日小整会誌 (J Jpn Ped Orthop Ass) 13(2) : 204-210, 2004.

Distal Quadricepsplasty for Isolated Contracture in the Quadriceps in Children

Phan Duc Minh Man, Phen Quoc Vu

Center for Traumatology and Orthopaedics

Abstract **Purpose** : Evaluation of distal quadricepsplasty using the Z technique for improvement in flexion of the knee in isolated contracture in the quadriceps in children.

Methods : From 1990 to 2000, we have performed this technique on forty two cases of a stiff-knee, involving thirty two children. The procedure consisted of a plasty Z technique between the rectus femoris tendon and the vastus intermedius muscle, and expansion in the vasti on both the sides of the patella. Then, we released any remaining adhesions and flexed the knee to more than 120°. After treatment, the knee was immobilized at about 60 degrees, and a splint was worn usually for 2 to 3 weeks for exercises.

Results : Their mean ages were 8.9 years(range four to fifteen years) and the average duration of the contracture prior to operating was 6.4 years(range three to ten years). There were 3 cases being with superficial infection due to skin necrosis. At a mean of three years(range one to six years) after the operation, the clinical results for thirty-two knees involving twenty eight patients were analyzed :

Restored flexion of the knee : >120°(8 cases), 60-120°(20 cases) and<60°(2 cases)

Average extension lag 24.5°

One case presented swelling at the knee at 4 years after the operation due to walking long distances.

Function : good walking and running in 23 patients(82.1%), with 20 of these with 60-120° ; flexion of knee and limp gait and weak running in the other 5 patients(17.9%).

In those between 7 and 11 years old(12 cases), good function was achieved in all at 3 to 5 months after the operation.

Conclusion : This technique was simple in practice and can be successfully applied to young patients 7 to 11 years old, and can restore flexion of knee up to 120°.

Contracture in the quadriceps femoris muscle in children leading to limitation in flexion of the knee is now usually only seen in poor or developing countries[10][11]. Its cause may be congenital contracture as in congenital torticollis[1]-[5][14] or acquired as in ischemic myositis[4][6][9][11] or traumatic myositis[10][13]. We further suspect many are related to injections into the muscle which are now happening in Asian countries where they often use intramuscular injections of drugs

929 Tran Hung Dao St., Dist. 5 Ho Chi Minh City, VIETNAM
Tel : (848)9235791 Fax : (848)8351789
E Mail:phanman@hcm.vnn.vn

into the thigh for new born children[10,11]. This condition results in children who have an unstable quadriceps gait and are unable to squat. This makes functional activities difficult such as moving around the rice fields or on the rough roads as well as toiletting[10].

Although Hněvkovskî(1961) was the first to describe this condition, it was Gunn(1964) who first reported the comedation between the disease and intramuscular injections. Injections of drugs(antibiotic, vit K…) into the thigh caused progressive fibrosis similar to compression in the muscle bundles and capillaries in Volkmann syndrom, and then there was a delay between the injection and the contracture of up to several years[6,9].

In the literature, there are three techniques reported for treating this condition : proximal release in the quadriceps(Sengupta, Judet)[1,7], release in the fibrosis(Thompson)[1,8,13] and distal quadricepsplasty(Payr)[7,10,12]. In this paper, we present a study of using distal quadriceps plasty with the Z technique between the rectus femoris and the vastus intermedius. There is little physiotherapy in the provinces to conservatively improve knee flexion. Therefore we employed surgery to gain a range of knee flexion $>100^{\circ}$ to assist squatting and improve function[10].

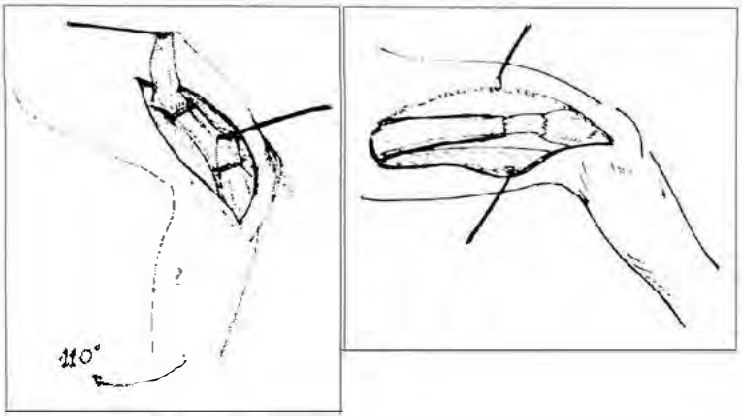
In this paper we present a follow-up study aiming to evaluate the distal quadriceps plasty with Z technique for the improvement in knee flexion. Thirty-two children presenting forty-two stiffknees were studied. Most of the children had received intramuscular injections in the thigh. A minimum follow-up of one year after surgery was a prerequisite for inclusion into this study.

Methods

From 1990 to 2000, this technique was routinely employed in children presenting stiff-knee. In this paper, we have retrospectively studied forty-two stiff-knees in thirty-two children, who had been followed for at least one year after surgery. Of these, 29 children had total stiff knee(with a range of motion between 0 and 5°) and 3 children with incomplete stiff-knee(with a range of motion between 0 and 25°). No child presented genu recurvatum. Their mean age was 8.9 years (range four-fifteen years), and the average duration of the knee flexion contracture prior to surgery was 6.4 years(range three-ten years). From their medical history, we noted intramuscular injection in the newborn(in 25 children), femoral fracture(in 3 children) and unknown etiology(in the other 4 children). We only practised this procedure when we made an incision through the skin and confirmed fibrosis in the rectus femoris muscle.

Functional evaluation included the range of motion, the walking gait, the distance the patient could walk, the ability to run, the ability to squat, and presentation of any pain or other complication. Any patient with a stiff-knee and deformity in the articular surface or any association with patella dislocation was excluded from this study.

The results from the operation were evaluated according to Mukherjee's classification with modifications. The results of the operation were classified as good(Group A) when the arc of active flexion-extension of the knee was between 90 and 120 degrees and the extension lag was under 25 degrees with normal walking, as fair (Group B) when the arc of active flex-



a|b

Fig. 1.

a : Detach the rectus femoris from patella insertion, and cut the vastus intermedius at a point at a distal third of the thigh, then divide the expansions of the vasti on both sides of the patella, sufficiently to achieve flex knee to more than 110°.

b : Quadriceps was lengthened by suturing the rectus femoris to the distal end of the vastus intermedius at 60° knee flexion.

ion-extension was between 60 and 90 degrees and the lag extension was larger than 25 degrees with or without slight limp, or as poor (Group C) when motion of knee was less than 60 degrees. Any patient with significant limp gait was classified as Group C. We also analysed the extent to which any extension lag affected the flexion of the knee and walking gait.

The procedure : An anterior longitudinal incision is made through the skin and superficial fascia from the distal third of the thigh to the distal pole of the patella. The deep fascia is divided along each side of the rectus femoris muscle and vastus intermedius from the proximal end of the skin incision to the patella, and these muscles are isolated from the vasti medialis and lateralis. Then the anterior part of the knee capsule is divided, including the lateral expansions of the vasti on both sides of the patella, far enough to overcome their contracture. In the next step, a z plasty is made between the rectus femoris tendon and the vastus intermedius, so the proximal transverse limb is in the position of the distal third of the vastus intermedius(conjunct tendon-muscle), and the distal transverse limb is in the position of the conjunction rectus femoris tendon and patella(Fig. 1-a). At this point, the knee is slowly plexed to 120 degrees, and any remaining intraarticular adhesions are released. In the Final step, the proximal stump of the divided rectus femoris tendon is sutured to the distal stump of the vastus intermedius, with knee joint at 45-60 degrees plexion(Fig. 1-b). A tourniquet is not necessary during this procedure but complete hemostasis is essential before wound closure. Postoperatively, the knee is immobilized using a splint at 60 degrees flexion for 2 to 3 weeks, after which the splint is worn for active quadriceps exercising. If the child is very young , the child is encouraged to practise active exercises during play and to wear the splint only at night.

Results

Most patients recovered significant flexion in the knee, compared with the preoperative condition. All were able to walk unassisted without ambulatory aid at three months after surgery. However, the majority had a slight limping gait that continued for more than six months and then decreased gradually to become normal walking in most(25/32 cases) of them by one year postoperatively. The remaining seven of the thirty-two children continued to present limping gait. Two of these recovered normal walking later, and there were only five with permenent sequelae, consisting of one case with secondary skin infection and needing to keep the flexion splint in 30° for 4 weeks for healing the wound. Another case had Turner syndrome and could not exercise unassisted. The other

Table 1. Correlation between arc of flexion extension and age

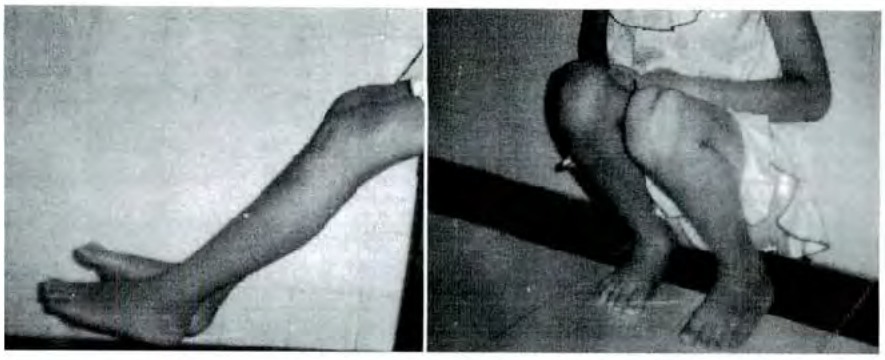
	Age			number of cases
	3 6 ys old	7 10 ys old	11 14 ys old	
Group A	4 knees	6 knees	0 knees	10
Group B	4 knees	9 knees	7 knees	20
Group C	1 knee	0 knees	1 knee	2

Table 2.

Case	Age	Sex	Prior duration with stiff knee (years)	Etiology ¥	Range of motion Postop‡ (R L)		Duration of Follow up (years)	Results Group	Walking Gait
1.	8	F	6	Fr	0 35 150	0 35 150	4	A	Normal
2.	8	F	6	UE	0 15 130		2	B	Normal
3.	10	M	6	Inj	0 10 100		2	B	Normal
4.	9	M	8	Inj	0 15 160		2	A	Normal
5.	9	M	5	Inj	0 10-150		2	A	Normal
6.	12	F	8	Inj	0 0 50		2	C	Limp
7.	13	F	8	Inj	0 15 80		1	B	Normal
8.	11	M	10	Fr	0 10 90		4	B	Normal
9.	11	F	10	Inj		0 20 120	4	B	Normal
10.	12	F	12	Inj	0 30 150		4	B	Limp
11.	4	F	3	Inj	0 25 140	0 20 120	4	B	Normal
12.	6	F	5	Inj	0 15 150	0 25 145	5	A	Limp
13.	10	F	5	Fr	0 20 140		1	A	Normal
14.	6	M	6	Inj		0 10 150	1	A	Normal
15.	5	M	5	UE		0 10 90	1	B	Normal
16.	4	F	4	Inj	0 10 150	0 10 150	4	A	Normal
17.	4	F	4	Inj	0 25 145	0 30 145	4	B	Normal
18.	4	F	4	UE	0 20 130		4	B	Normal
19.	10	M	6	Inj		0 0-110	4	B	Normal
20.	9	M	5	Inj		0 20 120	2	B	Normal
21.	7	M	6	Inj	0 10 145		6	A	Normal
22.	8	F	8	Inj		0 20 150	6	A	Normal
23.	4	M	4	UE†	0 0 50		3	C	Limp
24.	13	F	6	Inj	0 30 120		6	B	Normal
25.	7	M	5	Inj	0 20 130		4	B	Normal
26.	10	M	8	Inj	0 25 145		2	A	Normal
27.	9	M	5	Inj		0 0 90	5	B	Normal
28.	14	M	7	Inj	0 10 140		3	A	Limp

†Patient with Down's syndrome
‡Result evaluated on the operated knee (R=right, L left)
¥Etiology : Fr—Fracture, Inj Injection, UE=unknown Etiology

cases had only slight limping gait, and were in Group A. Functional follow-up was continued over the next years with some cases, and 12 children returned to hospital for a final follow-up examination. The other 16 children recewed a final follow-up examination when we visited and saw them at their houses, or final evaluation was based on the answers to questions that we sent to them if we could not meet them, The remaining 4 children were excluded from this study because they had been followed for less than one year at the time of this study, though they showed good walking and fair squating at that time.



a|b

Fig. 2.

a : Case 1, At 4 years postoperatively, with an extension lag of 35°.

b : patient can squat completely and walk normally. This patient later developed knee swelling at 4 years after the operation.

a|b

Fig. 3.

Case 12, stiff knee Bilateral, group A, followed for 5 years, walking with a slight limp gait.

It is important to note that Z plasty with full knee flexion of more than 120° may result in weakened muscle strength(demonstrated with high extension lag), and this result happened in Group A with 6/10 cases and most of these felt weak running a short distance.

This procedure may be not ideal for use in developed countries because its outcome is less effective than other surgical interventions. However, within the constraints of the health care provision in Vietnam, it resulted in functional improvement for patients in our care as well as bringing practical benefit for children living in the difficult socioeconomic situation prevauling in Vietnam.

Conclusion

This technique is simple in practice, effective and maybe best applied to patients at 7-11 years old and to those who cannot receive physiotherapy. It is successful in restoring knee flexion up to 120° for these patients. If more than 120° is attempted then there is some risk to the resulting quadriceps strength.

There were 28 children who had an average follow-up of 3 years(range 1 to 6 years). At this mean of three years, the clinical results for thirty-two knees, of the twenty-eight patients, were analyzed :

No child felt pain in the knee when standing up, walked a long distance, or ran a short distance.

Complication : There were 3 cases of infected skin due to necrosis, and one of these presented recurrent stiff-knee with under 60 degrees flexion.

The Force of the quadriceps muscle was normal when standing on the operated leg.

However, those cases with good squatting ability could not walk a long distance of more than one kilometer.

Restored flexion of knee : Group A(10 knees), Group B(20 knees), and Group C(2 knees). In Group A, there were 6 knees(in 3 children)being able to squat totally and stand up themselves. All of these were 7 10 years old (Table 1). Some(6/10 cases)of these had knee flexion over 120 degrees, related to high extension lag(Table 2).

The average extension lag at one year postoperatives was 24.5°. There were six cases that presented an extension lag greater than 25 degrees, and all of these recovered normal walking but felt weak when running more than one kilometre.

One child in Group A complained of knee swelling that developed at 4 years postoperativescaused by a walking long distances, but was able to squat totally(Fig. 2).

No case presented recurrent stiff-knee or postoperative decrease in the arc of active flexion extension of the knee at final follow-up.

Function : good walking and running were observed in 23 children(82.1%). In this group, there are 20 cases belonging to Group B(flexion 60-120°) and 3 cases belonging to Group A. However, these three cases continued to present slight limping gait during rapid walking or running. There were 5 children(17.9%)with persistent limping gait and weak running skills ; 17.9 with 3 children in Group A, and 2 in Group C(Fig. 3).

Results differed according to age : Those children in the 7-10 years old group(9 cases) had good function during the 3 to 5 months postoperatively, and the number of cases with good results(8/9)were better than in the other age groups(Table 1).

Discussion

The presented technique restored knee flexion > 90 degrees in most patients to help them move easily on rugged ground as well as improve toiletting in the province(82.1%) (Table 1). Although they could run and stand on the operated leg, they demonstrated slight weakness in the leg after walking long distances. This could be due to lack of postoperative therapy in the form of a strengthening programme. However, most reported a functional improvement postoperatively.

One disadvantage observed was extension lag (average 24.5 degrees) and only seen in Group A(Table 1) due to lengthening the quadriceps too much aiming to achieve full knee flexion. But this only affected the gait significantly when children practised rapid walking or played sports.

In our series, one child received the procedure for both legs and was able to squat totally, but developed intraarticular fluid collection in one knee after walking long distances, found at 4 years postoperatively(Case 1). This was treated by fluid removal and a period of rest. This sign may be predictive of early arthrosis from weakness in the quadriceps after lengthening.

In our experience, the ideal age at which to perform this technique was between 7 11 years. In our series, this age range was found to give better knee function at 7 11 years old than at any other age. We suggest this was probably due to these patients being able to exercise postoperatively which resulted in improvement in quadriceps strength, as well as their average duration of knee flexion contracture prior to

surgery was not long(Table 1).

References

1) Crenshaw AH : Campbell's Operative Orthopaedics, Mosby, St. Louis, 769 771, 1998.
2) FNK TJ, Barrett AM : Vastus Intermedius Contracture in Early Chilhood. J Bone Joint Surg 43-B : 326 334, 1961.
3) Gammie WEP, Taylor JH, Urich H : Contracture in the Vastus Intermedius in children. J Bone Joint Surg 45 B : 370 375, 1963.
4) Gunn DR : Contracture of the quadriceps muscle. J Bone Joint Surg 46 B : 492 497, 1964.
5) Hnevkovsk YO : Progressive fibrosis of the Vastus Intermedius muscle in children. J Bone Joint Surg 43 B : 318 325, 1961.
6) Jackson AM, Hutton PA : Injection induced contractures of the quadriceps in childhood. J Bone Joint Surg 67 B(1) : 97 102, 1985.
7) Judet R, Judet J, Lagrange J : Une technique de libération de l'appareil extenseur dans les raideurs du génou. Mém Acad Chir 82(29 30) : 944 947, 1956. (in French)
8) Hesketh KT : Experiences with the Thompson Quadricepsplasty. J Bone Joint Surg 45-B : 491, 1963.
9) Lloyd Roberts GC, Thomas TG : The etiology of quadriceps contracture in children. J Bone Joint Surg 46 B : 498 502, 1964.
10) Man Phan Düc Minh : Traitement de la raideur du genou en extension chez l'enfant, mémoire Traumatologie Orthopédie, 1994 (in French)
11) Mukherjee PK, Das AK : Injection fibrosis in the quadriceps femoris muscle in children. J Bone Joint Surg 62 A(3) : 453 456, 1980.
12) Nicoll EA : Quadricepsplasty. J Bone Joint Surg 45 B : 483, 1963.
13) Thompson TC : Quadricepsplasty to improve knee function. J Bone Joint Surg 26 : 366, 1944.
14) William PF : Quadriceps contracture. J Bone Joint Surg 50 B : 278 284, 1968.