patellar tendon medially (Fig. 8-G).

Results

Between 2003 and 2009, thirty-two knees with clinical valgus deformity of >10° underwent total knee arthroplasty with an expansile lateral arthrotomy technique¹¹. The mean follow-up period was five years (range, three to eight years). The mean age was fifty-four years (range, forty-two to sixty-two years), and seventeen of the patients were women. The mean preoperative clinical valgus and surgical valgus were 25.4° (range, 11° to 60°) and 19.6° (range, 5° to 50°), respectively. The knees with valgus angulation that could be reduced to <5° were excluded from the study.

With direct exposure by means of a lateral arthrotomy, it was possible to perform titrated sequential release of the tight lateral structures, depending on the severity of the fixed deformity. Iliotibial band release alone was required in the thirteen knees with surgical valgus of <15°. The seventeen knees with surgical valgus of between 16° and 40° required release of the posterolateral aspect of the capsule, either alone or with either the tendon of the popliteus or the lateral collateral

ligament. Deformities of $>40^\circ$ (two knees) required release of the tendon of the popliteus as well as the lateral collateral ligament. It was possible to achieve satisfactory joint exposure, balancing of the tibiofemoral gap, and deformity correction in all knees without tibial tubercle osteotomy. Effortless smooth patellar tracking was observed in all patients. All patients received either a deep dished tibial insert with a regular femoral component or a posterior stabilized knee prosthesis. Constrained implants were not used in any knee. Bone-grafting was done in three knees with lateral tibial bone defects (Figs. 9-A, 9-B, and 9-C).

The mean Knee Society clinical score improved significantly from 34 points (standard deviation [SD], 8.7) preoperatively to 95 points (SD, 7) at one year, and this score was maintained at the time of the latest follow-up (mean, five years). The mean Knee Society functional score improved significantly from 36 points (SD, 19) preoperatively to 84 points (SD, 13) at one year, and it was 83 points at the time of the last follow-up (Videos 2 and 3). Mild midflexion mediolateral instability ($<9^\circ$) persisted in both knees of a patient who had had severe deformities and release of both the tendon of the popliteus and the lateral collateral ligament (Figs 10-A through 10-D; Videos 4 through 7). The mean femorotibial anatomical valgus angle was 25.4° (range, 11° to 60°) preoperatively and was corrected to a valgus angle of 4° (range, 0° to 10°). The external rotation deformity of the leg was satisfactorily corrected, resulting in a good overall limb alignment and appearance.

No patient was seen to have progression of the knee deformity at the time of the latest follow-up. There were no progressive radiolucent lines, cysts, component migration, or loosening. There were no revisions, and the implant survival rate was 100% at the time of the last follow-up.

We believe that the above described approach is a good option as deformities can be addressed in an optimal manner and surgeons can perform lateral soft-tissue releases confidently in a sequential manner. It can be used for severe fixed valgus deformities, and it can preserve the lateral soft-tissue stabilizers that are needed to maintain the stability and survival of the prosthesis over the long term.

What to Watch For

Indications

- Any arthritic valgus knee can be treated with this approach.
- While mild or flexible valgus deformities can be treated successfully with a medial approach, moderate or severe flexed valgus deformities and valgus knees with preoperative patellar maltracking typically will benefit from the lateral approach.

Contraindications

- Infection and osteomyelitis, as with any replacement arthroplasty.
- Patients who are unable or unwilling to participate in postoperative physiotherapy.

Pitfalls & Challenges

- As a primary step, evaluate the “surgical valgus” in the knee, which will give you an idea of the lateral soft-tissue releases required.
- To avoid an excessive extension gap, reduce the thickness of the bone cuts in the distal part of the femur and proximal part of the tibia when a lateral bone defect or medial joint space opening (medial ligament laxity), or both, are present.
- The standard landmarks for femoral component rotation—i.e., the posterior condylar line (with 3° of external rotation relative to that line) and the Whiteside line (with rotation aligned perpendicular to that line)—may not be reliable. Use the interepicondylar axis or tibial cut surface parallel technique to align femoral rotation.
- The standard landmark for tibial component rotation, the junction of the medial and midthird of the tibial tubercle, may not be reliable. Align tibial rotation to the center of the trial femoral prosthetic groove and ankle center.
- Only the lateral retinaculum and iliotibial band are released as part of the approach and exposure. Release other structures (the posterolateral aspect of the capsule, the tendon of the popliteus, and the lateral collateral ligament) only if necessary and in a titrated fashion.
- The tendon of the popliteus is closer to the lateral articular surface than anticipated in many valgus knees (Fig. 11). Avoid avulsion at the femoral attachment by avoiding forceful manipulations and improper bone lever placement.
- Other options are available to provide continuity of lateral stabilizers in the lateral approach:
 - » In cases in which the tendon of the popliteus is avulsed or was intentionally released from the lateral epicondyle, suture it more distally to the lateral collateral ligament.
 - » Z-lengthening of the tendon of the popliteus.
 - » When both the tendon of the popliteus and the lateral collateral ligament are tight, release the tendon of the popliteus at the femoral attachment. Carefully isolate the lateral collateral ligament and release it as distally as possible. The released ends of the tendon of the popliteus and the lateral collateral ligament can be sutured with one another.
 - » In the above scenarios, suture the ends after

flexion gap balancing with the knee in 90° of flexion and before component fixation.

- » When both the tendon of the popliteus and the lateral collateral ligament are tight, lateral femoral condylar sliding osteotomy with distal advancement can be tried in selected cases.
- At the end of the releases, if you are not satisfied with the stability, use constrained implants, which should be readily available.

Clinical Comments

- What precautions should be taken to avoid lateral popliteal nerve palsy while knee arthroplasty is performed in patients with fixed valgus deformity?
- Is a symmetric or asymmetric tibial baseplate preferable in valgus knees and why?
- How much valgus angulation should be given to the distal femoral cut while an intramedullary jig is used in total knee arthroplasty in patients with valgus deformity?

Bhava R.J. Satish, MS, DNB

Kalpana Medical Centre, Koundampalayam, Mettupalayam Road, Coimbatore 641 030, India.

E-mail address: drbrjorthocentre@gmail.com

Jutty C. Ganesan, DNB, MCh

Damodarasamy Balachandar, MS

KR Hospital, Periyanaickenpalayam, Mettupalayam Road, Coimbatore 641 020, India

Prakash Chandran, MS, FRCS

15, Cresswell Close, Callands, Warrington WA5 9UA, North Cheshire, United Kingdom

Praveen L. Basanagoudar, MS, FRCS

Sagar Hospital Banashankari, DSI Institutions Kumarasamy Layout, Bangalore 560078, India

Disclosure: None of the authors received payments or services, either directly or indirectly (i.e., via his or her institution), from a third party in support of any aspect of this work. None of the authors, or their institution(s), have had any financial relationship, in the thirty-six months prior to submission of this work, with any entity in the biomedical arena that could be perceived to influence or have the potential to influence what is written in this work. Also, no author has had any other relationships, or has engaged in any other activities, that could be perceived to influence or have the potential to influence what is written in this work. The complete **Disclosures of Potential Conflicts of Interest** submitted by authors are always provided with the online version of the article.

References

1. Keblish PA. The lateral approach to the valgus knee. Surgical technique and analysis of 53 cases with over two-year follow-up evaluation. *Clin Orthop Relat Res.* 1991 Oct;(271):52-62.
2. Elkus M, Ranawat CS, Rasquinha VJ, Babhulkar S, Rossi R, Ranawat AS. Total knee arthroplasty for severe valgus deformity. Five to fourteen-year follow-up. *J Bone Joint Surg Am.* 2004 Dec;86-A(12):2671-6.
3. Stern SH, Moeckel BH, Insall JN. Total knee arthroplasty in valgus knees. *Clin Orthop Relat Res.* 1991 Dec;(273):5-8.
4. Clarke HD, Fuchs R, Scuderi GR, Scott WN, Insall JN. Clinical results in valgus total knee arthroplasty with the "pie crust" technique of lateral soft tissue releases. *J Arthroplasty.* 2005 Dec;20(8):1010-4.
5. Mihalko WM, Krackow KA. Anatomic and biomechanical aspects of pie crusting posterolateral structures for valgus deformity correction in total knee arthroplasty: a cadaveric study. *J Arthroplasty.* 2000 Apr;15(3):347-53.
6. Burki H, von Knoch M, Heiss C, Drobny T, Munzinger U. Lateral approach with osteotomy of the tibial tubercle in primary total knee arthroplasty. *Clin Orthop Relat Res.* 1999 May;(362):156-61.
7. Nikolopoulos DD, Polyzois I, Apostolopoulos AP, Rossas C, Moutsios-Rentzos A, Michos IV. Total knee arthroplasty in severe valgus knee deformity: comparison of a standard medial parapatellar approach combined with tibial tubercle osteotomy. *Knee Surg Sports Traumatol Arthrosc.* 2011 Nov;19(11):1834-42. Epub 2011 Apr 12.
8. Apostolopoulos AP, Nikolopoulos DD, Polyzois I, Nakos A, Liarokapis S, Stefanakis G, Michos IV. Total knee arthroplasty in severe valgus deformity: interest of combining a lateral approach with a tibial tubercle osteotomy. *Orthop Traumatol Surg Res.* 2010 Nov;96(7):777-84. Epub 2010 Oct 12.
9. Boyer P, Boublil D, Magrino B, Massin P, Hutten D; Guepar Group. Total knee replacement in the fixed valgus deformity using a lateral approach: role of the automatic iliotibial band release for a successful balancing. *Int Orthop.* 2009 Dec;33(6):1577-83. Epub 2008 Dec 09.

10. Keblish PA. The lateral approach. In Scuderi GR, Tria Jr AJ, editors. Surgical techniques in total knee arthroplasty. New York: Springer; 2002. p 137-48.

11. Satish BR, Ganesan JC, Chandran P, Basanagoudar PL, Balachandar D. Efficacy and mid term results of lateral parapatellar approach without tibial tubercle osteotomy for primary total knee arthroplasty in fixed valgus knees. J Arthroplasty. 2013 May 20. <http://dx.doi.org/10.1016/j.arth.2013.04.037>.

Figures

Fig. 1

Assess surgical valgus, which is the residual valgus of an extended knee when manual varus strain is applied with the patient under anesthesia. Clinical valgus is the maximal deformity seen on weight-bearing radiographs.

Fig. 2-A

Separate the lateral retinaculum and capsule complex into two layers (coronal z-plasty). This is a right knee with the patient's head on the left side of the figure and the foot on the right side. (Figure on right reproduced, with permission from Elsevier, from: Satish BR, Ganesan JC, Chandran P, Basanagoudar PL, Balachandar D. Efficacy and Mid Term Results of Lateral Parapatellar Approach Without Tibial Tubercle Osteotomy for Primary Total Knee Arthroplasty in Fixed Valgus Knees. J Arthroplasty. 2013 May 20. <http://dx.doi.org/10.1016/j.arth.2013.04.037>.)

Fig. 2-B

Graphic representation of Fig. 2-A. (Reproduced, with permission from Elsevier, from: Satish BR, Ganesan JC, Chandran P, Basanagoudar PL, Balachandar D. Efficacy and Mid Term Results of Lateral Parapatellar Approach Without Tibial Tubercle Osteotomy for Primary Total Knee Arthroplasty in Fixed Valgus Knees. J Arthroplasty. 2013 May 20. <http://dx.doi.org/10.1016/j.arth.2013.04.037>.)

Fig. 2-C

Include the retropatellar fat pad in the lateral retinacular flap.

Fig. 2-D

Release the iliotibial band from the Gerdy tubercle.

Fig. 3-A

Expose the knee with flexion after the quadriceps snip (arrow) and patellar eversion.

Fig. 3-B

Release the anterolateral aspect of the capsule adherent to the proximal part of the tibia. Note the release of the iliotibial band from the Gerdy tubercle and inclusion of the fat pad with part of the lateral meniscus in the lateral flap.

Fig. 3-C

Subluxate the tibia forward by hyperflexing the knee and internally rotating the leg.

Fig. 4-A

Make the proximal tibial cut perpendicular to the tibial axis. Note the use of a left-sided cutting block for the lateral parapatellar approach to the right knee.

Fig. 4-B

Make a distal femoral cut in 3° to 5° of valgus in relation to the anatomical axis. The cutting block may not touch the lateral femoral condyle, and there is minimal or no removal of bone from the lateral condyle.

Fig. 5

Perform extension gap balancing with the block.

Fig. 6-A

Place the proper size femoral 4-in-1 cutting block after confirming rotation. Align the posterior margin of the block parallel to the proximal tibial cut surface.

Fig. 6-B

Perform flexion gap balancing with the block.

Fig. 7-A

Align the tibial rotation with the trial femoral component and ankle center using an external alignment rod.

Fig. 7-B

Fix the original components and reduce the joint.

Fig. 7-C

Assess the patellar tracking and the quadriceps snip repair. Note the exceptionally good patellar tracking on this image.

Fig. 7-D

The quadriceps snip repair and good patellar tracking in another knee with the superficial retinacular layer attached to the lateral border of the patella.

Fig. 8-A

Flex the knee 70° to 90° to start the joint closure.

Fig. 8-B

Identify the previously separated coronal z-plasty layers of the lateral reticulum and capsular complex.

Fig. 8-C

Suture the free margins of the z-plasty layers.

Fig. 8-D

Depending on the “defect” on the lateral side, suture the free edges or overlap the edges of the z-plasty layers.

Fig. 8-E

Note the “lateral expansion” area at the completion of the z-plasty closure.

Fig. 8-F

In knees with a mild deformity, suture the proximal lateral tibial sleeve to the patellar tendon.

Fig. 8-G

In knees with a severe deformity, use the lateral fat pad to close the proximal-lateral tibial area. The white asterisks indicate the area of “lateral expansion.” (Reproduced, with permission from Elsevier, from: Satish BR, Ganesan JC, Chandran P, Basanagoudar PL, Balachandar D. Efficacy and Mid Term Results of Lateral Parapatellar Approach Without Tibial Tubercle Osteotomy for Primary Total Knee Arthroplasty in Fixed Valgus Knees. *J Arthroplasty*. 2013 May 20. <http://dx.doi.org/10.1016/j.arth.2013.04.037>.)

Fig. 9-A

Preoperative clinical photograph and anteroposterior radiograph of a patient with “windblown” knees. The defect is seen on the lateral tibial condyle of the left valgus knee. (Reproduced, with permission from Elsevier, from: Satish BR, Ganesan JC, Chandran P, Basanagoudar PL, Balachandar D. Efficacy and Mid Term Results of Lateral Parapatellar Approach Without Tibial Tubercle Osteotomy for Primary Total Knee Arthroplasty in Fixed Valgus Knees. *J Arthroplasty*. 2013 May 20. <http://dx.doi.org/10.1016/j.arth.2013.04.037>.)

Fig. 9-B

Intraoperative photographs showing a peripheral defect on the posterior aspect of the lateral tibial condyle, which was reconstructed with bone graft and screws. (Reproduced, with permission from Elsevier, from: Satish BR, Ganesan JC, Chandran P, Basanagoudar PL, Balachandar D. Efficacy and Mid Term Results of Lateral Parapatellar Approach Without Tibial Tubercle Osteotomy for Primary Total Knee Arthroplasty in Fixed Valgus Knees. *J Arthroplasty*. 2013 May 20. <http://dx.doi.org/10.1016/j.arth.2013.04.037>.)

Fig. 9-C

Postoperative clinical photograph and anteroposterior radiograph made five years after a right total knee arthroplasty was performed with a medial arthrotomy and a left total knee arthroplasty was performed through a lateral approach. The graft incorporated well with maintenance of femorotibial alignment. (Reproduced, with permission from Elsevier, from: Satish BR, Ganesan JC, Chandran P, Basanagoudar PL, Balachandar D. Efficacy and Mid Term Results of Lateral Parapatellar Approach Without Tibial Tubercle Osteotomy for Primary Total Knee Arthroplasty in Fixed Valgus Knees. *J Arthroplasty*. 2013 May 20. <http://dx.doi.org/10.1016/j.arth.2013.04.037>.)

Fig. 10-A

Anteroposterior radiograph, made with the patient in a lying position, and preoperative clinical photograph, made with the patient standing, showing severe dysplastic valgus deformity of both knees. (Reproduced, with permission from Elsevier, from: Satish BR, Ganesan JC, Chandran P, Basanagoudar PL, Balachandar D. Efficacy and Mid Term Results of Lateral Parapatellar Approach Without Tibial Tubercle Osteotomy for Primary Total Knee Arthroplasty in Fixed Valgus Knees. J Arthroplasty. 2013 May 20. <http://dx.doi.org/10.1016/j.arth.2013.04.037>.)

Fig. 10-B

Preoperative clinical photograph of the patient lying supine. The deformity measured 60° on the right side and 55° on the left side. (Reproduced, with permission from Elsevier, from: Satish BR, Ganesan JC, Chandran P, Basanagoudar PL, Balachandar D. Efficacy and Mid Term Results of Lateral Parapatellar Approach Without Tibial Tubercle Osteotomy for Primary Total Knee Arthroplasty in Fixed Valgus Knees. J Arthroplasty. 2013 May 20. <http://dx.doi.org/10.1016/j.arth.2013.04.037>.)

Fig. 10-C

Postoperative clinical photograph and anteroposterior radiograph made 3.4 years postoperatively. (Reproduced, with permission from Elsevier, from: Satish BR, Ganesan JC, Chandran P, Basanagoudar PL, Balachandar D. Efficacy and Mid Term Results of Lateral Parapatellar Approach Without Tibial Tubercle Osteotomy for Primary Total Knee Arthroplasty in Fixed Valgus Knees. J Arthroplasty. 2013 May 20. <http://dx.doi.org/10.1016/j.arth.2013.04.037>.)

Fig. 10-D

Axial view of both knees showing good patellar tracking. (Reproduced, with permission from Elsevier, from: Satish BR, Ganesan JC, Chandran P, Basanagoudar PL, Balachandar D. Efficacy and Mid Term Results of Lateral Parapatellar Approach Without Tibial Tubercle Osteotomy for Primary Total Knee Arthroplasty in Fixed Valgus Knees. J Arthroplasty. 2013 May 20. <http://dx.doi.org/10.1016/j.arth.2013.04.037>.)

Fig. 11

Attachment of the tendon of the popliteus just proximal to the lateral femoral condylar articular surface.

Fig. 1

Fig. 2-A

Fig. 2-B

Fig. 2-C

Fig. 2-D

Fig. 3-A

Fig. 3-B

Fig. 3-C

Fig. 4-A

Fig. 4-B

Fig. 5

Fig. 6-A

Fig. 6-B

Fig. 7-A

Fig. 7-B

Fig. 7-C

Fig. 7-D

Fig. 8-A

Fig. 8-B

Fig. 8-C

Fig. 8-D

Fig. 8-E

Fig. 8-F

Fig. 8-G

Fig. 9-A

Fig. 9-B

Fig. 9-C

Fig. 10-A

Fig. 10-B

Fig. 10-C

Fig. 10-D

Fig. 11