Evaluation of Thompson’s quadricepsplasty results in patients with knee stiffness resulted from femoral fracture

Hamid Mousavi, Behrouz Mir, Ali Safaei
Department of Orthopedics, School of Medicine, Isfahan University of Medical Sciences, ‘Isfahan Medical School Research Center, School of Medicine, Isfahan University of Medical Sciences, Isfahan, Iran

Background: Posttraumatic and/or postsurgical knee stiffness is one of the orthopedic complications which is difficult to be treated and can affect individual’s life negatively. The aim of this study is to investigate the results of quadricepsplasty in patients with knee stiffness resulted from femoral fracture. Materials and Methods: This is a cross-sectional study on all patients with femoral fracture which has caused knee flexion limitation referred to Kashani and Al-Zahra Hospitals in Isfahan from January 2010 to March 2013. The type and site of fracture, joint extension, and fracture fixation technique were recorded. Moreover, the range of motion (ROM) before surgery, under general anesthesia, and 3- and 6-month postoperation were measured. Results: Among the patients, 13 had a simple fracture (48%) and 14 had a segmental fracture (51.9%). Considering the fracture site, 11, 10, and 6 patients had femoral (40.74%), supracondylar (37.3%), and femoral supracondylar (22.2%) fractures, respectively. The fracture fixation was performed by the plate, external, and Wagner fixation techniques for 24 (88.9%), 2 (7.4%), and 1 (3.7%) patients, respectively. The mean ROM before operation, under general anesthesia, and 3- and 6-month postoperation were determined to be 33.15° ± 24.73°, 122.60° ± 10.22°, 99.63° ± 16.52°, and 100.74° ± 15.67°, respectively. The mean ROM value at various stages was not similar (P < 0.001). The mean changes in the ROM were 79.2° ± 24.6° and 62.1° ± 19.7° in the cases with simple and segmental fractures, respectively. The mean changes in the knee ROM were significantly higher in simple fractures in comparison with the segmental femoral fracture (P = 0.03). Conclusion: We found Thompson’s quadricepsplasty may successfully increase the range of knee flexion in knee fracture and also regardless of quadriceps time.

Key words: Flexion contracture, knee stiffness, Thompson’s quadricepsplasty

INTRODUCTION

Posttraumatic and/or postsurgical knee stiffness is one of the orthopedic complications which is difficult to be treated.[1] The influence of joint stiffness on individual’s function varies in different joints. For instance, good function is observed in stiffness of ankle and wrist, whereas knee stiffness affects occupational, daily, and leisure activities in negatively, especially in youth.[2]

Intra- or extramedullary fixation of distal femoral fractures can cause knee stiffness and under 70° flexion can pose gait problems and also limping. Underlying mechanism of knee stiffness as an adverse effect of femoral shaft fracture is fibrosis and contracture of quadriceps muscle. A major site for fibrosis is vastus intermedius, which passes directly anterior surface of femur. This makes the muscle prone to damage. Fibrosis of this region interferes with normal mechanism of knee flexion.[1,3]

Before the 1970s, nonoperative treatment was the choice for knee stiffness.[4] Operation success is significantly dependent on distal femoral fixation effectiveness.[4,6]

How to cite this article: Mousavi H, Mir B, Safaei A. Evaluation of Thompson’s quadricepsplasty results in patients with knee stiffness resulted from femoral fracture. J Res Med Sci 2017;22:50.

Access this article online

Quick Response Code:

Website:
www.jmsjournal.net

DOI:
10.4103/1735-1995.205237

This is an open access article distributed under the terms of the Creative Commons Attribution-NonCommercial-ShareAlike 3.0 License, which allows others to remix, tweak, and build upon the work non-commercially, as long as the author is credited and the new creations are licensed under the identical terms.

For reprints contact: reprints@medknow.com
One of the surgical procedures is quadricepsplasty, in which the quadriceps muscle is released for knee flexion improving. The most popular surgical method for knee stiffness is Thompson and Judet quadricepsplasty.\(^1\)

This study was carried out to investigate the results of quadricepsplasty in patients with knee stiffness resulted from femoral fracture.

**MATERIALS AND METHODS**

The current study was a cross-sectional experiment performed on all patients with femoral fracture which has caused knee flexion limitation referred to Kashani and Al-Zahra Hospitals (affiliated to Isfahan University of Medical Sciences), from January 2010 to March 2013 [Table 1].

The experimental protocol was approved by the Research and Ethics Committee of Isfahan University of Medical Sciences (Research Project Number: 391351). The patients signed an informed written consent before the study.

Inclusion criteria were being in the age range of 18–60, having knee stiffness following femoral fracture, knee flexion limitation of < 90°, and lacking underlying systemic diseases.

The exclusion criteria were positive history for neuromuscular diseases, previous disorders of knee joint, unwillingness to participate in the study, or to attend follow-up visits for any reason.

Thirty-four patients met the inclusion criteria, among whom seven patients were not willing to participate in the study. Thus, the study was conducted on 27 remained patients.

| Fracture related information | Number(%) |
|-----------------------------|-----------|
| Type of fracture (%)        |           |
| Simple                      | 13 (48)   |
| Segmental                   | 14 (51.9) |
| Site of fracture (%)        |           |
| Femoral shaft               | 11 (40.74)|
| Supracondylar               | 10 (37.03)|
| Supracondylar-shaft         | 6 (22.2)  |
| Joint extension (%)         |           |
| Positive                    | 9 (33.3)  |
| Negative                    | 18 (66.7) |
| Fracture fixation technique (%)|       |
| Plate                       | 19 (70.37)|
| Intramedullary nail         | 5 (18.51) |
| External fixation           | 2 (7.4)   |
| Wagner                      | 1 (3.7)   |
Finally, the data were analyzed using mean ± standard deviation for descriptive data and repeated measure and Bonferroni post hoc for analytics by the SPSS software version 22 (IBM SPSS Statistics 22, United States).

RESULTS

In the current study, 27 patients with a mean age of 27.85 years (age range of 18–60) were evaluated. Among the participants, 26 (96.3%) were males.

Two patients were complaining from extension contracture, and other 25 ones had flexion contracture.

The data related to fractures are given in Table 1.

Moreover, mean ROM values achieved under general anesthesia as well as measured ROM after 3 and 6 months were significantly higher than that measured before the operation (P < 0.001 for all mentioned measurements) [Table 2].

The ROM values 3 and 6 months after operation were not significantly different (P = 0.542) [Table 2]. However, both values were less than ROM achieved under general anesthesia (P < 0.001).

The mean changes in knee ROM were significantly higher in simple fractures in comparison with segmental femoral fracture (P = 0.03) [Chart 1 and Figure 1].

Figure 1 shows a comparison of simple and comminuted femoral fracture (Fx).

The results indicated that the ROM changes did not have a statistically significant relationship with age (r = 0.16, P = 0.42). Furthermore, the QT value and changes in knee ROM were not significantly related (r=0.159, P = 0.43).

The complications of the surgery were observed only in two cases; one case experienced patellar bone fracture and one had septic arthritis of knee.

DISCUSSION

Quadricepsplasty is a procedure for treating severe knee extension, as knee stiffness influences individual's life negatively and <70° of knee flexion can cause limping.\[7\]

Knee flexion limitation is caused by fibrosis, parapatellar retinaculum shortening, vastus intermedius fibrosis, and rectus femoris shortening\[1,3\]

Thompson's quadricepsplasty method is a procedure which resolves knee movements’ limitation by isolating rectus femoris from the vasti.\[1\]

In the current study, the mean preoperation ROM was 33° (10°–90°) and the mean ROM under general anesthesia was 123° (100°–140°). This is while the mean postoperation ROM values after 3 and 6 months were 100 and 101° (both in the range of 70°–120°), respectively. Considering the results, the knee ROM under general anesthesia and 3 and 6 months after operation were significantly higher than preoperation ROM. The values obtained in 3 and 6 months after operation were not significantly different, but both were less than the

Table 2: Descriptive data on the range of motion by time and type of fracture

| ROM (°)                | Type of fracture | Mean±SD     | Minimum | Maximum | n   |
|------------------------|------------------|-------------|---------|---------|-----|
| Before operation       | Simple           | 31.54±26.95 | 10      | 90      | 13  |
|                        | Segmental        | 34.64±23.41 | 10      | 90      | 14  |
|                        | Total            | 33.15±24.73 | 10      | 90      | 13  |
| Under general anesthesia| Simple           | 128.46±6.90 | 120     | 140     | 13  |
|                        | Segmental        | 117.14±9.94 | 100     | 130     | 14  |
|                        | Total            | 122.60±10.22| 100     | 140     | 13  |
| 3-month postoperation  | Simple           | 111.54±9.87 | 90      | 120     | 13  |
|                        | Segmental        | 88.57±13.51 | 70      | 110     | 14  |
|                        | Total            | 99.63±16.52 | 70      | 120     | 13  |
| 6-month postoperation  | Simple           | 110.77±10.38| 90      | 120     | 13  |
|                        | Segmental        | 91.43±14.06 | 70      | 110     | 14  |
|                        | Total            | 100.74±15.67| 70      | 120     | 13  |

SD = Standard deviation; ROM = Range of motion
achieved ROM during the operation under general anesthesia.

In a study of Kundu et al., the results of 22 cases undergone quadricepsplasty according to the Thompson's method were in accordance with ours. Twenty out of 22 patients achieved ≥90° of knee flexion with a range of 90–120.[1] In the other study that patients underwent Judet quadricepsplasty, preoperation ROM of 5°–80° changed to 45°–160° with a mean of 105°. However, their operation method was different from that in the current study. Thus, the results could suggest the effect of quadricepsplasty operation, rather than operation method, on performance improvement in patients.[8] In this regard, some other studies with different operation methods can be considered. For instance, 33% of patients in Nicoll study who underwent Judet quadricepsplasty method achieved >80° of knee flexion.[9]

Considering the results obtained from quadricepsplasty with other techniques, it seems that other techniques are probably less effective than Thompson's quadricepsplasty. However, there is no study available about the comparison of various techniques of quadricepsplasty in terms of effectiveness.

Alli et al. studied ten patients who underwent Judet quadricepsplasty because of severe extraction contracture of knee following femoral fracture and treatment by external fixation. The patients had preoperative knee flexion range of 33° on average and the flexion range of 88° was achieved in 24-month follow-up.[7]

In the study of Alici et al., 11 patients who underwent Judet quadricepsplasty were followed up for 49 months and mean improvement in knee flexion range was 70°, with a maximal movement range of 130°.[10] In another study, the clinical outcomes of 21 cases of Judet quadricepsplasty were investigated in follow-up of up to 101 months. Among patients participated in this study, 8 (38.10%), 9 (42.86%), and 4 (19.05%) patients achieved knee flexion range of >100°, 80°–90°, and 50°–80°, respectively.[11] As can be observed, our findings are in accordance with the results of three studies mentioned above. Nevertheless, the follow-up period was 24, 22, and 101 months, while the follow-up period for our study was 6 months. Hence, short follow-up period can be considered as a limitation of the current study.

The complications of the surgery were observed only in two cases; one case experienced patellar bone fracture and one had septic arthritis of knee. It seems that the complications were not related to surgical technique and were similar in different surgical methods. Complications can be attributed to various factors such as the surgeon's skillfulness and postoperation delivered care.

A small number of studies have been performed in this field, and no similar studies have been carried out in Iran. Moreover, in the current study, the relationship between the knee ROM and the fracture type and post-quadricepsplasty follow-ups were investigated.

Considering the results obtained in this study, it is suggested to conduct further studies to compare the results of various quadricepsplasty methods.

CONCLUSION
We found Thompson's quadricepsplasty may successfully increase the range of knee flexion in knee fracture and also regardless of QT.

Financial support and sponsorship
Nil.

Conflicts of interest
There are no conflicts of interest.

REFERENCES
1. Kundu Z, Sangwan S, Guliani G, Siwach R, Kamboj P, Singh R. Thompson’s quadricepsplasty for stiff knee. Indian J Orthop 2007;41:390-4.
2. Maheshwari, JMhaskar, Vikram A. Mastering Orthopedic Techniques: Knee Reconstruction. Post-traumatic Stiff Knee 2016:385.
3. Pujol N, Boismenu P, Beaufils P. Post-traumatic knee stiffness: Surgical techniques. Orthop Traumatol Surg Res 2015;101 1 Suppl;
S179-86.

4. Ali F, Saleh M. Treatment of isolated complex distal femoral fractures by external fixation. Injury 2000;31:139-46.

5. Neer CS 2nd, Grantham SA, Shelton ML. Supracondylar fracture of the adult femur. A study of one hundred and ten cases. J Bone Joint Surg Am 1967;49:591-613.

6. Connolly JF, King P. Closed reduction and early cast-brace ambulation in the treatment of femoral fractures. I. An *in vivo* quantitative analysis of immobilization in skeletal traction and a cast-brace. J Bone Joint Surg Am 1973;55:1559-80.

7. Ali AM, Villafuerte J, Hashmi M, Saleh M. Judet's quadricepsplasty, surgical technique, and results in limb reconstruction. Clin Orthop Relat Res 2003;415:214-20.

8. Oliveira VG, D'Elia LF, Tirico LE, Gobbi RG, Pecora JR, Camanho GL, *et al.* Judet quadricepsplasty in the treatment of posttraumatic knee rigidity: Long-term outcomes of 45 cases. J Trauma 2011;72:677-80.

9. Hahn SB, Lee WS, Han DY. A modified Thompson quadricepsplasty for the stiff knee. J Bone Joint Surg Br 2000;82:992-5.

10. Alici T, Buluç L, Tosun B, Sarlak AY. Modified Judet's quadricepsplasty for loss of knee flexion. Knee 2006;13:280-3.

11. Masse A, Biasibetti A, Demangos J, Dutto E, Pazzano S, Gallinaro P. The judet quadricepsplasty: Long-term outcome of 21 cases. J Trauma Acute Care Surg 2006;61:358-62.