Total Knee Arthroplasty for Treatment of Osteoarthritis of The Knee with Fixed Flexion Deformity

Mohamed A Khalil*, Elsayed M. Ibrahim, Elsayed M Bayomy
Orthopedic surgery of the Department, Faculty of Medicine, Benha University, Benha, Egypt
***Corresponding Author:** Mohamed A Khalil, **Phone number:** +20 120 335 6213, **Email:** m.abdelghany88@yahoo.com

ABSTRACT

Background: Fixed flexion deformity (FFD) caused by osteoarthritis is primarily caused by the rigidity and tethering of posterior soft tissues, particularly the posterior capsule. This results in functional, biomechanical, and gait limitations, affecting patients' ability to perform daily activities and satisfaction after total knee replacement (TKR). Correcting FFD is crucial during TKR to improve postoperative outcomes. Knee surgeons use various surgical corrective measures, but there is no universally accepted approach.

Objective: This study aimed to assess and achieve an effective repair as a sequential stepwise strategy focusing on soft tissue incisions is recommended over bone cuts.

Methods: The study involved 21 patients with 23 knees, treated at Benha University Hospitals.

Results: The postoperative knee clinical score ranged from 66-93, with a mean of 78.87, and the mean functional knee score was 78.70. The total knee score, including both clinical and functional scores, was 157.22, ranging from 121-173.

Conclusion: The stepwise approach for addressing fixed flexion contracture in osteoarthritic knees during total knee replacement has shown significant efficacy in correcting deformity, enhancing postoperative patient satisfaction, and achieving superior clinical outcomes.

Keywords: FFD, Osteoarthritis deformity, Correction, TKR.

INTRODUCTION

Knee flexion deformity is a condition where the knee cannot fully extend to 0°, resulting from factors like ligament contracture, bone impingement, and posterior capsular contracture [1]. It is caused by synovial inflammation in osteoarthritis, leading to fluid accumulation and chronic conditions. Persistent flexion deformity evolves as the posterior capsule expands and contracts. A comprehensive physiotherapy regimen is essential to address this condition. Total knee replacement is a successful therapeutic approach for end-stage osteoarthritis [2].

Patients and methods

Inclusion Criteria: The study involved 35 patients aged 60-80 years with knee osteoarthritis, presenting with fixed flexion deformity exceeding 15 degrees.

Exclusion Criteria: Participants with neoplastic lesion, osteomyelitis, infective knee disease, and previous knee surgeries were excluded.

Ethical considerations: An informed written consent was obtained from every patient. The study was done after approval from The Ethical Committee Benha University Hospitals (approval code: Ms 9-3-2022) between March 2022 and December 2022. The Helsinki Declaration was followed throughout the study's conduct.

Statistical analysis

Statistical analysis was done by SPSS v28 (IBM Inc., Armonk, NY, USA). Quantitative variables were presented as mean and standard deviation (SD). Qualitative variables were presented as frequency and percentage (%). Pearson or spearman correlation coefficient (r) was used for detection of correlation between two quantitative variables in one group.

RESULTS

There was a statistical relationship between preoperative and postoperative KSS scores (P value = 0.001). Meaning that in all cases included in the study, the postoperative clinical and functional KSS score was better. **(Table 1).**

Table 1: Statistical analysis of interpretation preoperative and postoperative KSS score.

		Mean ± S. D		P. value
Knee score	**pre**	21.39 ± 16.82		0.001*
	post	78.87 ±5.79		
Function score	**pre**	36.48 ± 14.39		0.001*
	post	78.70 ±9.20		
Total score	**pre**	58.30 ±25.42		0.001*
	post	157.22± 13.19		
Grading		**Pre**	**Post**	
Poor	**N**	23	0	**0.001***
	%	100.0%	.0%	
Fair	**N**	0	1	
	%	.0%	4.3%	
Good	**N**	0	11	
	%	.0%	47.8%	
Excellent	**N**	0	11	
	%	.0%	47.8%	

Data are presented as mean ± SD and number (%)

Out of twenty-one patients, nine patients (39.1%) needed blood transfusion of one unit of packed RBCs. One knee only needed one step (4.3%), fourteen knees needed two steps (60.9%), four knees needed three steps (17,4%), and four knees needed four steps (17.4%).

Received:19/09/2023
Accepted:19/11/2023

About two thirds of the cases needed only one or two steps which are osteophytes removal and posterior capsular release. **(Table 2).**

Table 2: Number of patients needed or not blood transfusion and Number of steps needed for correct flexion deformity.

	N	%
Need for blood transfusion	9	39.1
Number of steps		
One (Osteophytes removal)	1	4.3
Two (Capsular release)	14	60.9
Three (Capsulotomy)	4	17.4
Four (Increase distal femoral cut)	4	17.4
Total	23	100

Data are presented as number (%)

There was positive statistical relationship between Preoperative Flexion contracture degree and Number of steps needed to correct this flexion intraoperatively (P value=0.001), that means the higher the degree of flexion contracture, the more steps are needed. There was no statistical relation between the age of the patients and postoperative clinical KSS score (P value = 0.559), or functional KSS score (P value-0.4), or the total score (P value =0.327). **(Table 3).**

Table 3: Statistical relationship between preoperative flexion degree and number of steps needed and Age and postoperative KSS: EV M

Preoperative degree of flexion deformity	**Number of steps**	
	R	**P**
	0.601	0.001*
Age		
Knee score	-0.128	0.559
Function score	-0.184	0.400
Total score	-0.214	0.327

R: correlation coefficient. *: significant P value.

There was negative statistical relationship between body mass index of patients and both the function knee score (P value= 0.001) and the total KSS score (P value=0.039), high BMI is associated with decrease in the functional KSS and total knee society score. (Table XXII) (Fig. 108). There was no statistical relation between the age of the patients and postoperative clinical KSS score (P value = 0.493), or functional KSS score (P value-0.758), or the total score (P value =0.684). There was negative statistical relationship between preoperative flexion degree of patients and both the clinical knee score (P value=0.024) and the total KSS score (P value=0.031), this means that increased preoperative flexion degree is associated with decrease in the postoperative clinical KSS and total knee society score. **(Table 4).**

Table 4: Statistical relation between BMI and postoperative clinical andfunctional KSS score and preoperative flexion contracture degree and postoperative KSS score.

	R	P
BMI		
Knee score	-0.009	0.967
Function score	-0.548	0.001*
Preoperative FFD		
Knee score	-0.470	0.024*
Function score	-0.271	0.211

R: correlation coefficient. *: significant P value.

In this study, twenty-two knees had coexistent varus deformity of knee (95.65%), whereas one knee had coexistent valgus deformity (4.35%). The coexistent varus degree ranged from four to twenty degrees, whereas the only knee with valgus deformity had ten degrees of valgus.

There was no statistical relationship between the preoperative coexistent coronal plane deformity degree and postoperative knee score (P value=0.785), or function score (P value=0.997), or the total score which is the sum of both scores (P value=0.771). **(Table 5).**

Table 5: Relationship between the preoperative coexistent coronal plane deformity degree and postoperative KSS.

Coexistent coronal plane deformity	**R**	**P**
Knee score	-0.060	0.785
Function score	0.001	0.997
Total score	-0.064	0.771

R: correlation coefficient.

There was no statistical relation between coexistent medical problems in the patients and postoperative clinical KSS score (P value = 0.258), or functional KSS score (P value-0.323), or the total score (P value=0.885). There was no residual deformity in twenty knees (86.95%), whereas only three knees had residual deformities (13.05%). There was no statistical relation between any residual postoperative deformity and postoperative clinical KSS score (P value = 0.070), or functional KSS score (P value=0.204), or the total score (P value=0.736). **(Table 6).**

Table 6: Relation between coexistent medical problems in the patients, any residual postoperative deformity and postoperative clinical KSS score

Comorbidity	**Mean ± S.D**	**P-value**
Coexistent medical problems in the patients		
Knee Score	76.92±2.64	0.258
Function Score	80.42±7.53	0.323
Any residual postoperative deformity		
Knee Score	**83.00±6.82**	**0.070**
Function score	**74.00±8.22**	**0 .204**

Data are presented as mean ± SD.

There was a positive statistical relation between the presence of postoperative complication and postoperative clinical KSS score (P value = 0.035), functional KSS score (P value=0.047), and the total score (P value =0.017). **(Table 7)**

Table 7: Relation between presence of complications and KSS score.

Complications	Mean ± S. D	P. value
Knee score	74.67±4.84	0.035*
Function score	73.33± 10.80	0.047*

Data are presented as mean ± SD. *: significant P value.

DISCUSSION

Total knee arthroplasty is the gold standard surgical procedure for treating advanced stages of knee osteoarthritis. Biomechanical breakdown, accelerated by factors like developmental deformities, primary osteoarthrosis, rheumatoid arthritis, and post-traumatic deformities, leads to arthritis [3]. A flexion deformity of the knee results in reduced tibiofemoral contact area, accelerating degeneration. This research aimed to determine the subjective and objective outcomes of knee osteoarthritis treatment with fixed flexion deformity through total knee arthroplasty [4].

Firestone *et al* [5] assessed their results of total knee arthroplasty in fifty-one arthritic knees with more than twenty degrees of flexion contracture underwent TKR using posterior cruciate-retaining prosthesis.

The mean postoperative knee clinical score was 78.87± 5.78 points and the mean postoperative knee functional score was 78.70±9.2 and the mean Total knee score was 157.22 ± 13.19.

The mean preoperative flexion deformity was 16+ 4.65 and improved to be 0.65 degrees which is an amazing improvement.

Similar findings were noted by **Tanzer *et al*** [6]. Their study included 35 knees with less than 30 degrees of preoperative flexioncontracture.

In the current study, it was tried to achieve full correction intraoperatively in all cases, so we did not concentrate on the improvement happened through the period of follow-up in cases of slight residual flexion contracture intraoperatively.

Bakr 's [7] study included increase the distal femoral cut by 2 mm from the start if flexion deformity is moderate, whereas in the current study, it was preferred to delay this step until no full correction achieved by osteophytes removal and capsular lengthening measures.

In the current study, posterior stabilized cruciate substituting prosthesis were used, as PCL retention decreases ability to correct flexion deformity as it limits access to posterior structures. This recommendation of resection of PCL and the use of posterior stabilized prosthesis for correction of mild and moderate FFD was shared by many other authors in previous studies [8].

The proper choice of the implant design for treating moderate to severe flexion and varus knee deformity is also important. **Laskin** [9] reported declined knee motion and shorter survivorship besides increased loosening radiolucency and revision rates, when using cruciate-retaining implants in comparison to cruciate-substituting implants for severe varus deformities at ten years of follow-up. In cases of flexion contracture, the posterior cruciate ligament is considered part of the deformity or at least it should be released to help more correction.

If there is residual deformity, a capsulotomy is performed with caution to achieve the same goal of lengthening and relaxing the posteriorcapsule, four cases in our study needed this step (17.4%). For capsulotomy, two horizontal medial and lateral incisions are made in the posterior capsule, which lead to its lengthening.

Scuderi and Kochar [10] used the same approach for capsulotomy, whereas **Chai and colleagues** [11] used a fusiform shaped capsulotomy and capsolectomy especially with severe FFD, but it is demanding technique with many hazards on posterior neurovascular structures and should be preserved to severe cases. If further correction is needed, we preferred to shift to an easier and effective bony intervention which is increasing the distal femoral cut by 2-4 mm rather than doing more extensive soft tissue releases like hamstrings or biceps tenotomy,four cases needed this step to be corrected (17.4%).

These four steps were enough to correct all flexion deformities completely intraoperatively. Posterior osteophytectomy together with capsular lengthening by release and capsulotomy were the main three measures used to correct flexion deformity in 82.6% of cases, which indicated that soft tissue releases is the key to correct deformities rather than bony intervention that is saved as a reserve. This makes the operative course straighter and more rapid and keeps as much as possible bone stock.

Other advantage to this stepwise approach is that a revisit to the first steps including removal of any posterior osteophytes which become easier to be removed and more release of posterior capsule can be done after completion of femoral cuts which gives the surgeon more reserve options.

If there is residual flexion after the soft tissue releases and increase the distal femoral cut, which can be observed in severe fixed flexion deformities, further correction can be done by upsizing the femoral component [12]. This maintains the extension gap but decreases the flexion gap. The correction needs to be tailored to the deformity and a stepwise release and cut procedure employed to achieve full correction [13].

Any minimal residual flexion deformity may not affect long term functional results. **Cheng et al** [14] demonstrated that patients with a preoperative fixed flexion deformity showed continued improvement in their fixed flexion up to ten years after arthroplasty and

have similar outcomes with no preoperative fixed flexion.

In the current study, there was no need for this step in any case as the cases included in this study had mild to moderate deformity up to 30 degrees. There was a negative statistical relation between the preoperative FFD and the postoperative clinical KSS score, meaning that the more the preoperative flexion degree, the less the postoperative clinical KSS score.

This coincides to some degree with **Menke *et al.*** [15] who examined knee movement following TKR and found that pre-operative extension predicted post-operative extension. That gives us a predictable measure regarding postoperative results and so exhaustion of physiotherapy protocols to decrease the flexion contracture degree preoperative should be considered in higher degrees of FFD. Besides, the attempt of full correction of deformity intraoperatively is important together with the full advantage from postoperative physiotherapy to prevent recurrence of the flexion contracture.

In our study, there was statistical relation between body mass index and postoperative functional KSS score, but not the clinical KSS score, which indicates that the general condition of patient affects the satisfaction after TKR regardless of good technique and clinical improvement. Also, instructing the patients about reduction of body weight is a factor in increasing postoperative satisfaction.

Regarding complications, in our study no deep infection was encountered in any case, we tried as much as possible to decrease the operative time and to use porous saline or betanized saline irrigation as the most effective measure against periprothetic joint infection, together with the use of preoperative antibiotic coverage that is extended postoperatively for at least 48 hours. Two cases only (8.69%) had superficial wound infection that resolved within three weeks of continuous intravenous antibiotics with no need for debridement or any other interventions rather than daily dressing.

One case (4.34%) case had a burst wound from skin to the prosthesis after falling down on his flexed knee three weeks postoperatively. The patient admitted to the hospital and generous irrigation of the wound was done using a saline 0.9% concentration with antibiotic added on. Then, the wound was sutured in layers. None of the previously mentioned complications in this study led to revision of the prosthesis on the short to medium term (up to one year postoperatively).

Meanwhile, the presence of complications affected the postoperative clinical and functional scores negatively. Therefore, avoidance of iatrogenic complications is important for better results.

CONCLUSION

The stepwise approach to addressing osteoarthritic knee fixed flexion contracture during total knee arthroplasty has demonstrated significant efficacy, increased patient satisfaction, and improved clinical outcomes.

REFERENCES

1. **Lombardi A, Mallory T, Adams J, Herrington S (1997)**: A stepwise algorithmic approach to flexion contractures in total knee arthroplasty. J Am Acad Orthop Surg., 1:1-8.
2. **Mullaji A, Shetty G (2016)**: Correcting deformity in total knee arthroplasty: techniques to avoid the release of collateral ligaments in severely deformed knees. Bone Joint J., 98:101-4.
3. **Hoffart H, Dinges H, Kolbeck S, Ritschl P, Hommel H (2015)**: Novel computer-assisted method for revision arthroplasty of the knee. World J Orthop., 6:821-9.
4. **Su E (2012)**: Fixed flexion deformity and total knee arthroplasty. J Bone Joint Surg Br., 94:112-5.
5. **Firestone T, Krackow K, Davis J, Teeny S, Hungerford D (1992)**: The management of fixed flexion contractures during total knee arthroplasty. Clin Orthop Relat Res., 10:221-7.
6. **Tanzer M, Miller J (1989)**: The natural history of flexion contracture in total knee arthroplasty. A prospective study. Clin Orthop Relat Res., 9:129-34.
7. **Bakr H (2016)**: Total knee replacement in severe varus and flexion knee deformities using economical solutions. Egypt J Occup Med., 51:329-32.
8. **Lombardi A, Dodds K, Berend K, Mallory T, Adams J (2004)**: An algorithmic approach to total knee arthroplasty in the valgus knee. J Bone Joint Surg Am., 86:62-71.
9. **Laskin R (1996)**: The Insall Award. Total knee replacement with posterior cruciate ligament retention in patients with a fixed varus deformity. Clin Orthop Relat Res., 6:29-34.
10. **Scuderi G, Kochhar T (2007)**: Management of flexion contracture in total knee arthroplasty. J Arthroplasty, 22:20-4.
11. **Chai W, Chen Q, Zhang Z *et al.* (2021)**: Correcting severe flexion contracture with fusiform capsulectomy of posterior capsule during total knee arthroplasty. Int Orthop., 45:1463-8.
12. **Scuderi G, Meneghini R, Booth R *et al.* (2009)**: Technologic developments in total knee arthroplasty. J Bone Joint Surg Am., 91:49-51.
13. **Berend K, Lombardi A, Adams J (2006)**: Total knee arthroplasty in patients with greater than 20 degrees flexion contracture. Clin Orthop Relat Res., 452:83-7.
14. **Cheng K, Ridley D, Bird J, McLeod G (2010)**: Patients with fixed flexion deformity after total knee arthroplasty do just as well as those without: ten-year prospective data. Int Orthop., 34:663-7.
15. **Menke W, Schmitz B, Salm S (1992)**: Range of motion after total condylar knee arthroplasty. Arch Orthop Trauma Surg., 111:280-1.