

RESEARCH ARTICLE

Prognostic Factors Affecting the Results of Modified Thompson Quadricepsplasty for the Treatment of Extension Contracture of the Knee

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Abstract

Background: Knee extension contracture is a disabling complication after fractures around the knee. In this study we aimed to study factors influencing the outcomes of quadricepsplasty for the treatment of traumatic knee extension contracture. We hypothesized that there is no factor influencing the final range of knee motion.

Methods: In this retrospective study, we included 64 patients who underwent modified Thompson quadricepsplasty between 2008 to 2011 with a mean follow-up time of 36 months.

Results: The mean change in flexion was 66 degrees. Using Judet criteria, results were excellent in 41 patients (64%), good in 15 (23%), fair in 4 (6%) and poor in 4 (6%). Preoperative arc of flexion, duration of extension contracture, number of previous surgeries on the limb, and BMI of the patients were independently influencing the final flexion.

Conclusion: Modified Thompson quadricepsplasty is associated with high number of excellent and good results especially when it is performed earlier in more severe contractures. Preoperative arc of flexion, interval between trauma surgery and quadricepsplasty, the number of prior surgeries, and BMI influence the outcomes of quadricepsplasty.

Keywords: Knee, Judet, Modified thompson, Quadricepsplasty

Introduction

Knee stiffness is a major complication of high energy trauma to the lower limb, especially after complex periarticular fractures. Despite rigid internal fixation and early rehabilitation, extension contracture is sometimes inevitable (1). Extension contracture is considered a disability in Asian countries where the people need more flexion to perform social and religious customs (2-6).

Quadricepsplasty was described by Thompson, Judet, and others to improve the arc of knee motion (7-14). However, it is not clear which patient may benefit from surgery when risks and benefits are weighed (15). Also, factors that may predict the outcome have not been studied well. Our primary null hypothesis was that there is no factor affecting the range of knee motion after quadricepsplasty.

Materials and Methods

We retrospectively reviewed 80 patients who underwent modified Thompson quadricepsplasty for the treatment of extension contracture of the knee between 2008 and 2011. Surgery was done by the senior surgeon (ABN). Sixty-four patients were available for the final follow up. There were 59 males and 5 females with an average age of 38 (min-max, 17-74) years [Table1]. Inclusion criteria were stiffness due to traumatic events and failure to respond to intensive physiotherapy, and manipulation under anesthesia in some cases. Exclusion criteria were preoperative infection and nontraumatic stiffness of the knee [Table 2]. The mean interval between the last surgery and quadricepsplasty was 23 months (min-max, 11-90). The mean follow-up was 36 months (min-max, 6-84). Lysholm score and IKDC score were only assessed at the final follow up (16).

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Table 1. Demographic data

Age, mean (SD)	38 (14)
Sex, no (%)	
Male	59 (92)
Female	5 (8)
Body Mass Index, Mean (SD)	24 (3.9)
Months between trauma surgery and quadricepsplasty, mean (Min-Max)	23 (2-90)
Months to follow-up, mean (Min-Max)	36 (6-84)

SD: standard deviation

Surgical technique

A modification of Thompson quadricepsplasty was performed for all patients in this study by using a standard anterior longitudinal incision in 36 patients and anterolateral incision in the other 28 patients.

Under general or spinal anesthesia, the patient was placed in the supine position. The operation was performed without a tourniquet to avoid limiting proximal extension of the incision for adequate release of the rectus femoris, and to avoid tourniquet pressure on quadriceps muscle when flexing the knee during surgery.

First, rectus femoris was freed from the vastus lateralis, medialis, and intermedius. In our technique, vastus intermedius was released but never excised even when found scarred and fibrosed. Instead, the rectus femoris, vastus lateralis, and medialis were released from the vastus intermedius. Distal to the incision, lateral and medial patellar retinaculum was then released. Lengthening of the rectus femoris was not done in any of our patients. In patients with the history of proximal tibia fractures, intra-articular adhesions were released first followed by release of rectus femoris only if the knee was still tight. Hemostasis was done and the incision was closed over a suction drain.

Continuous passive motion (CPM) was started the day after surgery while patients were in the hospital. The CPM range was initially set to 0° - 70° of flexion, and gradually increased to the maximum achieved flexion.

The ROM of the knee was recorded in the supine position using a standard goniometer before surgery, immediately after surgery while the muscles were still lax, and at the last follow-up. Clinical results were

assessed using Judet's criteria with flexion > 100° as excellent, 81° to 100° as good, 50° to 80° as fair, and < 50° as poor.

Patients were divided into four groups according to body mass index (BMI) level. BMI below 18.5 is considered underweight, 18.5 to 24.9 is considered healthy, 25 to 29.9 is considered overweight, and BMI of 30 or higher is considered obese.

Statistical analysis

We analyzed the correlation of preoperative and intraoperative variables with the final outcome. The final knee flexion was the response variable. Explanatory variables were age, sex, BMI, preoperative flexion, duration of stiffness, multiple fractures, simultaneous surgery, associated trauma, type of incision used for the surgery and number of previous surgeries. Continuous data were reported as means with standard deviation and categorical data were presented as absolute data with percentages. Pearson's chi square test were done for categorical variables. Final arc of flexion compared between subgroups with the use of the independent sample t-test and one-way ANOVA for categorical variables and Pearson's correlation for continuous variables. To determine the independent influence on the final arc of flexion, variables were entered into a multivariable linear regression model. For all tests $P < 0.05$ was considered significant. All statistical analyses were performed using SPSS v.21.0 (IBM Corp., Armonk, NY, USA)

Results

The mean flexion achieved was 66 degrees at the final follow-up in compare to preoperative arc of motion. Considering the mean extension lag of the patients before surgery and at the final follow-up, the mean active ROM of 113 degrees was achieved [Table 3]. Using Judet criteria, results were excellent in 41 patients (64%), good in 15 patients (23%), fair in 4 patients (6%), and poor in 4 patients (6%).

The final and intraoperative flexion was significantly higher in patients who had lower preoperative flexion arc ($P < 0.001$). Patients who were treated with quadricepsplasty in the first 6 months after trauma surgery had significantly higher flexion than those operated after 6 months (133 vs. 114 $P = 0.01$). Patients who had more than four surgeries prior to quadricepsplasty achieved less flexion at final follow up ($P = 0.04$). Final flexion was significantly higher in normal BMI when compared to the overweight patients ($P = 0.02$) [Table 4]. Age, sex, presence of multiple fractures, associated injuries, anterior vs.

Table 2. Injury description

	Without fracture	One bone fracture			Two bone fracture			Three bone fracture
		Femur	Tibia	Patella	Femur & Tibia	Femur & Patella	Tibia & Patella	
(%) No	(6.3) 4	(28) 18	(9.4) 6	(4.7) 3	(20) 13	(13) 8	(4.7) 3	(14) 9
Total	4		27			24		9

Table 3. Flexion Range before, during quadricepsplasty and at final follow-up			
	Preoperative	Intra operative	Last follow-up
	Mean (SD)	Mean (SD)	Mean (SD)
	(Min-Max)	(Min-Max)	(Min-Max)
Flexion	41° (20°) (0°-105°)	134° (48°) (60°-140°)	119° (30°) (60°-140°)
ROM	37° (21°) (0°-105°)	134° (20°) (60°-140°)	116° (35°) (60°-140°)
Extension Lag	2.1° (11°) (0°-8°)	-	7.9° (18°) (0°-35°)

ROM: range of motion; SD: standard deviation

Table 4. Multivariable analysis of the factors affecting the outcome

	Final flexion Mean (SD)	P value
Sex		
Male	122 (35)	0.55
Female	109 (39)	
Age	-	0.25
Multiple Fracture	-	0.22
Associated trauma (with/without)		
With	118 (28)	0.47
Without	126 (23)	
Simultaneous surgery (with/without)		
With	124 (18)	0.76
Without	120 (22)	
Type of incision		
Anterior	120 (27)	0.49
Anterolateral	115 (30)	

anterolateral incision, and simultaneous surgeries (removal of previous internal fixation devices) had not significantly affect the results of quadricepsplasty [Table 5].

Postoperative Lysholm and IKDC scores were significantly higher in patients with excellent and good results according to the Judet criteria ($P=0.001$).

Complications

There were two cases of superficial wound infection that was treated with two weeks of antibiotics and one case of deep infection that required wound drainage and intravenous antibiotics.

Extension lag was seen in 32 patients (1-35 degrees) with a mean lag of 7.9 degrees. The lysholm and IKDC

Table 5. Analysis of Variables affecting outcome

	P value	R ²	95% CI	
			Lower Bound	Upper Bound
Preoperative flexion	0.001	0.18	0.33	0.84
Duration of stiffness	0.014	0.097	0.56	0.87
BMI (Normal; Overweight)	0.029	0.08	0.16	0.51
Number of previous surgeries (>4surgery)	0.025	0.12	0.22	0.56

scores were not statistically different with those without extension lag (mean Lysholm and IKDC scores were 62 and 60 in patients with extension lag versus 67 and 64 in patients without extension lag; $P=0.27$ for Lysholm, and $P=0.42$ for IKDC score).

Discussion

The average definitive flexion achieved was 66 degrees with 87% having excellent or good results. Higher preoperative flexion, quadricepsplasty after 6 months, more than 4 prior surgeries, and overweight BMI had lower favorable outcomes. Age, gender, presence of multiple fractures, associated upper limb, spinal, abdominal and head trauma did not significantly affect the outcomes.

Hahn et al. reported inverse correlation between preoperative ROM with intraoperative and final ROM, however, the interval between initial injury and quadricepsplasty had no effect on the results (17). Similarly Masse et al. assessed 21 patients after Judet quadricepsplasty and reported achieving significantly higher flexion in patients with less preoperative flexion while the interval to quadricepsplasty did not affect the results (8). Ebrahimzadeh et al. found 29 out of 36 patients with excellent/good results in whom

quadricepsplasty was done within 10 months of initial surgery. They noted preoperative ROM as an important prognostic factor and suggested earlier surgery, especially in more severe contractures (4). Lack of correlation between age and gender with the outcomes of quadricepsplasty was reported in many studies (4, 8, 17, 18). In this study, we further found that patients with normal BMI achieved more flexion than overweight patients.

Relatively large number of patients in compare to the other studies enables us to analyze the effects of other variables that were not addressed in the other studies. However, we admit to having limitation. First, this was a retrospective study that has drawbacks of such studies. Second, Lysholm and IKDC score were not available preoperatively to compare to the final scores.

Modified Thompson quadricepsplasty is associated with high number of excellent and good results especially when perform earlier in more severe contractures.

Preoperative arc of flexion, interval between trauma surgery and quadricepsplasty, the number of prior surgeries, and BMI influence the outcomes of quadricepsplasty.

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