

CLINICAL STUDY

Long-term results of surgical treatment of patients suffering from cerebral palsy

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Abstract

Objectives: Cerebral palsy is defined as a syndrome subsequent to attack of developing brain and characterized by loss of normal control of motor function. Orthopaedic surgeon have to select patients who will have benefit from surgery, and to perform it by that way, that will improve the motorical ability of the child.

Background: The operations performed in the past at one level were replaced by modern „multilevel approach“ in case of need. The aim of this study was the analysis of the long term results of that new surgical approaches.

Methods: Evaluated were 275 patients diagnosed as having spastic or mixed form of cerebral palsy (CP). The average age at the time of surgery was 7.8 years (3 to 16 years). Altogether in 20 years 941 surgical procedures, mainly on the lower limbs were performed.

Results: Overall 9 % excellent, 53 % very good, 26 % good and 12 % bad results were achieved. Using single level unilateral operations 7 % excellent, 46 % very good, 30 % good and 17 % fair results were achieved. Comparing to this, using the modern methods, 11 % excellent, 57 % very good, 23 % good and 9 % of bad results were achieved.

Conclusion: Authors believe, that the broad and early multilevel surgery, accomplished with proper physiotherapy is an important fact for improvement of outcome in treatment of children suffering from cerebral palsy (Tab. 2, Ref. 6).

Key words: cerebral palsy, operative treatment.

Neuromuscular diseases have many common features but their appearance in musculo-skeletal system is in many instances different. Any way, all of them are featured by a restricted movement leading often to contractures of muscles, joint deformities, and reduced quality of life.

The definition of the cerebral palsy is obscure. We understand cerebral palsy as syndrome whose subsequently to attack of developing brain is characterized by loss of normal control of motor function. In addition, some disturbances of sensory and intellectual function can be found (1).

The first what the orthopaedic surgeon can and MUST know, is to “pick-up” the child who will have benefit from surgery, and to perform it by that way, that will improve the motorical ability of the child (2).

Patients and methods

The main target for surgery was verticalisation and improvement of patients mobility, and palliative procedures or improve-

ment of hygiene for severely handicapped patients. Another indication was negative response to prolonged physiotherapy with regression of the range of movement.

Surgery was done between 1979 and 1998 on 445 patients, 207 girls and 238 boys diagnosed as having spastic or mixed form of cerebral palsy (CP). Altogether 941 surgical procedures were done. The age at the time of surgery was 7.8 years (3 to 16 years). Most operations were performed on children aged 8.4 (5–9) years. Surgery was performed in rare occasions on children under 2 or over 16 years (Tab. 1).

In the 11 patients having spastic monoplegia, preoperatively seven were able to walk with special shoes and 4 with orthoses.

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Tab. 1 a. Distribution of the patients according to the age and sex 1979–1993.

Age? Year	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	Total
1																0
2					3		1	1								5
3		1	1			2	5	2		1		1	1			14
4			1	1		2	3		4		1	1	1	1	1	16
5	1	1			3	2	3	1		3	2			2	2	20
6	2	1	2		2	1	2	1	2			1	3	1	2	20
7	1	1				1	2	2			3	2		1	1	14
8	1	1	1	1	1		2		4				1	1	1	14
9		1			5	2	1	2	2				2	1	1	17
10	2	2			1	1	2		1			2	1	2	1	15
11	1	1				4	1				1	2	2			12
12							1	1	1		2					5
13				1		1			3			1		2	1	9
14				2	1	1	1		1		1	2		2	3	14
15			1		3	2	2	2	1				1		1	13
16							1	1						2	1	5
17		1		1				1						1	1	5
18				1				1	1							3
19				1											2	3
20						1		1					1			3
over			3				1					2	1		2	9
Male	5	6	5	6	14	9	12	11	12	1	5	10	7	9	12	124
Female	3	4	4	2	5	11	16	5	8	3	5	4	7	7	8	92
total	8	10	9	8	19	20	28	16	20	4	10	14	14	16	20	216

Of 44 hemiplegic patients, 23 were able to walk independently wearing special shoes, 19 using orthoses, and two with tripod crutches.

In the group of 129 children suffering of spastic diplegia, preoperatively 8 children walk with orthosis, 17 with tripod crutches and 31 with roller. Standing independently were able 12 children, 46 with support. Six children were able to sit without support, and nine with support of the upper part of the body. Nonwalkers were 73 children.

In children with triplegia four were able to walk with tripod crutches and 14 with rollers. Eight patients were able to stand and one to sit with support. Nonwalkers were 9 children.

In the group of quadruplegics (77 children) only three were able to stand without support and 19 with support. Six children were able to sit without, 20 with support of upper limbs and 18 with additional support of the back. All 77 were nonwalkers.

Surgical procedures

Until 1994 the procedures were done unilaterally and at one level. Preferred were soft tissue procedures. Since 1994 multi-level, bilateral operations were done in one session (in the case of need).

At the third level – hip joint region, we paid special attention to the problematics of adductors. This was the second most often used procedure. By this we performed in 1979–1993, 50 adductor tenotomies and in 1994–1998, 184 open adductor tenotomies. In 14 children we also performed in addition iliopsoas tenotomy, bilaterally. The indication for this procedure was the increase of migration percentage and clinically progressive shortening of these muscles. The effect of pelvic osteotomies on the hip joint stability was not analyzed here.

At the second level – knee, we performed altogether 213 hamstring lengthenings. Until 1993 in addition to hamstring lengthening also neurotomy was performed, but because of unpredictable results this procedure was abandoned.

For six children having fixed contractures over 30 degrees in addition to tenotomy of distal hamstrings we perform also posterior capsulotomy, and distal patellar retinaculum and tenotomy of gastrocnemius aponeurosis. Postoperatively we use P.O.P. back slab for 6 weeks, with early mobilisation. Distal hamstring lengthenings in 113 occasions was done on the musculotendineous junction and 100 by the classical “Z” lengthening. Unilateral medial hamstring tenotomy was done on 32 percent of all hamstring releases. Between 1979 and 1993 61 mostly unilateral classical “Z” hamstring elongations were done. Since

Tab. 1 b. Distribution of the patients according to the age and sex 1994–1998.

Age/year	94	95	96	97	98	Total
1						
2			1	2	2	5
3			1	4	5	10
4	1			7	7	15
5	2	1	5	9	6	23
6	3	2	4	7	13	29
7	2	1	3	3	6	15
8	4	5	5	7	9	30
9	2	3	4	2	6	17
10	3	2	4	3	2	14
11	5	1	2	8	4	20
12	1		3	2	8	14
13			2	3	5	10
14	1	1	2	2	1	7
15	2		1	1		4
16		1	1	1	2	5
17						0
18			1			1
19						0
20						0
Over 20	4	1	1		3	9
Male	16	7	14	36	40	113
Female	14	11	26	25	39	115
Total	30	18	40	61	79	228

1994 till 1998, 152 distal hamstring lengthening on musculotendineal junction, and 8 proximal hamstring lengthening was performed.

Most surgical procedures were done on the first level – ankle and foot. Tendon Achilles lengthening was performed at 227 occasions, Vulpius and Strayer technique was used for 82 occasions (altogether 309 operations). Between 1979 and 1993, 107 “classical Z” tenotomies of Achilles tendon was performed. Since 1994 till 1998 we performed 120 Achilles tendon lengthenings mostly based on Hoke’s sliding technique. In this period also 41 Strayer and 41 Vulpius elongations of triceps surae muscle were done.

Another surgical procedure at this level (with or without combination with Achilles tendon lengthening) were 10 plantar fasciotomies, and 18 flexor hallucis longus tenotomies. For equinovarus deformity tibialis posterior tenotomy (9 operations) or it’s transfer – 3 surgical procedures was done. For flexible feet we performed tibialis anterior tenotomy (twice) or it’s split transfer (at 8 occasions) with insertion of the splitted part to the basis of fifth metatarsal.

For severe fixed deformities of the foot we performed for nine patients wedge tarsal osteotomy or triplearthrodesis (also for 9 children). For younger children (less than 12 years old) with moderate planovalgus deformity we used Green/Grice extraarticular arthrodesis in 11 occasions – for 8 with double cortical grafts according to Smetana (8) and 3 with screw fixation.

Results

After the surgery the patients were observed as follows; 14 days postoperatively, and than invited for evaluation of ROM at each level (and in case of need X ray examination) and their

Tab. 2 a. Evaluation of the postoperative results (1979–2005).

Result	Monoplegia		Hemiplegia		Diplegia		Triplegia		Tetraplegia		Total	
	n	%	n	%	n	%	n	%	n	%	n	%
Excellent					15	11	1	7	9	12	25	9
Very good	10	91	38	86	68	53	8	57	22	28	146	53
Good	1	9	6	14	32	25	4	29	28	36	71	26
Fair					14	11	1	7	12	16	27	10
Very fair									6	8	6	2
No of operations	11	4	44	16	129	47	14	5	77	28	275	100

Tab. 2 b. Evaluation of the postoperative results (1979–1993).

Result	Monoplegia		Hemiplegia		Diplegia		Triplegia		Tetraplegia		Total	
	n	%	n	%	n	%	n	%	n	%	n	%
Excellent					4				3		7	7
Very good	4		15		19		4		7		49	46
Good	1		3		17		1		10		32	30
Fair					8		1		7		16	15
Very fair									2		2	2
No of operations	5	5	18	17	48	45	6	6	29	27	106	100

Tab. 2 c. Evaluation of the postoperative results (1994–2005).

Result	Monoplegia		Hemiplegia		Diplegia		Triplegia		Tetraplegia		Total	
	n	%	n	%	n	%	n	%	n	%	n	%
Excellent					11		1		6		18	11
Very good	6		23		49		4		15		97	57
Good			3		15		3		18		39	23
Fair					6				5		11	7
Very fair									4		4	2
No of operations	6	4	26	15	81	48	8	5	48	28	169	100

functional ability (sitting, standing, walking) at 6 weeks and then 3, 6, 12 months and yearly. In this way we were able to evaluate together 275 patients, from 3 to 22 years after the surgery.

We evaluated the results of treatment according to proposals for postural and movement standards (3).

We compared pre and post-operative ability of patients, and in addition the best movement which the child was able to do.

The postoperative results were assessed as;

- 1) excellent – child preoperative horizontal became verticalized,
- 2) very good – improvement in 2 grades (see explanation),
- 3) good – improvement in 1 grade,
- 4) bad – no improvement,
- 5) very bad – worsening.

Of 445 patients who underwent 941 surgical procedures we were able to examine 275 with 453 surgical procedures. Excluded were 170 patients (156 surgical procedures). Their documentation was incomplete, missed X rays or surgical procedures not well described.

Excellent, very good and good results were obtained in 62 percent of patients (before 1994, 83 % of 106 patients, and after 1994, 91 % of 169 patients). In this group were patients who changed horizontal to vertical position or significantly improved their function. Bad or very bad results were achieved in 12 % of patients (before 1994, 17 % of 106 patients and after 1994, 9 % of 169 patients) (Tab. 2).

There were no patients with spastic monoparesis or hemiparesis who have excellent or bad and very bad results.

Of 129 patients suffering spastic diplegia 15 were unable to stand without support, 46 were unable to walk, but able to stand with support and only 12 without support. After the operation all 15 were verticalized (excellent results); five of them are able to walk with walker or tripod crutches and 10 free, without support, wearing normal shoes. In 68 patients from the group of spastic diplegia we observed improvement in two grades (very good results). All of them are able to walk with or without support. Improvement of one grade (good results) for patients suffering spastic diplegia we recorded for 32 children. In this group 14 children had bad results, because five had relaps of adduction contracture of hip, 4 relaps of knee contracture and 5 equinus deformity. In three children after repeated more extended surgery for the knee contracture and 5 hip contractures we achieved good motion of the joints.

As expected the worse situation was in the group of tetraplegic patients (despite 76 % of excellent to good results) because in this group 8 % had very bad and 16 % bad results of all tetraplegics. In this group we achieved excellent results in 9 children (12 %); 8 of them were able to sit only with support of upper limbs and one without support. Postoperatively all nine are able to walk with rolator. For 12 children in this group the results are bad; 8 are unable to turn themselves in bed and 4 are able to sit with support, as before surgery. In six patients there was worsening after the operation. All these patients suffer of a severe form of mixed spastic – athetotic CP, with marked mental retardation. All these patients had painful dislocation of both hip joints before surgery. The large soft tissue release (catarsis of the hip joint) with relief of pain in three of them, but no change of mobility. We are of the opinion, that patients who were assessed as having excellent results, belong more to the group of diplegic than quadruplegic patients. On another hand, if the relief of pain will be considered as good (or even very good results) the final score for this group should be different.

Discussion

According to the anatomical distribution, at the upper level procedures we assessed 64 children (124 open adductor tenotomies including 24 iliopsoas tenotomies without bony procedures). Our only one major complication at this level – cutting the femoral vein was treated successfully by vascular surgeon with no subsequent damage. This patient is now walking. Miller (4) referred about 80 % successfully treated subluxated hips in CP if tenotomy of adductors were performed at mean age of 4.5 years. Our results are similar – 70 % success.

In patients operated at the second level – knee we proved Reimers (5, 6) quasi paradoxal statement, that their inability to sit comfortably is because of short hamstrings. Only 8 (8 %) of 99 evaluated procedures in 50 patients were unable postoperatively to straighten their legs (even after repeated surgery, included posterior capsulotomy). In two occasions the complication was persistent peroneal nerve paresis and in six another transient paresis of this nerve, caused by too rapid postoperative extension of the knee.

Another complication was genu recurvatum in four patients (7 elongations). The additional surgery at upper (hip) and lower (ankle) level did not improve this situation, and the children wear orthosis.

At the third level, the most used surgical procedure was lengthening of Achilles tendon. Overlengthening by “Z” technique observed in 16 instances caused severe calcaneo valgus deformity. In eight children later hamstring lengthening for knee flexion contracture didn't influence this deformity. In two patients shortening of the Achilles tendon recurred and one was reoperated.

Conclusion

We reviewed 275 patients treated for cerebral palsy from 7 to 27 years after the surgery. The surgery was performed in the past at one level. This was changed in 1994 by performing surgery at one stage at all affected levels, leading to quicker recovery as the first step for the “jump” in patients function.

Including more surgery on the musculotendinous junction instead tendons shortened the time of surgery preserving anatomical structures, and paralelly shortened the time of postoperative immobilisation.

Comparing the pre and post 1994 year policy we found in the modern approach 91 % of excelent, very good and good results.

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