Acta orthop. Scandinav. 34, 258–270. 1964.

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RESECTION OF THE OBTURATOR NERVE IN THE TREATMENT OF ADDUCTOR SPASTICITY IN CEREBRAL PALSY

By

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INTRODUCTION

Spasticity of the hip adductors is a common disability in cerebral palsy. Adduction of the thighs and scissoring of the legs interfere with balance, gait and sometimes even with physical care of the patient. Coxa valga and dislocation of the hip are not infrequently observed, especially in elderly patients. In the treatment of this deformity various surgical procedures have been suggested, but their value has been open to considerable doubt. Favourable reports during the first decade of this century were for a long time virtually ignored and as late as 5–10 years ago every form of operative treatment for adductor deformity was strongly criticized in many centres for cerebral palsy. Surgical procedures seem to have been miscredited mainly for the following two reasons; first, because operations were previously performed on a purely mechanical basis instead of being based on careful neurological, functional and developmental studies in each particular case, and secondly, because the necessity of intensive preoperative and postoperative physical training was neglected. This paper presents an analysis of a follow-up study, based on uniform evaluation of a clinical material before and after complete intrapelvic resection of the obturator nerve. Special emphasis has been placed on neurological classification, analysis of motor function before and after surgery, developmental aspects of motor and mental abilities and studies of undesirable side effects with regard to their character and extensiveness.

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HISTORICAL REVIEW

A functional disorder caused by spasticity of the hip adductors was early recognized as a very localized condition. Surgical intervention in order to relax the spastic muscles therefore seemed to be a procedure which justified therapeutic trial. In principle one of the following three ways was chosen to attain this goal:

1) Resection of muscle insertion; adductor tenotomy.
2) Interruption of impulses from the periphery stimulating muscular activity; division of posterior nerve roots.
3) Resection of the nervous supply to the adductor muscles; peripheral neurectomy.

Tenotomies were practiced during the late nineteenth century. Surgical procedures involving nerve elements were designed shortly before the first world war.

Foerster's operation (1908) comprises laminectomy and division of several posterior nerve roots. The results have been considered poor. The operation is practically abandoned and of little therapeutic interest.

Stoffel (1910) is generally credited with the idea of peripheral nerve resection. However, *Lorenz* (1891) and *Lauenstein* (1892) were the first to perform partial neurotomies together with tenotomies in spastic hip adductors. The procedure was extrapelvic. Intrapelvic extraperitoneal nerve resections were suggested by *Henschen* (1913) and *Selig* (1919). Their methods were considered to be modifications of the ideas of *Lorenz* and *Stoffel*. The intrapelvic technique became popular for some time but was soon considered too radical. It was stated by *Albee* (1919), *Foerster* (1922), *Bade* (1922) and *Silfverskiöld* (1924) that the results were no better than with extrapelvic approaches. It was also pointed out that the procedure held a risk of excessive muscle relaxation, leading to abduction contractures.

The lack of adequate analytical studies of clinical material, evaluated on a uniform basis both pre- and postoperatively, led to controversial opinions as to the value of peripheral nerve surgery. *Albee* (1919), when discussing nerve sections in his textbook wrote that they occasionally give satisfactory results, but are not uniformly practised in spastic paralysis. Negative as well as positive experiences have alternated in various reports: *Carrol & Craig* (1951), *Barnett* (1952), *Silver* (1957), *Phelps* (1957), *Banks & Green* (1960) and *Pollock* (1962). *Phelps* (1957) made a remarkable statement: "neurectomy of any type has no

permanent value in the treatment of cerebral palsy", thus ignoring the careful and positive report of *Stoffel* (1912). When reading *Lindeman's* recent textbook (1963), one arrives at a far more encouraging conclusion. Obturator nerve resection is said to decrease the spasm in the adductors in an exceptional way, especially in children of 4–6 years of age. The operation eliminates the scissoring gait and creates conditions under which the child can learn to walk.

SURGICAL PROCEDURE FOR INTRAPELVIC OBTURATOR NERVE RESECTION

We used the surgical technique devised by *Loeffler* (1921) and *Gocht* (1925). When the operation involved one side only, a longitudinal incision along the border of the rectus abdominis muscle was the usual practice. In bilateral neurotomies Pfannenstiel's square rectangular cut just above the symphysis was preferred. After opening of the anterior part of the rectus sheath the transversal fascia and the peritoneum were moved aside bluntly. With the fingers palpating through the soft connective tissue down to the obturator foramen it is easy to find the obturator nerve as a dense, round, mobile chord. A blunt hook is put around the nerve and electric stimulation is applied to check adductor muscle activity. Two or three centimetres are then resected. The wound is closed. As a rule there is no or very little bleeding. The child is often ready to be started on exercises by the next day. It is indeed a minor and very simple procedure, always well tolerated by the patient. It affects the child much less than an extrapelvic operation and requires no plaster immobilization.

THE ANATOMICAL BACKGROUND OF THE OPERATION

The adductor muscles are innervated in several ways and some muscles are doubly innervated. Even total resection of the obturator nerve therefore causes only partial denervation of the adducting muscles. They will become weaker but still have part of their function left.

The obturator nerve originates from L2, L3 and L4. Just before entering into the obturator foramen and the channel the nerve is divided into two branches. The anterior supplies adductor longus, adductor brevis and gracilis. The posterior, shorter branch goes to obturator externus and adductor magnus. Adductor magnus is also innervated from the sciatic nerve and the pectineus muscle is supplied by the femoral nerve.

INDICATIONS FOR SURGERY

In order to arrive at a proper classification of cases, acceptance of patients for operation was determined by the following qualifications:

1) Each case should be exactly classified with regard to neurological type and degree of disability.
2) The developmental and functional level of motor activity ought to be known in detail.
3) The aim of the operation in each particular case should be defined.
4) The patient's possibilities to benefit from the surgical procedure should be seriously considered.
5) The operation must be preceded—and succeeded—by carefully planned and intensive periods of physical training.

The main indication for operation has been a desire to achieve a better gait or to improve the child's chances of learning to walk or, if walking was not considered possible, to gain a more stable way of sitting. In a few cases surgery was performed with a view to facilitating physical care of the patient since pronounced adduction contractures caused sores in the groin. In a few other cases the operation was mainly performed to prevent hip dislocation when subluxation was already a fact.

CLINICAL MATERIAL

The clinical material consists of 41 cerebral palsy patients from 1–21 years of age. Patients operated upon after the age of seven had not been under our care before that age.

The distribution in age groups and types of cerebral palsy syndromes is illustrated in Table 1, indicating the evaluation before surgery. Most of the cases, 28 out of 41, had hypertonic diplegia of varying severity. The degree of preoperative deformity or disability is illustrated by the different groups in Tables 3, 4 and 5. The time of follow up after operation is found in Table 2. In roughly 15 per cent the period of follow up was less than two years, but in no case less than one year. All patients belonging to group I (Table 1) had received from several months to years of intensive preoperative physical therapy. All of them were also given postoperative physical training over a period of months or years. Preoperative treatment had only been advised in a few selected cases from group II (Table 1) while most of these children, especially

those with microcephaly and severe tetraplegia, were considered too mentally retarded to co-operate.

TABLE 1

General indication, clinical diagnosis and age at operation in 41 cases.

General indication for operation	Clinical diagnosis	Age in years at operation						
		1-3	3-5	5-7	7-9	9-11	>11	Tot. no.
Group I								
Improved	Hypertonic diplegia	6	8	6	2	1	5	28
motor function	Hypertonic hemiplegia	...	...	...	...	1	...	1
	Dystonic tetraplegia	...	...	1	2	...	...	3
Group II								
Mainly facilitation	Severe tetraplegia							
of physical care	in metally retarded	2	1	2	...	...	4	9

TABLE 2

Observation time for the clinical material (41 cases).

Clinical diagnosis	Time of follow-up in years				
	1-2	2-3	3-4	4-5	5-7
Hypertonic diplegia	4	7	7	7	3
Hypertonic hemiplegia	...	1	...	...	...
Dystonic tetraplegia	1	...	...	...	2
Severe tetraplegia + mental retardation	2	3	1	3	...
Total no. cases	7	11	8	10	5

The operation was performed on both sides in 34 patients and on one side in 7 (hypertonic hemiplegia 1; dystonic 1; hypertonic diplegia 5).

During the period of follow up other surgical interventions have been undertaken in 15 cases: release of the gastrocnemius in 11, transposition of the posterior tibial tendon in one and transposition of the biceps femoris in 4 cases. Adductor tenotomy, complementary to obturator nerve resection, was later performed in one case.

RESULTS

The results of surgery have been analysed during two different post-operative periods:

1) the immediate effect obtained within the first weeks of operation.
2) the late results after 1–7 years of follow-up.

This way of examining the patients offers a more reliable method of reaching an opinion about the surgical procedure as such, since both developmental factors and other, concurrent forms of treatment may interfere with the picture of late results.

The resection of the obturator nerve immediately breaks the reflexes to the spastic hip adductors, but also affects the spasticity at large. This immediate effect on muscle tone in the legs has been illustrated in Table 3. The table further shows that 4 of the 41 cases displayed obvious adductor hypotonia and insufficient adductor function during the early postoperative period. Slight symptoms of insufficiency occurred in many other cases the first days after surgery, but then decreased considerably.

TABLE 3

Immediate effect of obturator neurectomy on muscle tone in the legs.

Degree of adductor spasm	No. cases	Generally decreased hypertonus	Adductor hypotonia with insufficiency
Severe (Scissoring of legs in supine at rest)	17	14	3
Moderate ("Scissors gait")	15	14	1
Slight (Walking with adducted and slightly flexed knees)	9	9	0

A very surprising early result of the operation was the immediate improvement of internal rotation and flexion in the hip joint and the favourable effect on drop foot. Mostly, however, such improvement was of a minor degree and often only temporary.

One of the great advantages of the operation was without doubt the clearly improved way of sitting. This was true for most of the cases. The results in this respect can be seen in Table 4. The operation weakens the otherwise strong extensor thrust reflex, which forces the child backwards and interferes with balance. With improved sitting ability the child's mental development was found to gain favourably and often to a high extent. This was seen especially during the early postoperative period, mainly among our youngest children.

Astonishing was the rapid improvement in crawling and walking. Table 5 gives the results.

TABLE 4

Immediate effect of obturator neurectomy on the sitting position within the first few weeks in 37 cases (4 microcephalics excluded).

Capability in sitting posture	Before neurectomy	After neurectomy	Acquired capability
Tailor's seat	23	35	12
With abducted and extended legs	1	26	25
Steady on chair with support	20	31	11
Steady on stool without support	14	27	13

TABLE 5

Immediate effect of obturator neurectomy on creeping and walking ability within the first few months in 37 cases (4 microcephalics excluded).

Motor capability	Before neurectomy	After neurectomy	Acquired capability
Ability of holding crawling position ...	22	34	12
Crawling on hands and knees	16	25	9
Walking with walking aids	10	22	12
Independent walking	10	15	5

TABLE 6

Desired effect compared to actual results with obturator neurectomy at follow-up examination in 41 cases.

Clinical diagnosis (dominating syndrome)	For improved standing/walking		For improved sitting besides walking		For improved sitting posture only		For easier daily care	
	Desired	Actual	Desired	Actual	Desired	Actual	Desired	Actual
Hypertonic diplegia	25	23	25	25	3	3	...	...
Hypertonic hemiplegia	1	1	...	...	...	...	...	...
Dystonic tetraplegia	...	...	...	...	3	3	...	...
Severe tetraplegia in mentally retarded	...	...	...	...	5	5	4	4

Table 6–9 illustrate the late results. In Table 6 a comparison is made between the desired and achieved conditions. It can be seen that only rarely did the operation fail.

The basic reason for operation was to arrive at a better balance between adductor and abductors. Results in this respect are shown in Table 7, where the clinical material has been divided according to the

TABLE 7

Result of obturator neurectomy on adductor/abductor balance at follow-up examination.

Degree of adductor spasm	No. cases	Satisfactory improvement	Partial improvement	Unimproved adductor spasm	Improvement with adductor weakness
Severe (Scissoring in supine at rest)	17	5	9	0	3*
Moderate ("Scissors gait")	15	11	4	0	0
Slight (Walking with adducted and slightly flexed knees)	9	8	1	0	0

* includes the only case where adductor tenotomy was made in addition to obturator neurectomy.

TABLE 8

Effect of obturator neurectomy on other spastic leg deformities of the 28 cases with hypertonic diplegia.

Type of spastic deformity	Present before op. in no. cases	Useful improvement	Partial improvement but unsatisfactory	No. improvement	Deterioration
Tip toe gait	25	0	13	12	0
Internal rotation of legs	26	7	14	5	0
Hip joint flexion	27	12	10	5	0

TABLE 9

Undesirable results of obturator neurectomy at follow-up examination of the 28 cases with hypertonic diplegia.

Degree of motor handicap	No. cases	Remaining "scissors gait" (but improved)	Adductor insufficiency in walking	Adductor insufficiency in crawling	Hip joint instability
Independent walking	14	1	0	0	0
Walking with sticks	2	0	0	0	0
Walking with saw-horse crushes	4	1	0	0	2
Walking only in spec. walker	8	5	0	4*	3*
Total	28	7	0	4	5

* Three identical patients in these two groups.

degree of preoperative adductor spasm. The best results were found—not unexpectedly—in those children where the adductor spasm was less from the beginning. Table 8 presents the end results for other spastic deformities in the lower extremities. These results seem to be better than they really are, and are probably influenced by other operations performed during the follow-up period.

Undesirable consequences have been collected in Table 9. Scissoring gait remained in 7 of the 28 cases with hypertonic diplegia. In about ¼ of this material even a complete obturator nerve section was not enough to overcome adductor dominance in walking. Appreciable residual adductor insufficiency was observed in but a few cases, mostly affecting only certain activities. Not in a single case, however, did this weakness in the adductors affect the upright position or the gait. When walking, all of these patients still were scissoring. The weakness in the adductors would show up when the children were crawling. This was especially marked for the 4 most seriously affected cases in the diplegia group. These four children also had marked instability of the hips. Although this condition was apparent before the operation, the obturator nerve resection had made it worse. All these children did, however, show improvement in sitting. The parents and the physiotherapists felt that the children had gained from the operation in the long run, mainly with regard to many physical and mental activities. It was obvious that these cases with insufficient adductors represented a special type where the component of mucsular weakness dominated the spastic component. The rest of the cases where the effect of surgery was insufficient, represent the other extreme, with the spastic component strongly dominating.

DISCUSSION AND CONCLUSIONS

Our experiences have led us to conclude that this operation is easily overcome by the child and obviously very effective. In well classified and selected cases even small children will benefit. The surgical treatment should be combined with adequate physical training both before and after operation. After the operation the child should be brought back to the milieu where it has been trained preoperatively and where the physiotherapist is well aware of the problems for which surgery was suggested.

The operation is particularly suitable for cases with hypertonic diplegia of a moderate to pronounced degree. It also has its advantages

in different forms of severe tetraplegia where permanent adductor dominancy causes difficulties in sitting, lying or physical care of the patient. In most cases of dystonic cerebral palsy combined with more or less distinct athetoid shifts, operation should be avoided. In these cases the adductor spasm is never permanent, it is induced through changes in posture and is always variable.

One strong reason for suggesting operation in early childhood is the developmental aspect. The effect on the extensor thrust reflex, the negative influence of which is broken or markedly decreased by the operation, opens a way of utilizing motor and intelligence potential. These developmental conditions justify surgery even if experiences from a longer follow-up period than ours would show that the results may not persist into adult life.

In summarizing the effects of obturator nerve resection on motor function, it can be stated that:

1) *For walking and standing ability* the operation was found to give satisfactory results in all children with spastic diplegia of a slight degree. Instability of the hip joints occurred in a few of the severe cases with pronounced muscle insufficiency but the chances of improvement would in these cases not have been any better without an operation. In none of the cases was adductor insufficiency present in the upright position. A positive Trendelenburg sign was not found to contraindicate surgery.
2) In patients with hypertonic diplegia the operation was always beneficial *for sitting ability* often to a surprising degree. Negative effects on this function were never observed. This indication sometimes also holds true for severely disabled patients with the dystonic type of cerebral palsy, mainly those with concurrent spastic signs (ancle clonus, positive Babinski etc.). One must accept that in these cases standing and walking cannot be expected to improve. Sometimes, however, they do.
3) *For crawling and standing on the knees* improvement was not infrequently achieved. This was especially true in cases with strong spastic muscles. They often learned to crawl by alternating hands and knees, impossible to them before the operation. When there was a more pronounced general weakness of the muscles, insufficiency of the adductors was sometimes apparent in crawling, resulting in a swimming type of movements. However, these children could never crawl at all before the operation. In addition,

the adductor weakness was not seldom found to be temporary and partial.

4) *For better physical care* obturator nerve resection is justified in many instances where severe mental retardation is combined with tetraplegia. Microcephalic patients do not seldom develop pronounced adductor spasticity, prohibiting washing and clothing.
5) *Hip subluxation or dislocation* is not unusual in these mentally retarded cases. The operation should be performed before the deformity ends in a fixed dislocation.
6) When the hip *abductors were very weakened* resection of the obturator nerve was sometimes the only way of getting the hip joint into active abduction movements. This experience is an additional indication for surgery early in childhood.

SUMMARY

A follow-up study was made of 41 cases with cerebral palsy, who had been treated with intrapelvic resection of the main trunk of the obturator nerve for disabling spasticity of the hip adductors. The mean age at operation was 5 years. The time of follow-up was 3–4 years on the average. Bilateral operation was performed in 34 cases. Twenty-eight of the cases had spastic diplegia, 1 spastic hemiplegia, 3 dystonic tetraplegia, and 9 concerned a group of mentally retarded with severe tetraplegia. The operation was found to be of great value in well classified and selected cases. The indications are discussed. Special emphasis is laid on careful neurological, functional and developmental studies preoperatively, and on the necessity of intensive pre- and postoperative physical training.

RESUME

Une étude complémentaire a été faite sur 41 cas de paralysie cérébrale traités par résection intrapelvienne du tronc principal du nerf obturateur pour invalidité spasmodique des adducteurs de la hanche. A l'époque de l'opération, l'âge moyen était de 5 ans. La période d'observation a été en moyenne 3–4 ans. Une opération bilatérale a été pratiquée dans 34 cas. 28 des malades souffraient de diplégie spasmodique, un d'hémiplégie spasmodique, 3 de tétraplégie dystonique et 9 appartenaient à un groupe de retardés mentaux avec tétraplégie grave. On a trouvé que l'opération était de grande valeur dans les cas bien classifiés et bien sélectionnés. Il est discuté des indications. Il est recommandé en

particulier de procéder avant l'opération à des études minutieuses de l'état neurologique, fonctionnel, et aussi du développement du malade et il est insisté sur la nécessité d'un traitement d'entraînement physique intensif avant et après l'opération.

ZUSAMMENFASSUNG

Eine Nachuntersuchung von 42 Fällen mit cerebraler Parese, die mittels intrapelviner Resektion des Hauptstammes des n. obturatorius wegen verkrüppelnder Spastizität der Hüftadduktoren behandelt worden waren, wurde vorgenommen. Das Durchschnittsalter zur Zeit der Operation war 5 Jahre. Der Zeitpunkt der Nachuntersuchung war im Durchschnitt 3–4 Jahre. Doppelseitige Operation wurde in 34 Fällen ausgeführt. Achtundzwanzig der Fälle hatten spastische Diplegie, 1 spastische Hemiplegie, 3 dystonische Tetraplegie und 9 betrafen eine Gruppe von geistig Zurückgebliebenen mit schwerer Tetraplegie. In gut klassifizierten und ausgewählten Fällen erwies sich die Operation als sehr wertvoll. Die Anzeigestellung wird besprochen. Besondere Wert wird auf eine sorgfältige neurologische, funktionelle und entwicklungsmässige Untersuchung vor der Operation und auf die Notwendigkeit einer intensiven præ- und postoperativen körperlichen Übungsbehandlung gelegt.

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