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Operative Treatment of the Knee Contractures in Cerebral Palsy Patients

Zoran Bozinovski, Neron Popovski

University Clinic for Orthopedic Surgery, Skopje, Republic of Macedonia

Corresponding author: Assoc. Prof. Bozinovski Zoran MD. PhD: Str. Vodnjanska 17, 1000, Skopje, R. Macedonia; tel. +38970260786, e-mail: bozinovski.z@gmail.com

ABSTRACT

Introduction: Knee flexion is one of the main problems of the lower extremities in cerebral palsy patients. Many operative procedures are recommended for contractures of the knee in cerebral palsy patients. We performed simple operation and analyzed the results after operative treatment with nine years follow up. **Method** : 85 patients with spastic cerebral palsy were treated in period 2001 – 2010. 40 were ambulatory and 45 non ambulatory with ability to stand with support. All of them underwent same surgical procedure with distal hamstrings lengthening. Tenotomies were performed on m. semitendinosus, m. semimembranosus, m. gracillis and biceps femoris. Only m. semitendinosus was tenotomized completely, other muscles were tenotomized only on tendinous part. The patients had a plaster immobilization for five days after the surgery with the knee extended. **Results**: All 85 patients had improvement of the popliteal angle pre and post operative respectively. Improvement in the crouch gait was noticed in the period of rehabilitation. We had no complication with the wound. Three of the patients had overcorrection and achieved recurvatum of the knees. **Conclusion**: We consider this procedure very simple with satisfying improvement of standing, walking and sitting abilities in children with spastic cerebral palsy.

Key words: Cerebral palsy, knee flexion contracture, distal hamstrings lengthening.

1. INTRODUCTION

Knee flexion contracture is one of the main problems of the lower extremities in cerebral palsy patients. The prerequisites for normal gait are: stability in the stance phase of gait, clearance of the foot in the swing phase, proper foot preposition in swing, and an adequate step length. In the stance phase, the knee provides shock absorption and energy conservation; in the swing phase, it allows foot clearance. To accomplish these functions, the knee must extend fully in stance and flex approximately 60 degrees in swing. Consequently, balanced muscle action at the hip, knee, and ankle joints, combined with adequate acceleration from the hip flexor and triceps sure muscles, is essential (1). These prerequisites are not met in patients with spastic cerebral palsy due to the primary neurological condition and therefore are considered as primary reasons for the most common sagittal contractures and deformities in these patients. These conditions in most cases lead even the collaborative patients to relinquish their efforts for walking.

There are many surgical options for treating the flexion contracture of the knee in spastic cerebral palsy patients, some are soft tissue only like distal hamstring lengthening (2, 3), distal hamstring lengthening combined with posterior knee capsulotomy or knee extensor mechanism shortening (4), medial or combined medial and lateral hamstring lengthening procedures (5).

Our approach to this problem is treating these patients with distal hamstrings, medial and lateral, lengthening.

2. PATIENTS AND METHODS

In the period 2001 – 2010, 85 patients with spastic cerebral palsy were treated. 40 were ambulatory and 45 non ambulatory with ability to stand with support. All of them underwent same surgical procedure with distal hamstrings lengthening. Tenotomies were performed on m. semitendinosus, m. semimembranosus, m. gracillis and biceps femoris. Only m. semitendinosus was tenotomized completely, other muscles were tenotomized only on tendinous part. The patients had a plaster immobilization for five days after the surgery with the knee extended. We divided the patients in two groups- ambulatory and non-ambulatory patients. We divided the patients further in four age groups (5-7y, 8-10y, 11-13y and 14-16y) and analyzed the values of the popliteal angle pre-operative and at nine years of follow-up postoperative with chi-square and t-test.

3. RESULTS

The group of ambulatory patients had total of 40 patients. The average values of the popliteal angle was 76,82 degrees in the group of 5-7y, 70,46 degrees in 8-10y group, 68,13 degrees in 11-13y and 61,35 in 14-16y group (Table 1). At the follow up we found improvement of the values of the popliteal angle in all of the age groups ranging from 123,14 degrees in 5-7y group to 101,94 in 14-16y group (Table 2). We analyzed the data using the chi-square and t-test. These tests confirmed high statistical significance of the postoperative results (p<0,0001) (preoperative val-

Age	Patients	Bilateral	Mean	Min	Max	St. dev
5-7	8	16	76.82	70	90	6.38
10-Aug	16	32	70.46	55	90	8.77
13-Nov	10	20	68.13	60	85	7.65
14-16	6	12	61.35	50	80	8.52

Table 1. Ambulatory patients preoperative popliteal angle

Age	Patients	Bilateral	Mean	Min	Max	St. dev
5-7	8	16	123.14	100	145	11.47
8-10	16	32	120.81	110	140	9.22
11-13	10	20	119.31	110	140	11.52
14-16	6	12	101.94	95	130	12.51

Table 2. Ambulatory patients postoperative popliteal angle

ues of the popliteal angle compared with postoperative values and also high statistical significance of the results comparing the separate age groups).

The group of non-ambulatory patients comprised total of 45 patients with ability to stand with support. The average values of the popliteal angle preoperative was 68,60 degrees in the group of 5-7y, 74,85 degrees in 8-10y group, 64,75 degrees in 11-13y and 58,56 in 14-16y group (Table 3). At the follow up we found improvement of the values of the popliteal angle in all of the age groups ranging from 130,50 degrees in 5-7y group to 107,77 in 14-16y group (Table 4). Using the same statistical test as in the ambulatory patients we found high statistical significance of the postoperative results in the non-ambulatory patients ($p<0,0001$) (comparing the preoperative values with the postoperative values of the popliteal angle and also high statistical significance of the results comparing the separate age groups).

We did not find a statistical significance comparing the

Age	Patients	Bilateral	Mean	Min	Max	St. dev
5-7	15	30	68.60	50	90	9.82
8-10	13	26	74.85	60	90	8.60
11-13	18	36	64.75	50	80	8.40
14-16	9	18	58.56	50	70	6.85

Table 3. Non-ambulatory patients preoperative popliteal angle

Age	Patients	Bilateral	Mean	Min	Max	St. dev
5-7	15	30	130.5	100	150	13.54
8-10	13	26	129.03	100	150	12.33
11-13	18	36	118.19	100	140	12.25
14-16	9	18	107.77	90	125	9.11

Table 4. Non-ambulatory patients postoperative popliteal angle

postoperative values of the popliteal angle comparing the ambulatory with the non-ambulatory group ($p>0,005$).

Also we found lower correction of the popliteal angle in the ambulatory patients compared to non-ambulatory in all age groups except in the group of 11-13y (in ambulatory patients group 5-7y 5,6% less, 8-10y 6,3% less, 11-13y 0,9% more, 14-16y 5,4% less).

4. DISCUSSION

Patients with spastic cerebral palsy are highly demanding both for their caregivers and for the clinicians treating these conditions in order to obtain the best possible result with the treatment of this condition. Gait abnormalities in children with cerebral palsy are the consequence of contractures across joints, muscle spasticity, and physically inappropriate muscle action. Though abnormalities involving one of the major joints of the lower extremity will usually have consequences on the function of the other joints, it is possible to recognize certain primary disorders at each joint. The most common gait abnormalities of the knee in patients with cerebral palsy occur in the sagittal plane. Based on the experience gained from performing gait analysis on more than 588 patients with cerebral palsy, four primary gait abnormalities of the knee have been identified: jump knee, crouch knee, stiff knee, and recurvatum knee (6). The treatment options of patients with spastic cerebral palsy range from conservative to surgical treatments depending on the severity of the condition (7, 8). Analyses have been made to understand the relationship between the joint contractures in cerebral palsy patients and their effect on stance and gait (9).

In the treatment of the flexion knee contracture in spastic cerebral palsy patients we focused on the soft tissue procedures. Authors have been describing various soft tissue procedures comprising distal hamstrings lengthening alone or combined with posterior knee capsulotomy and quadriceps mechanism shortening (2, 3, 4, 5). The values of the popliteal angle that we obtained postoperatively with our method of choice are comparable and consistent with the results of the similar studies (10, 11). Improvement of the crouch gait was obtained in the rehabilitation period. We did not find any wound complications. Three of the patients had overcorrection and achieved recurvatum of the knees.

5. CONCLUSION

We consider that, distal hamstrings lengthening is a simple surgical procedure with satisfying and reproducible improvement of the popliteal angle. With this procedure we can achieve improvement of the standing, walking and sitting abilities in children with spastic cerebral palsy.

CONFLICT OF INTEREST: NONE DECLARED

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