Operative procedure for primary TKR: How to increase ROM

Chapter · May 2017

DOI: 10.1007/978-3-662-54082-4_12

3 authors, including:

Samih Tarabichi
Al Zahra Private Hospital
35 PUBLICATIONS **406** CITATIONS

SEE PROFILE

Operative Procedure for Primary TKR: How to Increase ROM

12

Samih Tarabichi, Ahmed El-Naggar, and Mohamed Adi

Contents

12.1 Introduction

Deep knee flexion is a real concern for Middle Eastern and Asian patients undergoing total knee replacement (TKR). Since many daily activities, such as praying, dining, or using the oriental toilet, and many social encounters such as attending the Shaikh's majlis are carried out on the ground [1, 2] (Fig. 12.1). It has been shown that during prayers, people routinely flex the knee between 150 and 165°, 20–30 times each day [3]. Often, patients in these societies tend to refuse TKR because of

S. Tarabichi (✉)
Burjeel Hospital for Advanced Surgery, Dubai, United Arab Emirates
e-mail: samtarabichi@yahoo.com

A. El-Naggar
Dubai Hospital, Dubai, United Arab Emirates

M. Adi
Strasbourg University Hospital, Strasbourg, France

S. Matsuda et al. (eds.), *Soft Tissue Balancing in Total Knee Arthroplasty*,
DOI 10.1007/978-3-662-54082-4_12

Fig. 12.1 Deep knee flexion activities including kneeling, squatting, and sitting cross-legged are considered crucial to people in this region (**a**) His Highness Sheikh Mohamed bin Zayed Al Nahyan and His Majesty King of Bahrain with the royal family during prayer (Wam). (**b**) The founder of United Arab Emirates Sheikh Zayed Bin Sultan Al Nahyan sitting on the floor in his "Majlis," which is part of social activity in our region for receptions and also to address grievances

concerns that the postoperative range of motion (ROM) will be less than adequate for their daily living [4]. Therefore, high ROM post-TKR should be pursued when possible on patients whose daily activities require a higher ROM to enable them to maintain their lifestyles. In fact, high-flexion activities post-TKA are safe and do not increase the complication rate as compared to the other series [5].

12.2 Factors Affecting Knee Flexion

In order to achieve full flexion post-TKR, many factors, in addition to the surgical technique, should be addressed. Some of these factors can be controlled by the surgeon such as the implant design, surgical techniques, postoperative pain management, and rehabilitation. Other factors such as preoperative ROM, patient's body mass index, and patient's physical ability unfortunately cannot be controlled by the surgeon [6].

The implant design has the least direct effect on obtaining full flexion, and the implant is only useful in being more accommodating to full flexion. However, in order to accomplish full flexion in any patient, it's important to remember that pain management and good rehabilitation program and multidisciplinary approach to the patient should be established in the hospital on a solid basis. Aggressive rehabilitation and adequate pain control are important in preventing postoperative contracture of the soft tissue and achieving better flexion [7].

We truly believe that surgical procedure is quite important to improve the ROM after TKR, and in this chapter, we will focus on quadriceps release technique. We still consider preoperative ROM has a great effect on the outcome of the TKR as many of the international studies so far claim that the ROM postoperatively averages the same as preoperatively [8]. However, in our series which are more than 6000 cases, we were able to obtain a better average ROM postoperatively compared to preoperatively. We consider that this is mainly due to the fact that we have performed routinely a modified quadriceps release (Tarabichi's maneuver) in all our patients to increase the ROM intraoperatively [9]. In the literature, no one has discussed before the importance of the quadriceps release in achieving better flexion in TKR. The purpose of this chapter again is to discuss the anterior knee release and how to obtain a better flexion intraoperatively. Nevertheless, always be reminded that the other factors should be met in order to obtain a better ROM.

12.3 Quadriceps Muscle Release (The Forgotten Release)

Quadriceps release has been used by sports medicine in order to increase the ROM. It is normally done through arthroscopy to increase the mobility for patients who suffer from posttraumatic and postsurgical knee stiffness. The stiffness is typically developed after a period of inactivity in the lower limbs [10]. It has been demonstrated that the restriction in ROM of stiff knee is frequently caused by adhesions that tether the distal quadriceps tendon and/or muscle to the bone surface, thereby preventing the quadriceps muscle and tendon from its normal excursion during flexion [11].

We have done analysis of knee movement; on average in order for the knee to bend from 0 to 90°, the quadriceps tendon normally stretches 6 cm which varies depending on femur size; the larger the femur, the more quadriceps stretching is needed to achieve the flexion (Fig. 12.2). The stretching of the quadriceps per 1° of knee flexion is more on the extreme ends of ROM. The quadriceps have to stretch

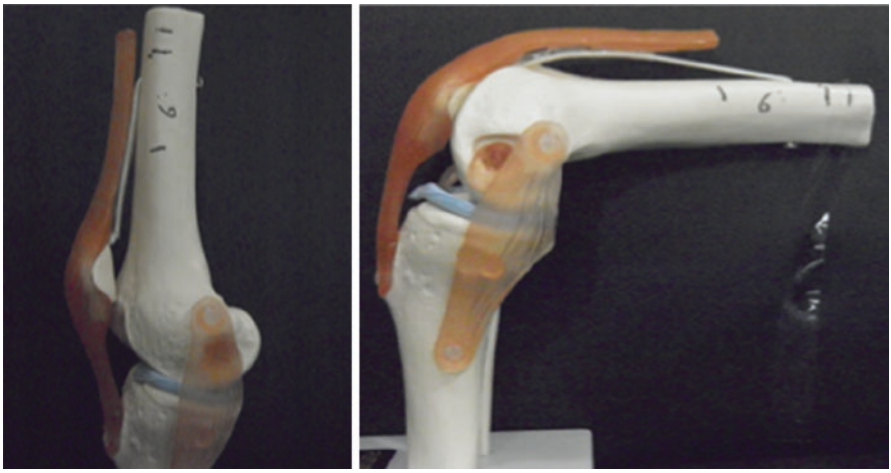


Fig. 12.2 Quadriceps tendon stretches 6 cm on average when the knee bends from 0 to 90°

1.5 cm in order for the knee to bend from 135–155°; the average stretching is 0.7 mm per 1° compared to 0.4 mm per 1° in the ROM of 80–110°.

In our experience, as in the case of posttraumatic stiff knee, the anterior adhesions between the quadriceps muscle and the anterior surface of the femur are the main responsible factors for the restriction of ROM in the stiff arthritic knee. Therefore, we adapted our surgical techniques to address these adhesions and to improve the ROM in all our patients who undergo TKR (Fig. 12.3).

In another study, we performed 42 modified quadriceps muscle releases on patients with advanced osteoarthritis scheduled for TKR. The ROM was documented intraoperatively both before and immediately after the release. Passive flexion improved significantly in all patients (mean, 32.4° of improvement, *P*: 0.001) following a modified quadriceps release only, before doing any ligamentous release and excision of posterior osteophytes [9]. These results strongly suggest that adhesions of the quadriceps muscle to the underlying femur are the major factors which prevent the distal excursion of the quadriceps tendon, thereby preventing deep flexion in patients with osteoarthritis.

12.4 Surgical Technique

Our technique is a standard subvastus approach, initiated with an anterior midline skin incision. Once the extensor mechanism is mobilized, the underlying suprapatellar pouch can be identified and is subsequently excised along with any adhering bands or fibrotic tissue (Fig. 12.4a, b). Doing so provides direct access to the deep interface of the quadriceps muscle and the anterior surface of the femur, allowing the release to be carried out (Fig. 12.4c, d).

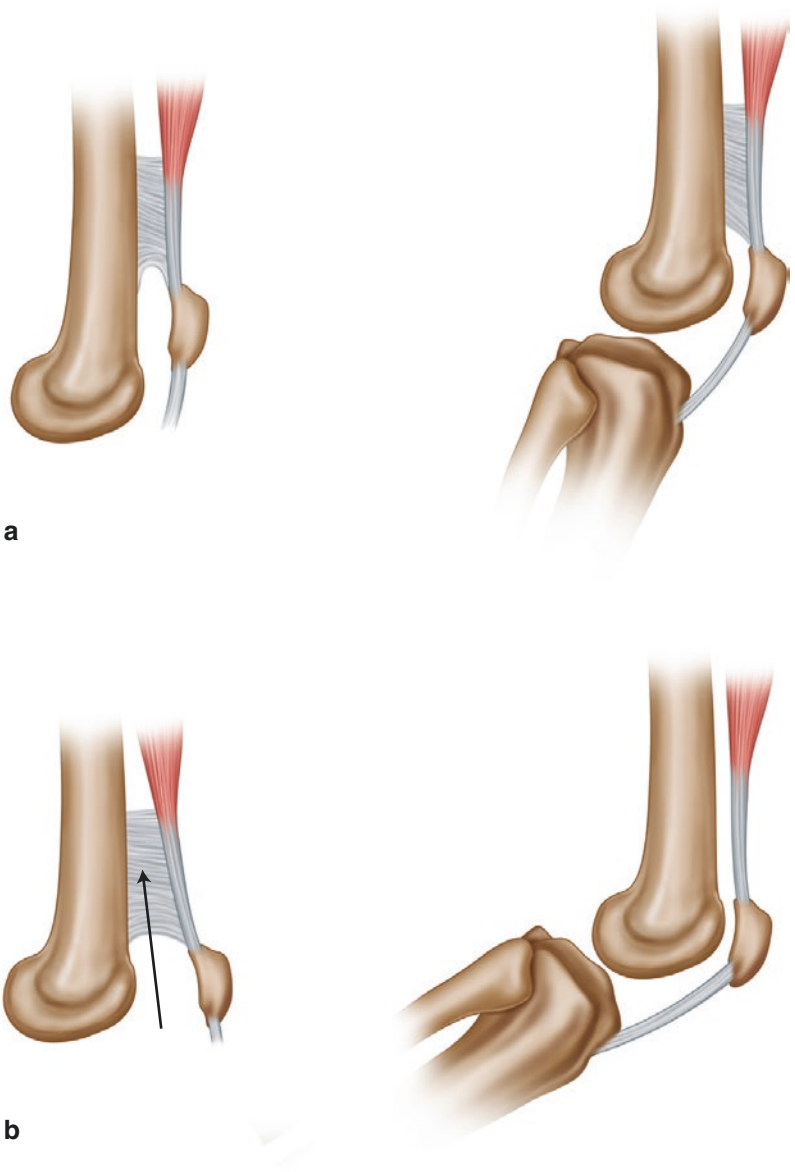


Fig. 12.3 Simplified illustrations demonstrating the basic principle of our approach. (**a**) How fibrotic adhesions between the quadriceps and the distal femur (*left*) can limit flexion substantially (*right*) by limiting quadriceps excursion. The suprapatellar pouch is represented by the inverted "U" distal to the aforementioned adhesions. (**b**) How a modified quadriceps release, demonstrated by the cartoon arrow above (*left*), would allow the extensor mechanism further excursion, leading to a greater ROM (*right*)

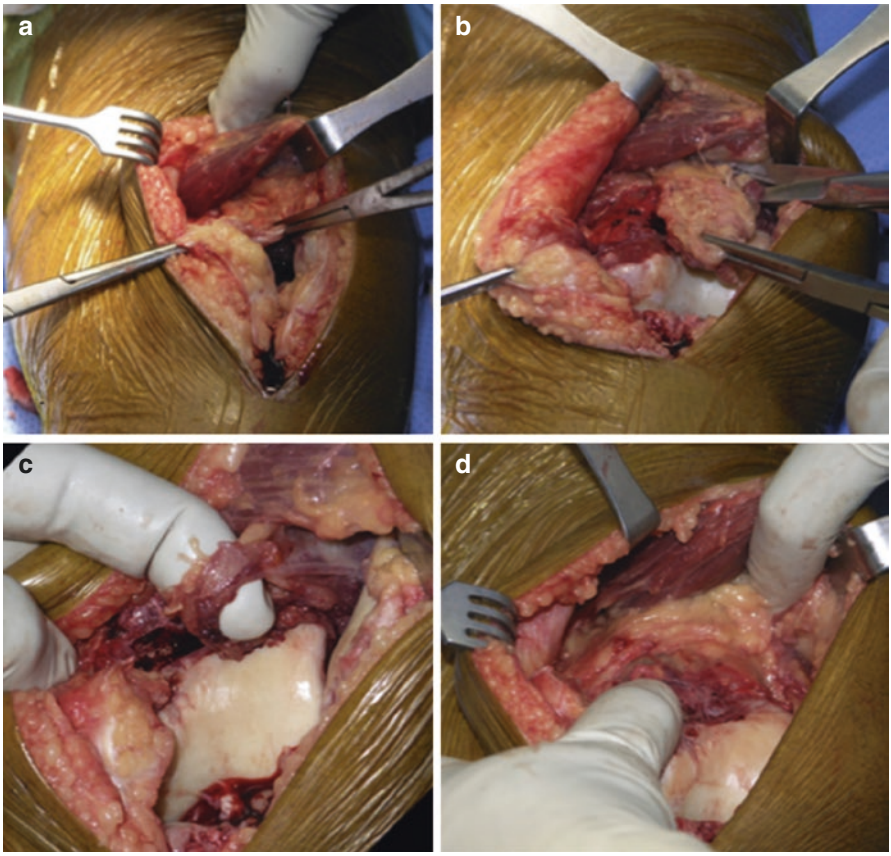


Fig. 12.4 Photographs of the knee anterior aspect while undergoing quadriceps release prior to bone cut. (**a**, **b**) The extensor mechanism being retracted laterally while the surgeon identifies and completely resects the suprapatellar pouch. (**c**) A fibrotic band found tethering the underbelly of the quadriceps muscle to the distal femur during the blunt release, which was subsequently excised. (**d**) The net outcome of the release, which is the removing of the majority of adhesions between the quadriceps muscle and the distal anterior aspect of the femur

The release is carried out in a stepwise fashion where the knee is flexed after each release. If the ROM is estimated to be below 130°, the release is progressed further proximally until a ROM of over 130° is obtained (Fig. 12.5). No bony resection, ligament releases, or lateral/medial retinacular releases were performed at that point in time, as was described by Nicoll in his conventional quadricepsplasty [12].

In our institution, we actually do not proceed with surgery and bone cut until we get a good ROM of the knee through anterior quadriceps release, and this has some advantages.

The first is the fact that obtaining better flexion will make the surgery much easier. There will be less tension on the soft tissue which will prevent skin necrosis

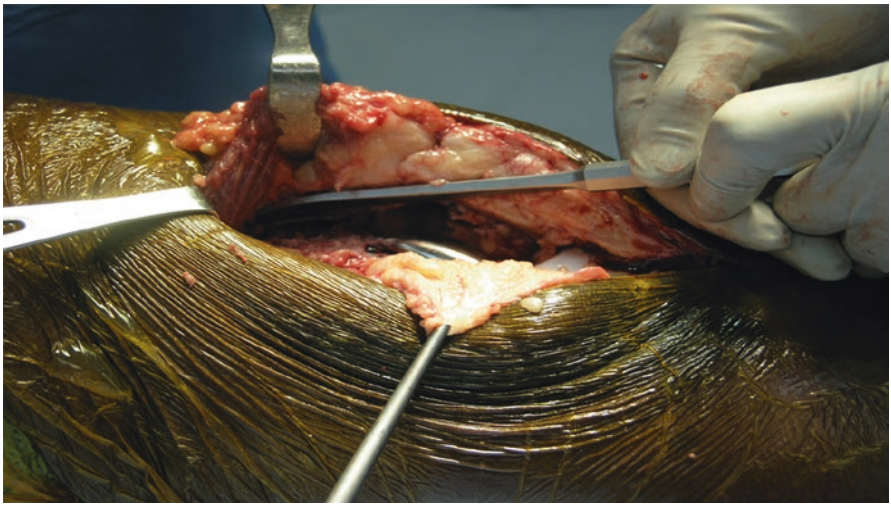


Fig. 12.5 Photo of the knee anterior aspect; the release is progressed proximally until a ROM of over 130° is obtained

Fig. 12.6 A 74-year-old woman who underwent quadriceps release prior to start TKR. Despite the large posterior osteophytes that can be seen in the prerelease lateral x-ray (*left*), we were able to truly improve flexion from 105° to 140° as shown in the post-release lateral x-ray (*right*)

and damages to the edges of the bone because of the hard retraction and it also decreases the tension on the patellar tendon; hence it prevents the incidental avulsion of patellar tendon in case of arthritic stiff knee.

Second, it will make the surgery more precise, and while the knee is fully bent, the surgeon will be able to visualize the knee well. The third advantage of obtaining full flexion intraoperatively is that we are giving the patient a better chance in obtaining better ROM postoperatively (Figs. 12.6 and 12.7).

Fig. 12.7 A 58-year-old woman who had quadriceps release prior to bony resection. Photos of the lateral aspect of the left knee in passive flexion before (*left*) and after (*right*) release

12.5 Results of Quadriceps Release

Our results of follow-up over 1028 patients show 3% of our cases (198 patients) have poor ROM (flexion less than 90°) preoperatively. This group dropped to 0.10% after 3 months postoperatively (Table 12.1). We found 88% of our patients (878 patients) achieved excellent ROM (flexion more than 125°) after 3 months postsurgery. Similarly, 30% of them were able to achieve full flexion 3 months after surgery (Figs 12.8 and 12.9).

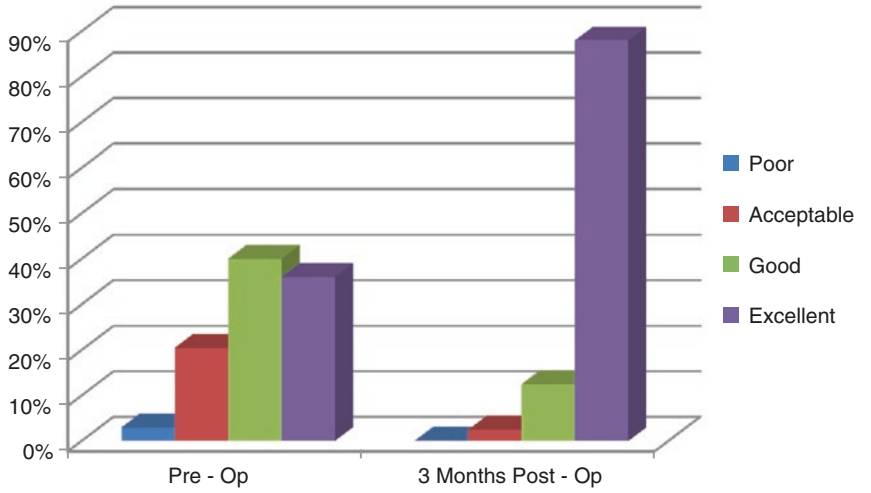
12.6 Discussion

Some surgeons claim that if we do the tibial tubercle osteotomy and move it proximally about 1 cm which is the maximum, we can improve the ROM in patients especially with patella baja. We have tried that on the model; moving the tibial tubercle osteotomy 1 cm proximally will improve the ROM only about 10°. Subsequently, doing tibial tubercle osteotomy on osteoarthritic stiff knee will allow the surgeon to perform the TKR easily, but when he returns the tibial tubercle back even with 1 cm proximally, the knee will be stiff again. Therefore, we are doing quadriceps muscle release techniques in all our TKR patients to improve the ROM.

Although the quadriceps release technique is an easy and safe procedure, some surgeons have concerns about the postoperative heterotopic ossification (HO) following quadriceps release. The formation of HO after TKR is known to be associated with loss of ROM, stiffness, as well catching and snapping in the patella-femoral joint [13]. In our series of over 6000 cases, we had six patients which developed HO postsurgery. The ROM in our HO patients was not affected, which is the same

Table 12.1 Show significant increase in the number of patient who had a good to excellent ROM 3 months postsurgery (more than 85%)

ROM	Degree	Pre–op (%)	3 months post–op (%)
Poor	<90	3	0.10
Acceptable	90–105	21	2.50
Good	110–125	40	12.50
Excellent	>125	36	88



There is a significant decrease in number of patients who had poor range of motion (less than 0.10%)

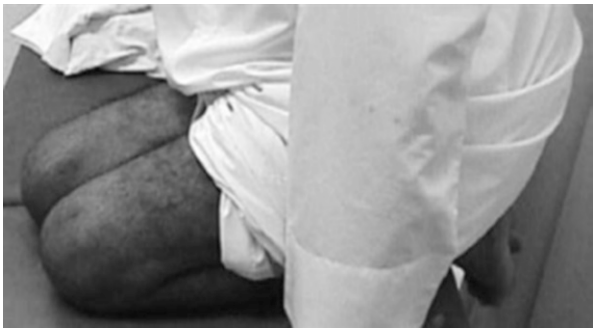


Fig. 12.8 Patient with bilateral TKR kneeling with full flexion, as per definition, 3 months postoperatively

finding in the Toyoda study (Fig. 12.10). Toyoda group found that the ROM in the knees with HO has some limitation at early post-op evaluation. However, there was no significant difference in ROM compared to the knees without HO after 1 year of surgery [14].

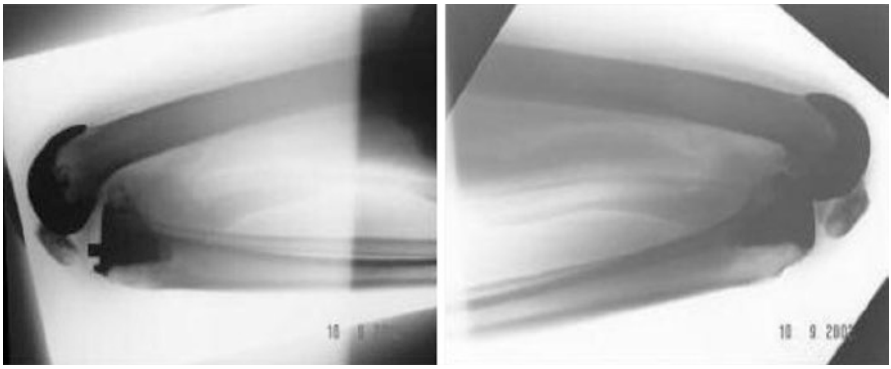


Fig. 12.9 Lateral x-ray of the same patient, 3 months postoperatively

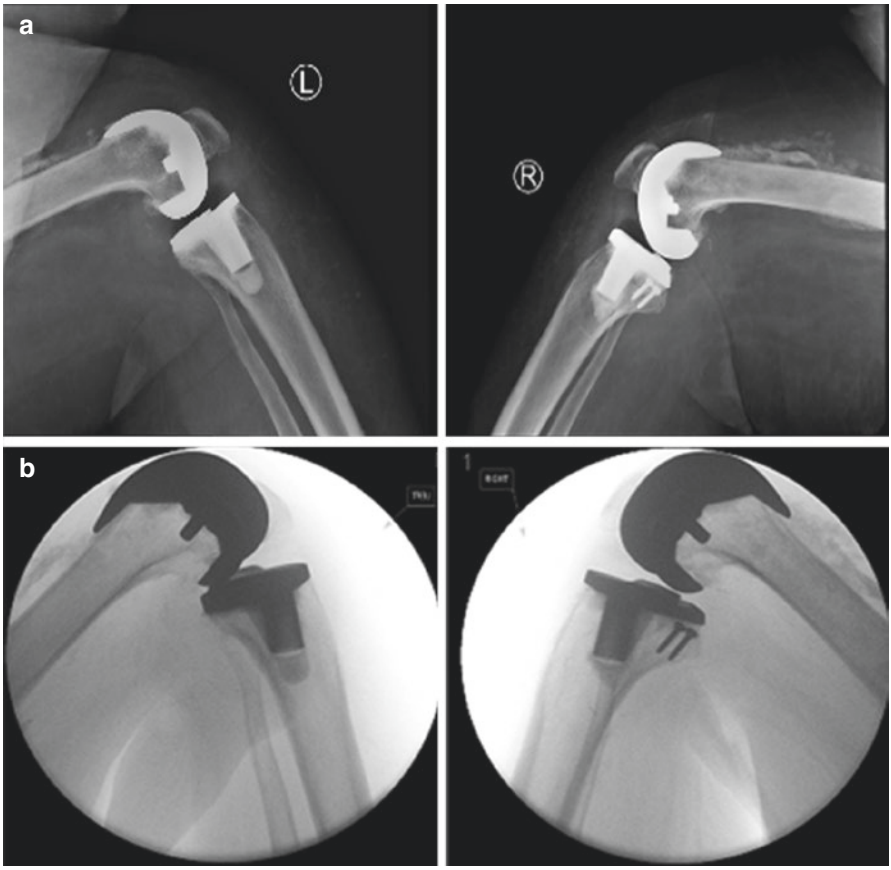


Fig. 12.10 (**a**) A 59-year old female patient 3-month post-bilateral TKR with extensive HO as seen in the lateral x-rays. (**b**) C-arm shows same patient has a good ROM on both knees despite the presence of HO

Conclusion

High ROM post-TKR is important for many patients, and it should be done whenever it is possible to enable our patients to continue their lifestyles as normal as possible. Quadriceps muscle release is an essential surgical technique in TKR which improves ROM in arthritic stiff knee.

The success in obtaining an immediate and significant improvement in ROM by only releasing the quadriceps muscle from its tethering adhesions and keeping other pathological changes such as large osteophytes, severe knee deformities, and irregular articular surfaces intact clearly demonstrates that the inadequate excursion of the quadriceps muscle and tendon is the principal limiting factor to improve knee flexion [9].

We strongly recommend performing quadriceps muscle release in all TKR especially in stiff knee. Our experience has shown a meticulous and careful quadriceps release will enable the surgeon to do his entire primary TKR plus revision on stiff knees without requiring to do the tibial tubercle osteotomy. At our institute, we have not needed to perform the tibial tubercle osteotomy for the last 9 years.

References

1. Tarabichi S, Tarabichi Y, Tarabish A, Hawari M. Importance of full flexion after total knee replacement in Muslims' daily a lifestyle. J Indian Med Assoc. 2006;38:17–22.
2. Tarabichi S, Acker SM, Cockburn RA, Krevolin J, Li RM, Wyss UP. Knee kinematics of high-flexion activities of daily living performed by male Muslims in the Middle East. J Arthroplasty. 2011;26(2):319–27.
3. Hefzy MS, Kelly BP, Cooke TD. Kinematics of the knee joint in deep flexion: a radiographic assessment. Med Eng Phys. 1998;20:4.
4. Villar RN, Solomon VK, Rangam J. Knee surgery and the Indian knee. The importance of the preservation of flexion. Trop Doct. 1989;19:1.
5. Tarabichi S, Tarabichi Y, Tarabish A, Hawari M. Achieving deep flexion after primary total knee arthroplasty. J Arthroplasty. 2010;25(2):220–4.
6. Kansara D, Markel D. The effect of posterior tibial slope on range of motion after total knee arthroplasty. J Arthroplasty. 2006;21(6):809–14.
7. Mauerhan DR, Mokris JG, Ly A, et al. Relationship between length of stay and manipulation rate after total knee arthroplasty. J Arthroplasty. 1998;13:896.
8. Collins JE, Rome BN, Daigle ME, Lerner V, Katz JN, Losina E. A comparison of patient-reported and measured range of motion in a cohort of total knee arthroplasty patients. J Arthroplasty. 2014;29(7):1378–82.
9. Tarabichi S, Tarabichi Y. Can an anterior quadriceps release improve range of motion in the stiff arthritic knee. J Arthroplasty. 2010;25(4):571–5.
10. Epps CE. Complications in orthopaedic surgery. Philadelphia: JB Lippin- cott Co; 1978. p. 498.
11. Smillie IS. Injuries of the knee joint. 4th ed. Williams & Wilkins: Baltimore; 1973. p. 365.
12. Nicoll EA. Quadricepsplasty. J Bone Joint Surg. 1963;45- B:183.
13. Iorio R, Healy WL. Heterotopic ossification after hip and knee arthroplasty: risk factors, prevention, and treatment. J Am Acad Orthop Surg. 2002;10:409.
14. Toyoda T, Matsumoto H, Tsuji T, Kinouchi J, Fujikawa K. Heterotopic ossification after total knee arthroplasty. J Arthroplasty. 2003;18(6):760–4.