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A mini-invasive procedure for treating arthrofibrosis of the knee

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ABSTRACT

Objective: The aim of this study was to introduce the results of a novel mini-invasive operative technique comprising mini-incision release, "pie-crusting" lengthening of the quadriceps extensor, and arthroscopic lysis in severe arthrofibrotic knees.
Methods: From 2010 to 2014, 17 patients (12 males and 5 females with a mean age of 44 years (range, 19–62 years)) with severely arthrofibrotic knees were treated with this operative technique. The mean follow-up duration was 23 months. The knee range of motion (ROM) was assessed with a goniometer. The functional outcomes were evaluated according to the Hospital for Special Surgery (HSS) score and Judet's criteria.
Results: The ROM significantly improved from 29.7° (range, 7°–56°) preoperatively to 127° (range, 120°–136°) at the final follow-up in all patients ($p < 0.001$). According to Judet's criteria, all patients achieved excellent results (ROM > 100°). The HSS score was improved from 70 points (range, 60–85 points) preoperatively to 91 points (range, 84–98 points) ($p < 0.001$) at the final follow-up. No extension lag, skin necrosis, quadriceps weakness, wound dehiscence or quadriceps tendon rupture occurred.
Conclusions: Mini-invasive quadricepsplasty-associated arthroscopic lysis and manipulation of the knee in flexion is simple and easy and should be considered as a legitimate treatment for arthrofibrosis of the knee.

Introduction

Arthrofibrosis of the knee is a common complication, usually caused by trauma or surgery, that results in the loss of knee motion. Severely arthrofibrotic knee may result in significant functional impairment. Despite it has been reported widely, the treatment of a severely arthrofibrotic knee represents a dilemma faced by orthopedic surgeons. Many methods have been introduced to treat arthrofibrotic knees, including two classical procedures, Thompson quadricepsplasty and Judet quadricepsplasty, and their modifications.[1–5] These traditional procedures require extensive exposure and have a high rate of associated complications, such as extension lag, skin necrosis, recurrent adhesion, and wound dehiscence.[1,6–10] Additionally, although a number of new treatment techniques exist, their outcomes remain suboptimal.[11–13] Thus, there is no consensus regarding the ideal treatment strategy has been reached. The purpose of this study was to introduce a mini-invasive operative technique and to report the treatment outcomes of 17 consecutively treated severely arthrofibrotic knees.

Patients and methods

The present retrospective study comprised 17 knees in 17 patients who were admitted to the Central Hospital of Lishui City and Dou's Traumatology Hospital of Jinyun County, Zhejiang Province, China between Nov 2010 and May 2014 with postoperative arthrofibrosis of the knee resulting from femoral and periarticular knee fractures and anterior cruciate ligament injury. The study was approved by the research committee of our institute. The study group comprised 12 males and 5 females with a mean age of 44 years (range, 19–62 years) (Table 1). Causative factors for arthrofibrosis included a mid-shaft femoral fracture in 4 patients, a distal femoral fracture in 7 patients, a tibial plateau fracture in 2 patients, a femoral shaft fracture associated with an ipsilateral patellar fracture in 1 patient, a tibial eminence anterior cruciate ligament avulsion fracture in 2 patients, and a patellar fracture in 1 patient (Table 1). All patients received early surgery after trauma. All patients failed a controlled nonoperative regimen of physical therapy, which lasted for a period of 1–5 months, and manipulation under

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Table 1
Patient data.

Case	Gender	Age (yr)	Initial diagnosis	Treatment	ROM (deg)			HSS (points)	
					Preo	*Immediately*	*Final*	*Preo*	*Final*
1	M	44	Distal femoral fracture	Open reduction and internal fixation, plate	2–28	0–120	0–125	66	89
2	M	55	Anterior cruciate ligament avulsion fracture from tibia	Open reduction and internal fixation, cerclage wire	0–42	0–127	0–130	72	90
3	M	61	Patella fracture		7–26	2–131	2–123	65	85
4	M	46	Tibial plateau fracture	Open reduction and internal fixation, plate	0–50	0–124	0–127	80	93
5	M	62	Mid-shaft femoral fracture	Open reduction and internal fixation, plate	0–18	0–130	0–132	62	95
6	M	37	Distal femoral fracture	Open reduction and internal fixation, plate	9–34	4–121	3–124	71	88
7	M	52	Distal femoral fracture	Open reduction and internal fixation, plate	0–20	0–132	0–130	84	94
8	M	41	Tibial plateau fracture	Open reduction and internal fixation, plate	0–10	0–124	0–120	63	90
9	M	53	Distal femoral fracture	Open reduction and internal fixation, plate	0–12	0–127	0–123	64	93
10	M	24	Mid-shaft femoral fracture	Open reduction and internal fixation, plate	3–29	0–125	0–129	77	98
11	M	45	Femoral shaft fracture associated with an ipsilateral patellar fracture	Open reduction and internal fixation, plate and cerclage wire	5–30	0–130	0–129	68	87
12	M	46	Mid-shaft femoral fracture	Open reduction and internal fixation, plate	4–49	0–126	0–125	82	96
13	F	44	Distal femoral fracture	Open reduction and internal fixation, plate	6–38	1–121	0–124	61	94
14	F	19	Anterior cruciate ligament avulsion fracture from tibia	Open reduction and internal fixation, cerclage wire	0–21	0–121	0–130	62	90
15	F	43	Distal femoral fracture	Open reduction and internal fixation, plate	2–9	0–120	0–128	60	84
16	F	38	Mid-shaft femoral fracture	Open reduction and internal fixation, plate	0–56	0–131	0–136	85	92
17	F	37	Distal femoral fracture	Open reduction and internal fixation, plate	15–33	2–127	2–124	77	95

Preo – preoperatively; *Immediately* – immediate postoperatively; *Final* – the final follow-up.

anesthesia. Patients with any of the following were excluded from the study: distal femoral deformity, patellar fusion to the anterior aspect of the femur, weakness of the quadriceps muscles secondary to neurological deficit, and interruption of the knee extensor mechanism. The criteria of Judet were used to access clinical outcomes.

Surgical technique

The surgical procedure is sequential and comprises three states: mini-incision release, “pie-crusting” lengthening of the quadriceps extensor, and arthroscopic lysis of the arthrofibrotic knee, and manipulation of the knee in flexion after each state. The operative procedure is performed under epidural or general anesthesia, with the patient in a supine position. Tourniquet use is optional; a tourniquet is placed proximally around the thigh but is not inflated in the first two stages unless troublesome bleeding occurs.

As previously described by Wang et al,[11–13] the first stage, mini-incision release, consists of releasing the quadriceps extensor, suprapatellar pouch, lateral patellar retinaculum, patellofemoral joint space, and the vastus medialis expansion. A 5-cm longitudinal anterolateral skin incision is made starting from the superolateral corner of the patella and extending 5 cm proximally (Fig. 1 skin incision). After the quadriceps extensor and the suprapatellar pouch released from the femur using a periosteal elevator, a blunt curved dissection scissor is used to incise the lateral patellar retinaculum along the lateral border of the patella and patellar tendon percutaneously, and to separate the adhesions within the patellofemoral joint space, and to incise the medial and lower part of the vastus medialis expansion using an inside-out technique. At this time, the first stage is completed, and the maximum flexion of the knee is examined by gentle manipulation and remains unsatisfactory due to quadriceps extensor contracture (Fig. 2 ROM before pie-crusting). The skin incisions are bilaterally retracted with right-angled retractors, and the rectus femoris and vastus intermedius adhesive tendons are appropriately exposed with the knee extended, requiring further management.

The second stage involves “pie-crusting” lengthening of the quadriceps extensor. Pie-crusting of the tendons is performed by poking an 11-blade scalpel straight through the tendons, distally to proximally (Fig. 3 pie-crusting). The cuts begin at the patellar insertion of the tendons, the length of the cuts and the interval between two cuts are approximately 6 mm and 5 mm respectively. Several staggered rows of cuts are made depending on the contracture severity, and the longitudinal fibers of the bilateral tendon edges are not cut to prevent tendon tears (Fig. 4 schematic diagram of pie-crusting). Manipulation of the knee in flexion is periodically attempted throughout the pie-crusting procedure to assess the arc of knee flexion, and the quadriceps extensor is gradually lengthened. Pie-crusting is considered complete once the flexion is 120° (Fig. 5 ROM after pie-crusting), and the skin is closed without closure of the fascia or muscle.

The third stage comprises arthroscopic lysis of the arthrofibrotic knee. After inflating the tourniquet, standard anterolateral and anteromedial portals are established. A blunt trocar is easily passed into the previously restored suprapatellar pouch. The arthroscope is inserted, and the joint is routinely inspected. Any adhesions of the suprapatellar pouch, medial and lateral gutters, intercondylar area, intercondylar notch, and anterior interval are debrided. Gentle manipulation is performed in flexion after adhesion lysis; the arc of knee flexion should reach more than 120°.

A suction drain is inserted to prevent hemarthrosis, and a bulk compressive dressing is applied using an elastic bandage wrapping from foot to thigh.

Fig. 1. Skin incision.