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ORIGINAL PAPER

Equivalent results of medial and lateral parapatellar approach for total knee arthroplasty in mild valgus deformities

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Abstract
Purpose When performing total knee arthroplasty (TKA) in valgus knee deformities, a medial or lateral parapatellar approach can be performed, but the lateral approach is often considered technically more difficult. The purpose of this study was to compare intra-operative, early clinical and radiological outcomes of medial and lateral parapatellar approaches for TKA in the setting of moderate knee valgus (<10°).
Methods We prospectively analysed 424 knees with pre-operative valgus deformity between 3° and 10° that underwent TKA over an 18-year period; 109 were treated with a medial approach and 315 with a lateral approach. Intra- and post-operative outcomes and complication rates after a minimum follow-up of one year were compared.
Results Tourniquet (p=0.25) and surgical (p=0.62) time were similar between groups. The popliteus tendon was released more frequently in the medial-approach group (p=0.04), while the iliotibial band was released more frequently in the lateral-approach group (p<0.001). A tibial tuberosity osteotomy was performed more frequently in the lateral- than medial-approach group (p=0.003). No significant differences in limb alignment (p=0.78), or Knee Society Score (KSS) knee (p=0.32) and function (p=0.47) results were noted based on surgical approach, and complication rates were similar between groups (p=0.53).
Conclusions Lateral parapatellar approach is a safe and effective surgical technique for performing TKA in moderately valgus knees. These equivalent early results are encouraging for systematic use of the lateral approach in moderately valgus knees.

Keywords Valgus · Total knee arthroplasty · Lateral approach · Lateral arthrotomy · Tibial tubercle osteotomy

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Introduction

Total knee arthroplasty (TKA) is a well-established procedure and has proven to be durable and effective for treating knee osteoarthritis. The medial parapatellar approach is generally considered the standard for TKA. In the setting of valgus osteoarthritis, it can be challenging to achieve good soft tissue balance during surgery due to contracture of lateral structures (lateral collateral ligament, popliteus tendon, iliotibial band (ITB), posterolateral capsule, lateral patellar retinaculum).

In 1991, Keblish [1] recommended a lateral parapatellar approach for knees with a fixed valgus deformity, as this method provides direct access to lateral structures, facilitating ligament balance. This technique proved to be useful in severe valgus knee deformities, promising direct exposure and release of the contracted lateral soft tissues and improvement of patellar tracking [2–6]. However, for many orthopaedic surgeons, the lateral approach is less familiar, and there are concerns regarding the ease of exposure and tissue coverage for closure. We began using the lateral approach in valgus knees in the early 1990s and now use it on a regular basis. To our knowledge, there is no study comparing medial and lateral parapatellar approaches in moderately valgus knees (<10°).

The purpose of this single-centre study was to compare surgical factors and short-term clinical and radiographic outcomes of the medial and lateral approach for TKA in knees with moderate valgus (<10°). We hypothesised that the lateral approach would result in similar complication risk and outcomes to the medial parapatellar approach and could be systematically used in moderately valgus knee deformities.

Materials and methods

Patients and data collection

A review of a prospectively collected knee arthroplasty registry identified 2998 patients who underwent TKA between 1993 and 2011; 424 had a pre-operative hip-knee-ankle (HKA) angle between 183 and 190°, corresponding to a valgus deformity between 3 and 10°. These patients were classified based on whether they underwent TKA via a medial (109) or lateral (315) parapatellar approach.During prospective data collection, pre-operative patient demographics, knee range of motion (ROM), Knee Society Scores (KSS) [7] and radiographic assessment were performed. Radiographic assessment included standing anteroposterior (AP) and lateral views of the knee, a 30° axial patellar view and standing full-leg films. HKA angle, tibial mechanical angle (TMA) and femoral mechanical angle (FMA) were manually measured on full-leg films using a goniometer. Patellar height was assessed by calculating the Blackburne-Peel Index on lateral radiographs. Figures 1 and 2 show pre- and postoperative radiographs.

A total of 327 patients (77.1 %) were available for follow-up at a mean of 3.4 years (range, 2.8–9.3 years) following TKA, including 238 patients (75.6 %) from the lateral approach group and 89 (81.6 %) from the medial approach group.

Surgical procedure and rehabilitation

The senior author performed the same surgical technique in all patients. A longitudinal paramedial skin incision was created, with small variations as needed to accommodate prior scars. This incision was placed either medially or laterally, and the corresponding parapatellar approach was used. To facilitate closure at the end of the procedure in the lateral approach, the lateral retinaculum complex was opened into two layers to create a Z-plasty, the fat pad was preserved and kept laterally and sutured to the patellar tendon according to Keblish [1]. In the lateral approach, lateral release was continued posteriorly over Gerdy's tubercle to the posterior edge of the tibial plateau. In cases where exposure was difficult, a tibial tuberosity osteotomy (TTO) was performed at the surgeon's discretion to facilitate exposure. TTO was accomplished with an oscillating saw according to Whiteside [8]. In a lateral approach, the bone fragment was elevated and medially displaced, the patella was subluxed and the medial periosteum was left intact to maintain the blood supply needed for osteotomy consolidation. After prosthesis implantation, the fragment was fixed with two 4.5-mm cortical screws. A posterior-stabilised, tri-compartmental TKA (Tornier, Saint Ismier, France) was used in all cases. The patella was always resurfaced. Intra-operative findings, including surgical time, tourniquet time, the need for additional releases to facilitate ligament balancing and any intra-operative complications were recorded. A standard post-operative physical therapy regimen was initiated following surgery focusing on controlling pain and oedema and restoring motion and strength, with a minimum one year follow-up.

Outcome assessment

Any peri-operative or early post-operative knee complications, including fracture, skin necrosis and infection, were noted and recorded. Post-operative ROM, KSS knee and function scores and radiographic data were obtained post-operatively. Radiographic assessment included AP, lateral, patellar, and long-leg films. HKA angle alignment, femoral and tibial mechanical axes and the Blackburne-Peel Index were recorded, as was done pre-operatively.

Pre-operative findings

Characteristics of patients in both medial and lateral parapatellar approach groups were similar pre-operatively. The lateral approach group was slightly older and had slightly higher weight and body mass index (BMI) than the medial approach group and had slightly higher KSS (~5 points). This group exhibited ~1° greater valgus than the medial group. While statistically significant, none of these differences were clinically significant. There were no differences in sex, osteoarthritis grade or history of prior open knee surgery between groups. The lateral approach group did exhibit a significantly higher Blackburne-Peel Index pre-operative (Table 1).

Statistical analysis

Comparisons between categorical variables were performed using Fisher's exact test, normally distributed continuous variables were compared with unpaired *t* test and statistical significance was defined as $p \leq 0.05$.

Fig. 1 Preoperative X-ray of a patient with grade 3 right knee valgus

Results

Intra-operative findings

No significant differences in surgery or tourniquet time were noted between the two approaches (Table 2). Release beyond the knee capsule was performed in significantly more patients in the lateral approach group (35.4 vs. 20.4 %; p=0.006). The additional lateral releases performed to achieve ligament balance also differed between groups, with the ITB most commonly released in the lateral approach (27.3 %) and the popliteus most commonly released in the medial approach (12.0 %).

In the lateral approach group, a TTO was performed more often (20.8 vs 8.0 %; p=0.003) (Table 2), and a TTO was performed more often early in the data-collection period: 69 TTOs in 151 patients from 1993 to 2007 (45 %); it was never performed in the most recent five years of data collection (164 patients from 2007 to 2011) (Table 3).

Outcomes

No significant differences were noted between groups post-operatively in regards to KSS knee or function score, ROM, alignment, patellar height and peri-operative complications. The medial approach group had longer mean follow-up (5.1 vs 2.8 years) (Table 4).

Discussion

The primary finding of this study was that both the medial and lateral parapatellar approaches resulted in good results following TKA in knees with mild valgus, with no differences in complication risk. Achieving a balanced knee may be more difficult in cases of valgus deformity that in knees with standard varus osteoarthritis, possibly resulting in excessive release of lateral structures [9, 10]. The main theoretical advantage of the lateral approach is better visualisation of these tight

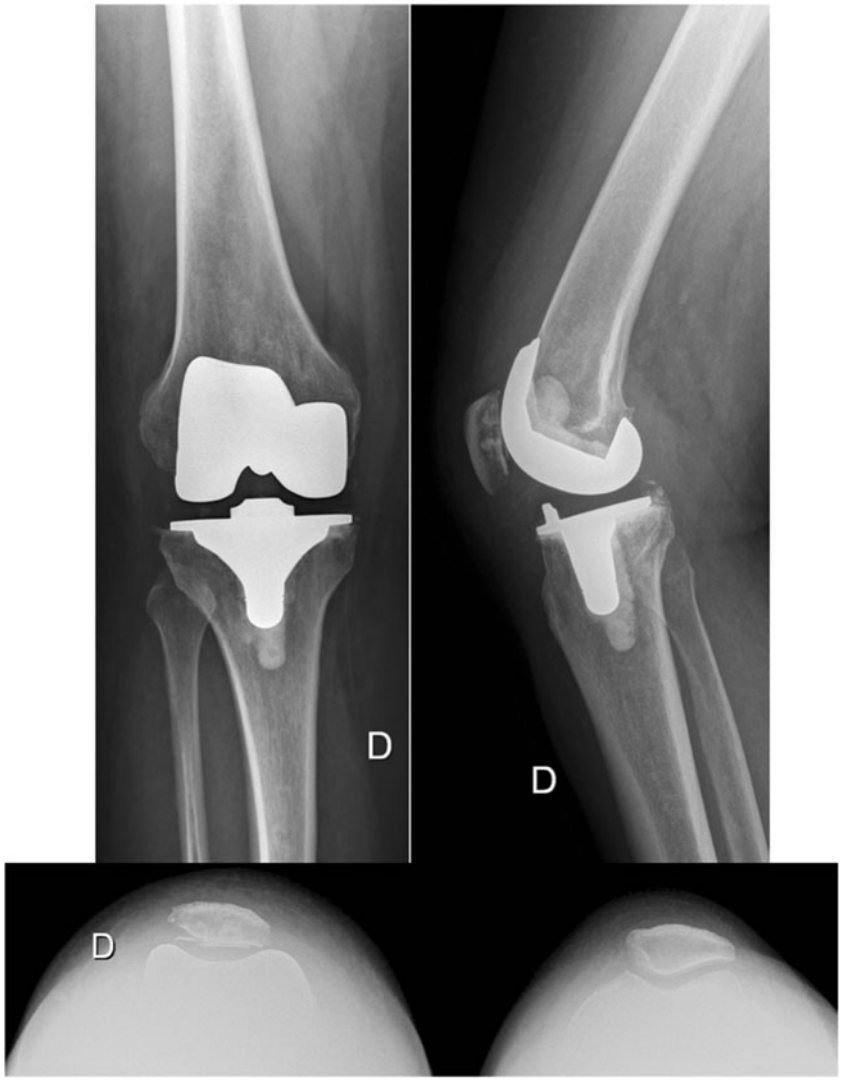

Fig. 2 Postoperative X-ray of the same patient

lateral tissues, as a lateral release technique forms part of the approach. MacAuley et al. [11] observed that revision risk was increased 20 times if both the lateral collateral ligament and popliteus tendon were released during TKA. They recommended preservation of at least one of these structures for long-term implant survival. Satish et al. [12] demonstrated preservation of at least one of these structures in 30 of 32 patients undergoing TKA via a lateral parapatellar approach without TTO. In the subset of patients with moderate knee valgus (<15°) in their series, the release of tight lateral structures comprised only the ITB in all 13 cases. In our study, the popliteus tendon was released significantly more often in the medial approach, while ITB was significantly more often released in the lateral approach.

In his series of 48 TKAs performed using either approach, Sekiya et al. [9] found a tendency towards fewer release procedures in the lateral approach group (two release procedure per knee in the medial group and 1.5 per knee in the lateral group; $p=0.14$). This finding suggests that additional extensive lateral release is often unnecessary to obtain good ligament balancing via the lateral approach, as lateral arthrotomy is enough in most cases.

A further advantage of the lateral approach is the avoidance of a medial retinacular release. As a lateral retinacular release is sometimes necessary in cases of valgus deformity, the performance of both medial and lateral patellar releases is not desirable due to concern of patellar devascularisation [3, 13, 14].

Previous work by Sekiya et al. in a group of patients randomised to TKA via either a medial or lateral approach demonstrated decreased post-operative flexion (109°) in the medial group versus 124° in the lateral group ($p<0.001$) [9]. In our study, we noted no difference in post-operative ROM based on surgical approach. The different results in ur study may be due to lower mean pre-operative valgus deformity (6°) compared with Sekiya et al. (13.7°).

Patellofemoral instability is a common cause of post-operative pain and functional limitations in TKA, which

Table 1 Patient demographic and pre-operative data

	Lateral approach (n=315)	Medial approach (n=109)	Significance
Age (years)	70.9±9.4	68.1±11.2	p=0.020
Sex			
Male	60 (19.1 %)	24 (22.0 %)	p=0.49
Female	255 (80.9 %)	85 (78.0 %)	
Weight (kg)	74.9±12.7	71.2±16.3	p=0.029
BMI (kg/m^2)	27.6±4.3	26.4±5.2	p=0.030
Prior open knee surgery	51 (16.2 %)	15 (13.8 %)	p=0.33
OA grade			p=0.45
Grade 1	5 (2.0 %)	2 (3.4 %)	
Grade 2	68 (27.2 %)	21 (35.6 %)	
Grade 3	122 (49.2 %)	24 (40.7 %)	
Grade 4	53 (21.4 %)	12 (20.3 %)	
KSS–knee	51.8±15.6	47.1±18.2	p=0.017
KSS–function	57.4±18.7	52.1±20.7	p=0.019
Flexion contracture ≥5°	100 (31.7 %)	39 (35.8 %)	p=0.48
Alignment			
HKAA (°)	186.6±2.3	185.4±2.3	p<0.0001
FMA (°)	93.7±3.0	93.1±3.4	p=0.10
TMA (°)	90.4±2.8	89.4±3.4	p=0.0064
Blakburne-Peel Index	0.84±0.23	0.77±0.17	p=0.001

BMI body mass index, *OA* osteoarthritis, *KSS* Knee Society Score, *HKAA* hip-knee-ankle angle, *FMA* femoral mechanical angle, *TMA* tibial mechanical angle

may lead to revision surgery [15, 16]. The lateral approach may also result in improved patellar tracking in some patients following TKA [5, 6, 10]. Hay et al. [6] compared a medial parapatellar approach and a lateral subvastus approach with a TTO and found a significantly greater incidence of lateral patellar subluxation in the medial group (3 of 12) compared with the lateral group (0 of 16) (p=0.034). The authors recommended considering a lateral approach in patients in whom problems with patella tracking were anticipated. Similarly, in patients with large valgus deformities, the lateral approach may be more efficient in restoring alignment [2, 17]. Apostolopoulos et al. showed that the lateral approach combined with TTO was beneficial to restore a better mechanical

Table 2 Intra-operative data

	Lateral approach (n=315)	Medial approach (n=109)	Significance
Surgical time (min)	90.5±23.8	89.3±21.1	p=0.62
Tourniquet time (min)	78.4±20.4	76.1±17.1	p=0.25
Lateral release needed			
None or capsule only	204 (64.6 %)	86 (79.6 %)	p=0.006
Popliteus	12 (3.8 %)	13 (12.0 %)	p=0.004
IT band	86 (27.3 %)	3 (2.8 %)	p<0.0001
Osteotomy of LFC	1 (0.3 %)	1 (0.9 %)	p=1.0
Other	12 (4.1 %)	6 (5.5 %)	p=0.42
Tibial tuberosity osteotomy	65 (20.8 %)	9 (8.0 %)	p=0.003

IT iliotibial, *LFC* lateral femoral condyle

Table 3 Number of tibial tubercle osteotomies (TTOs) performed in the lateral approach group by year

Year	No. cases	No. TTO
1993	2	0
1995	4	0
1996	1	0
1997	4	0
1998	5	1 (20 %)
1999	11	7 (63 %)
2000	16	13 (81 %)
2001	13	10 (76 %)
2002	14	11 (78 %)
2003	9	5 (55 %)
2004	20	7 (35 %)
2005	25	7 (28 %)
2006	27	5 (18 %)
2007	33	0
2008	32	0
2009	22	0
2010	36	0
2011	41	0
Total	315	65 (20.8%)

Table 4 Comparison of post-operative variables in medial- and lateral approach group

	Lateral approach (n=238)	Medial approach (n=89)	Significance
Follow-up (years)	2.8±3.4	5.1±4.2	p<0.0001
KSS–knee	88.8±13.7	86.9±15.7	p=0.32
KSS–function	74.3±24.6	72.1±24.8	p=0.47
Flexion contracture ≥5°	9 (3.8 %)	8 (9.0 %)	p=0.09
Alignment			
HKAA (°)	180.7±2.9	180.8±2.8	p=0.78
FMA (°)	90.3±1.8	90.5±2.0	p=0.41
TMA (°)	90.4±1.9	90.1±1.2	p=0.09
Blackburne-Peel Index	0.64±0.22	0.62±0.21	p=0.45
Complications			p=0.53
Fracture	5 (1.5 %)	3 (2.8 %)	
Skin necrosis	2 (0.6 %)	1 (0.9 %)	
Infection	3 (0.9 %)	3 (2.8 %)	

TTO tibial tuberosity osteotomy, *KSS* Knee Society Score, *HKAA* hip-knee-ankle angle, *FMA* femoral mechanical angle, *TMA* tibial mechanical angle

axis in patients with considerable valgus deviation (15–36°; mean 24°) [2]. In our series, there was no difference in post-operative mechanical axis between groups, which is consistent with Sekiya et al. [9], who found no difference in post-operative mechanical axis based on surgical approach.

In our study, the rate of complications was equivalent in the two groups (p=0.53); in particular, the risk of skin necrosis and infection did not increase in the lateral group. Factors like equivalent surgical time and facilitated closure were favourable; arthrotomy could always be sutured facilitated by fat-pad preservation and z-plasty of the lateral retinaculum. TTO was performed in 66 cases in the lateral group (20.8 %) and nine in the medial group (8 %), mostly in the early part of this series (before 2007). The decision to perform a TTO was determined pre-operatively based on the expectation that it would be necessary for adequate visualisation in many patients. As time passed, the TTO rate decreased, and this pocedure was never performed in the latter five years of the study (164 patients from 2007 to 2011), as it became clear that adequate exposure could be achieved without osteotomy, as suggested by Keblish and others [12, 18, 19]. These results are consistent with Fiddian et al. [19], who could rotate the patella without TTO in 27 patients who underwent TKA in valgus knees. As a result of our experience, we perform TTO during the intervention when exposure is not sufficient with a large and complete soft tissue release.

Many authors are unfamiliar with using the lateral approach, which is considered technically more difficult than the medial approach. This is due to the presumed necessity of performing a TTO, the anticipated difficulty in lateral soft tissue closure and increased surgical time. We found no difference in surgical or tourniquet time between approaches, confirming that using the lateral approach for a valgus knee is safe and efficient. Further, there was no difference in complication risk despite the more frequent performance of TTOs in the lateral group; recent reports describe complication rates of 3–8 % in patients undergoing TTO [5, 20, 21]. [22]. In 2008, Piedade et al. [23] investigated the influence of TTO on TKA complications in 1474 patients. Over a two year follow-up, they noted no statistically significant difference in the number of revisions when a TTO was performed, although they did note an increased risk of skin necrosis. In our study, the greater number of TTOs performed in the lateral group was not associated with a greater number of complications, even for skin necrosis. This difference may be due to a lower incidence of significant valgus (>7°; 6 %) versus the series reported by Piedade et al. (60 %).

To our knowledge, our series is the first to compare medial and lateral approaches in moderately valgus knees (HKA<190°). Equivalent early results are encouraging for the routine use of the lateral approach, as the TTO rate reduced over time. Limitations of the study include the relatively short follow-up and study design, which did not randomise patients to the different groups, potentially leading to additional unknown differences between cohorts that may have affected results.

Conclusion

The lateral parapatellar approach is an effective, reproducible and efficient method for performing TKA in the setting of moderate knee valgus. Functional and radiological results are comparable with the classic medial parapatellar approach, with no increase in operative time or complication risk.

References

1. Keblish PA (1991) Surgical Technique and Analysis of 53 Cases With Over Two-Year Follow-Up Evaluation. Clin Orthop Relat Res 271:52
2. Apostolopoulos AP, Nikolopoulos DD, Polyzois I et al (2010) Total knee arthroplasty in severe valgus deformity: interest of combining a lateral approach with a tibial tubercle osteotomy. Orthop Traumatol Surg Res 96:777–784. doi:10.1016/j.otsr.2010.06.008
3. Burki H, von Knock M, Heiss C et al (1999) Lateral Approach With Osteotomy of the Tibial Tubercle in Primary Total Knee Arthroplasty. Clin Orthop Relat Res 362:156
4. Hirschmann MT, Hoffmann M, Krause R et al (2010) Anterolateral approach with tibial tubercle osteotomy versus standard medial approach for primary total knee arthroplasty: does it matter? BMC Musculoskelet Disord 11:167. doi:10.1186/1471-2474-11-167
5. Chalidis BE, Ye K, Sachinis NP et al (2014) Lateral parapatellar approach with tibial tubercle osteotomy for the treatment of non-correctable valgus knee osteoarthritis. Knee 21:204–208. doi:10.1016/j.knee.2013.05.008
6. Hay GCG, Kampshoff JJ, Kuster MSM (2010) Lateral subvastus approach with osteotomy of the tibial tubercle for total knee replacement: a two-year prospective, randomised, blinded controlled trial. J Bone Joint Surg (Br) 92:862–866. doi:10.1302/0301-620X.92B6.24027
7. Insall JN, Dorr LD, Scott RD, Scott WN (1989) Rationale of the Knee Society clinical rating system. Clin Orthop Relat Res
8. Whiteside LA (1995) Exposure in difficult total knee arthroplasty using tibial tubercle osteotomy. Clin Orthop Relat Res 32–35
9. Sekiya H, Takatoku K, Takada H et al (2014) Lateral approach is advantageous in total knee arthroplasty for valgus deformed knee. Eur J Orthop Surg Traumatol 24:111–115. doi:10.1007/s00590-012-1137-2
10. Rossi R, Rosso F, Cottino U et al (2014) Total knee arthroplasty in the valgus knee. Int Orthopaedics (SICOT) 38:273–283. doi:10.1007/s00264-013-2227-4
11. McAuley JP, Collier MB, Hamilton WG et al (2008) Posterior cruciate-retaining total knee arthroplasty for valgus osteoarthritis. Clin Orthop Relat Res 466:2644–2649. doi:10.1007/s11999-008-0436-8
12. Satish BRJ, Ganesan JC, Chandran P et al (2013) Efficacy and Mid Term Results of Lateral Parapatellar Approach Without Tibial Tubercle Osteotomy for Primary Total Knee Arthroplasty in Fixed Valgus Knees. J Arthroplasty 28:1751–1756. doi:10.1016/j.arth.2013.04.037

13. Kayler DE, Lyttle D (1988) Surgical interruption of patellar blood supply by total knee arthroplasty. Clin Orthop Relat Res 229:221–227
14. Wetzner SM, Bezreh JS, Scott RD et al (1985) Bone scanning in the assessment of patellar viability following knee replacement. Clin Orthop Relat Res 215–219
15. Petersen W, Rembitzki IV, Brüggemann G-P et al (2014) Anterior knee pain after total knee arthroplasty: a narrative review. Int Orthop (SICOT) 38:319–328. doi:10.1007/s00264-013-2081-4
16. Malo M, Vince KG (2003) The unstable patella after total knee arthroplasty: etiology, prevention, and management. J Am Acad Orthop Surg 11:364–371
17. Nikolopoulos DD, Polyzois I, Apostolopoulos AP et al (2011) 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 19:1834–1842. doi:10.1007/s00167-011-1474-4
18. Keblish PA (2002) The Lateral Approach. Surgical Techniques in Total Knee Arthroplasty 137–148. doi: 10.1007/0-387-21714-2_18
19. Fiddian NJ, Blakeway C, Kumar A (1998) Replacement arthroplasty of the valgus knee. A modified lateral capsular approach with repositioning of vastus lateralis. J Bone Joint Surg Br 80:859–861
20. Wishart M, Arnold MP, Huegli RW et al (2012) Anterolateral approach using tibial tubercle osteotomy for total knee arthroplasty: can we predict failure? Int Orthop (SICOT) 36:2485–2490. doi:10.1007/s00264-012-1693-4
21. Zonnenberg CBL, Lisowski LA, van den Bekerom MPJ, Nolte PA (2010) Tuberositas osteotomy for total knee arthroplasty: a review of the literature. J Knee Surg 23:121–129
22. Young CF, Bourne RB, Rorabeck CH (2008) Tibial Tubercle Osteotomy in Total Knee Arthroplasty Surgery. J Arthroplast 23:371–375. doi:10.1016/j.arth.2007.02.019
23. Piedade SR, Pinaroli A, Servien E, Neyret P (2008) Tibial tubercle osteotomy in primary total knee arthroplasty: A safe procedure or not? Knee 15:439–446. doi:10.1016/j.knee.2008.06.006