FROM THE ORTHOPEDIC HOSPITAL, AARHUS, DENMARK
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ON OBSTETRICAL PARALYSIS OF THE UPPER EXTREMITIES

(Erb-Duchenne's and Klumpke's Brachial Plexus Paralysis.)

BY

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As to the etiology of obstetrical paralysis of the upper extremities, most authors now take it for granted that it arises during parturition as a result of birth injury. Among the more recent authors, however, some think it is due to other etiological factors.

Erlacher, for instance, thinks that in most cases the lesion arises before birth, as uterine contractions may wedge the head against the shoulder so that the brachial plexus suffers injury.

Also Weil thinks that only in a minority of the cases does the lesion arise from pressure of the forceps or pressure exerted by the fingers against the plexus in assisting the delivery, while most often it is the result of intrauterine pressure injury. In support of this view, he points out the occurrence of the paralysis in persons born by spontaneous delivery, and also that dangle joint (shoulder) is sometimes seen shortly after birth, besides very early atrophy. Finally, he mentions the very frequent combination of such paralysis and other congenital deformities—*e.g.*, torticollis, scoliosis and, especially, elevation of the scapula—the last-mentioned of which he takes in particular to be an etiological factor in the production of the paralysis.

Schubert thinks the lesion undoubtedly is hereditary and he likewise emphasizes its frequent combination with other deformities, in particular with elevation of the scapula. He assumes the high level of the scapula to be due to a *vitium primae formationis,* and he ascribes the paralysis to a developmental

defect in the central nervous system. He refutes, at any rate, the idea that the lesion in most cases should be due to birth injury—and also the hypothesis advanced by Weil, that uterine pressure should be the cause of the high scapula.

Blencke has reported two cases of obstetrical paralysis in mother and child and thinks that the coincidence of the two cases is to be explained only as attributable to a hereditary factor. He considers birth injury excluded; and yet he mentions a "schwere Geburt" in the case of the mother and "Zangengeburt" in the case of the child.

In our material, too, plexus paralysis has been encountered in relatives, namely in two sisters, B 10109 (Case 9) and B 7570 (Case 35) (see below); and recently we received a new case of Erb-Duchenne paralysis—a little girl (B 13147, Case 11) whose mother stated that two others of the 6 siblings of the child had presented a similar paralysis of the arm immediately after birth, but in their cases the affection had subsided spontaneously. Instead of assuming a hereditary factor, however, it seems more reasonable to ascribe the occasionally familial occurrence of the lesion to a hereditary appearance of a narrow pelvis resulting in difficult delivery. Indeed, such difficulties were present in both of Blencke's cases.

In the case of siblings with birth paralysis whose delivery was managed by the same obstetrician—something that probably will happen relatively often—we further have to think of the possibility that it might be a matter of poor technique on the part of the midwife or physician attending to the delivery. Thus, Bentzon cites Guillemot who obtained information about 30 cases of birth paralysis, some of them very severe, and all arising during deliveries managed by the same midwife.

Finally, Valentin has reported two cases of severe bilateral plexus paralysis which he had occasion himself to observe. Clinically the two cases were quite uniform. Both children died and autopsy revealed quite different findings: In one case the cervical intumescence of the spinal cord showed an affection that probably was of traumatic character and had led to destruction of the nervous substance, probably resulting from birth

injury. In the other case, which likewise was diagnosed as a bilateral plexus paralysis of the nerves from C_8 and Th_1, the autopsy revealed a focus in the spinal cord that in all probability had to be designated as infectious. During pregnancy the mother had been vaccinated three times for typhoid fever, and the possibility could not be excluded that the lesion in the child involved a typhoid focus. While Valentin in previous works had taken the stand that the birth mechanism in a majority of the cases was the cause of the paralysis, he now thinks, therefore, that we also have to presume the possibility of intrauterine origin—at any rate in bilateral plexus paralysis. Clinically, however, these two cases of Valentin's were of a character quite different from that of the usual Erb-Duchenne and Klumpke paralyses.

As mentioned, nearly all authors hold that congenital paralysis—at any rate of the types dealt with in this paper—arises during the process of delivery, and in this country, Bentzon has demonstrated experimentally that nerve injury may arise under the manoeuvres performed during delivery, and that in the great majority of these experimental cases the injury implicates just the nerves innervating the muscles involved in Erb-Duchenne paralysis.

In this type of plexus paralysis the following 7 muscles are involved: the deltoid, innervated by the axillary nerve; the supraspinatus and infraspinatus, innervated by the suprascapular nerve; the biceps brachii and the brachialis, supplied by the musculo-cutaneous nerve; the brachio-radialis and the supinator brevis, supplied respectively by the radial nerve and the deep branch of the radial nerve.

The brachial plexus itself will not be reviewed here. It suffices to mention that it is formed by the anterior rami of C_5, C_6, C_7, C_8 and Th_1. These unite into a braid situated between the scalenus anterior and medius, with its three upper roots above the subclavian artery, and the two lower roots back of this vessel, running herefrom along the subclavian artery, posteriorly to the clavicle, the subclavian muscles and the pectoralis, down into the axilla. Each root of the plexus sends a ramus communicans to the middle or inferior cervical

ganglion, before they enter the plexus. The long nerves to the arm and its muscles arise from the plexus, together with several shorter nerves to the shoulder and its surrounding muscles.

Bentzon thinks that the mechanism in the origin of the plexus paralyses is a forced separation of the cervical vertebral

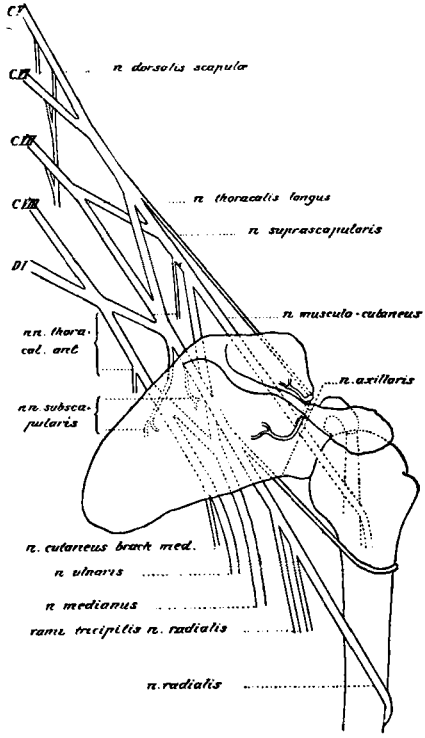


Fig. 1.

Schematic presentation of the stretching of the nerve under displacement of the scapula. (After Bentzon.)

column and the shoulder, resulting sometimes in overstretching of the brachial plexus with more or less extensive ruptures of its nerve trunks.

In such a manoeuvre the four nerves mentioned will be in danger of injury from overstretching, as the three last-mentioned nerves are fixed peripherally. The suprascapular nerve, running

through the incisura suprascapularis, is fixed to the scapula and has to follow its movements, even at the place where the afore mentioned manoeuvre gives the widest range of motion. The musculo-cutaneous nerve passes through the coracobrachial muscle near its origin from the coracoid process, and hence it has to follow the shoulder downwards. The axillary nerve is twisted round the cervical neck of the humerus, resting directly on the periosteum, so that it, too, has to follow the movements to their full extent.

The ulnar and median nerves, on the other hand, are not fixed, and hence they are able to avoid taking part in the movements.

As to the radial nerve, its main trunk is twisted round the body of the humerus, and when this nerve is not always injured under the conditions here mentioned, it is because the humerus in the forcible lowering of the shoulder is adducted, rotated outwards and brought forwards, and thus the stretching of the nerve is avoided. If conditions of delivery make this manoeuvre impracticable, also this nerve will be in danger of overstretching.

The conditions for the production of the Klumpke paralysis, in which nerves from the lower section of the plexus (C_8 and Th_1) are involved, may be present in various forms of traumatism. Sometimes it results from overstretching due to hyperelevation of the arm and shoulder, sometimes from particularly vigorous downward and backward forcing of the shoulder, in which cases the lower sections of the plexus probably are injured by squeezing between the clavicle and the first rib.

Frequency.

Obstetrical paralysis is not particularly frequent. Rendu gives 1 case in 1500 births. Duval & Guillain cite the following statistical data: Joly found 3 cases in 5460 births (Clinique Baudelocque) and 3 in 6000 births (Clinique de la rue d'Assas). Dr. Axel Olsen, obstetrician-in-chief of the Lying-in Hospital of Aarhus, has kindly permitted me to count the cases observed in that institution: in 30,688 deliveries in the last 25 years, the

lesion occurred in 26 cases, *i.e.*, about 1 case in 1200 deliveries. This figure also includes several cases of solitary radial paralysis.

Clinical Features.

General two main types of obstetrical paralysis of the upper extremity are recognized, namely:

1) Upper plexus paralysis, also called the Erb-Duchenne type, which is due to injury to the nerves from C_5 and C_6.

2) Lower plexus paralysis, also designated as the Klumpke type, due to injury to the nerves from C_8 and Th_1.

Sometimes, in addition, a third type is set up—the total plexus type—involving the entire arm. Finally, some authors (*e.g.*, Byron Stookey) recognize also a middle type, due to injury to C_7.

The distinction between these various types is not quite clear-cut, however, and there are several atypical forms, too. Moreover, obstetrical paralysis may also result from injury to solitary nerves as, for instance, isolated radial paralysis. The latter are rare phenomena, however. In this country, such cases have been reported by Hauch & Ottsen, Ekkert Petersen, Tingmann Petersen and Brun.

Of the types mentioned, the first one—Erb-Duchenne's paralysis—is by far the most frequent. In his statistical account of 1100 cases, Sever found this type in 864.

The lesion is more common on the right side than on the left. Sever gives this occurrence as 670 times on the right side, 430 on the left.

Undoubtedly this difference in the frequency of localization is attributable to the numerical preponderance of the vertex presentation (occipito-læva anterior) in delivery. For, with this presentation, the right shoulder and arm are located anteriorly in the parturient canal, and if the shoulders happen to get stuck, the right shoulder will therefore be more liable to injury from traction for delivery of the shoulders. In breech presentation, it is especially the socalled classical delivery of the arms that

is apt to result in strong traction, involving here, too, the right arm in most of the cases.

Obstetrical paralysis is equally frequent in the two sexes. The large material reported by Sever comprises 551 male and 549 female patients.

Erb-Duchenne's Paralysis.

From an orthopedic point of view the Erb-Duchenne paralysis is the most interesting, not only because it is the most common type of plexus paralysis, but also because, according to its nature, it is more amenable to treatment than the others.

The lesion is easy to recognize even immediately after birth. The paralyzed arm hangs perfectly inert along the trunk, inward-rotated maximally in the shoulder-joint, the elbow completely extended and the forearm markedly pronated. Absolutely free mobility (active) in the wrist and finger-joints is typical of such cases, although paralysis of the muscles of the hand supplied by the radial nerve is no uncommon finding, that is, volar and ulnar flexion of the hand.

This typical position of the arm is a natural result of the paralysis of the aforementioned 7 muscles, as the antagonists of these muscles at once produce the attitude described. When this takes place immediately after birth, it is due to the spasticity physiologically present in the newly born child. A similar injury in an adult will not at once result in such a position.

Clear-cut Erb-Duchenne paralysis is not associated with sensory disturbances. On the other hand, a mild form of Horner's syndrome is seen occasionally (cf. below).

In most cases of this kind the paralysis soon begins to subside, and complete recovery is attained within a few weeks. Rendu states that 80 % of these patients recover completely without any treatment whatever.

It is far from being the rule that the treatment of such cases is left to orthopedists; most often the treatment is directed by the family physician or by the obstetrician in whose clinic the child was born, and when patients who failed to recover

primarily are brought to an orthopedic clinic for treatment, they usually present a clinical picture somewhat different from the above.

As mentioned, the paralysis disappears rather rapidly. But, on the other hand, contractures make their appearance rather

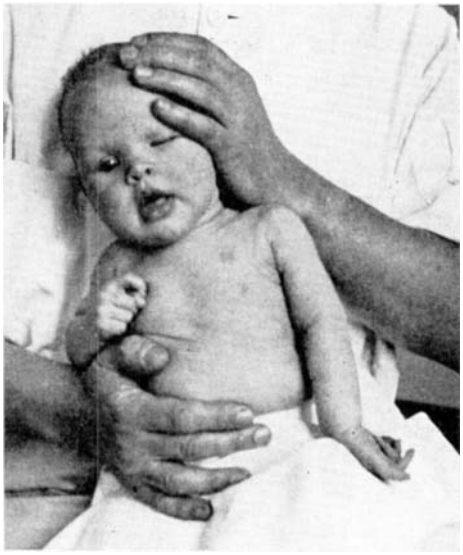


Fig. 2.
A recent case of Erb-Duchenne paralysis complicated with a radial paralysis. (Patient B13234, Case 12.)

rapidly, too, and these phenomena usually constitute the predominant clinical features, while remnants of the paralysis are seen only in the more recent cases.

Bentzon has set up the following 4 stages of the lesion, chiefly based on therapeutic considerations:

1) The newborn child.

2) The infant with unnatural position of the arm and remnants of real paralysis, though as yet free from organic contracture.

3) The somewhat older child with commencing or fully developed contracture.

4) The older, truly inveterated (stationary) cases with fully developed contractures and complete disappearance of paralysis.

Before going on to further mention of these different groups which I shall try to elucidate by means of our material here in the Orthopedic Hospital, Aarhus, it will be appropriate briefly to outline this material in general.

It comprises altogether 50 patients, 43 cases of Erb-Duchenne paralysis and 8 cases of Klumpke paralysis, 1 patient having Erb-Duchenne paralysis on one side and Klumpke paralysis on the other. (In the case records the Erb-Duchenne type will be designated as E.-D., the Klumpke type as Kl.)

The sex distribution of the material was 28 male patients and 22 female. The right side was attacked in 29 cases, the left in 22.

Only two of the patients had presented signs of other injuries at birth, namely: B 3659 (Case 2) who had a slight degree of facial paralysis after a severe forceps delivery, and B 9359 (Case 21) who suffered a fracture of the clavicle on the same side as the paralysis.

On the whole, fracture of the clavicle is not particularly often combined with obstetrical paralysis. Its significance to the development of the paralysis has been discussed a good deal, but it can hardly be of any great importance in this respect as the combination of the two lesions is so rare. Occasionally a patient presents a fracture of the clavicle on one side and paralysis on the other. McFadden goes even so far as to think that fracture of the clavicle undoubtedly has saved the child from paralysis in a good many cases.

We shall then turn to consider the individual groups—or, rather, stages—separately.

STAGE I

The Newborn.

We have had no occasion to see, let alone treat, any quite newly born children. Of the patients belonging to the next group—infants—however, several were so small that it would al-

most have been just as correct to enter them in this group, also considered from a therapeutic point of view, as we make no difference in the treatment of the two categories.

STAGE II

Infants.

This group, which thus includes all recent or relatively recent cases under treatment here, comprises altogether 13 patients, 7 boys and 6 girls. The lesion was located on the right side in 7 patients, on the left in 6. The age at the institution of treatment has varied from 3 days to about 4 months. The lesion was of the Erb-Duchenne type in 12 cases, of the Klumpke type in 1.

All these patients but one were treated with application of an abducting and outward-rotating splint to the upper extremity —the so-called "cheerio-splint".

CASE RECORDS

Case 1. (B 2654.)

Girl, born 18/9/37. Admitted 29/9/37.

Diagnosis: Erb-Duchenne paralysis, right.

Birth on term, but difficult; breech presentation.

This is a very mild case, but the arm is rather flaccid yet. There is already some function of the biceps, and the arm moves to some extent. Hence no treatment is instituted. On reexamination, 2 weeks later, additional progress is ascertained. Reexamination, 20/4/38: Recovery. This further confirmed on subsequent examinations, the last on 24/11/39.

Case 2. (B 3659.)

Girl, born 16/2/38. Admitted 4/3/38.

Diagnosis: Erb-Duchenne paralysis, right.

Born by difficult forceps delivery. Examination shows typical E.-D. on the right side, and peripheral facial paralysis on the left side. Mobility of the hand normal. (The mother states that also the hand was completely paralyzed after birth.) Treated with "cheerio-splint". Reexamination, 24/11/39: Recovery. 2/2/42: Arm perfectly normal.

Case 3. (B 3938.)

Boy, born 1/4/38. Admitted 11/4/38.

Diagnosis: Erb-Duchenne paralysis, right.

Born in foot presentation; delivery otherwise easy. Weight at birth: 3000 g. Examination shows typical E.-D. on the right side, with maximal inward rotation of the arm. No paralysis of the radial group. Treated with "cheerio-splint". 3 months later: No demonstrable contraction of the biceps. Reexamination, 12/9/38: Contraction of the biceps. 25/2/42: All paralysis gone; there still remains a very tightening of the subscapularis. Good use of the arm.

Case 4. (B 4912.)

Girl, born 21/4/38. Admitted 5/9/38.

Diagnosis: Erb-Duchenne paralysis, right; Torticollis.

Born in breech presentation, by extraction. After birth, treated with "cheerio-splint" and electricity. Splint not employed for the last month. Examination shows the right arm hanging flaccid and non-moving. Movements of the hand lively, but with a tendency to ulnar and volar flexion. Complete paralysis of the muscles of the Erb-Duchenne group. Treated with "cheerio-splint". Condition remaining essentially unchanged. 5/7/41: Myotenotomy of the right sternocleidomastoid. Reexamination, 22/12/41: Torticollis straightened well. Still complete paralysis of the biceps and deltoid; the arm hangs in the usual position of inward rotation.

Case 5. (B 4932.)

Girl, born 5/9/38. Admitted 7/9/38.

Diagnosis: Erb-Duchenne paralysis, left.

Birth very severe. Examination shows typical E.-D., with complete paralysis of the biceps and deltoid. Treated with "cheerio-splint"; favorable progress. Reexamination, 26/1/42: Complete recovery except for a few degrees lacking in extension of the elbow.

Case 6. (B 9049.)

Boy, born 15/4/40. Admitted 24/5/40.

Diagnosis: Erb-Duchenne paralysis, right.

Born on term; delivery said to have been very quick. Examination shows typical E.-D., involving in particular the deltoid. There is already some function of the biceps. Treated with "cheerio-splint". (It has not been practicable to reexamine this patient.)

Case 7. (B 9354.)

Boy, born 24/6/40. Admitted 3/7/40.

Diagnosis: Erb-Duchenne paralysis, right.

Birth rather difficult, with particular difficulty in the passage of the shoulders. Examination shows typical E.-D., with movement of the hand and fingers preserved. Treated with "cheerio-splint". 11/7/40: Biceps and deltoid quite flaccid yet. 9/9/40: Perhaps slight contraction of

the deltoid. 17/12/40: Good use of the arm. 5/3/41: He is now able to pass the arm up along the head and back to the occiput. Reexamination, 20/10/41: He is now able to use the arm well; good muscular power. Only a little is lacking in complete outward rotation. There is no atrophy. So the patient has practically recovered.

Case 8. (B 10064.)

Boy, born 8/11/40. Admitted 13/11/40.

Diagnosis: Erb-Duchenne paralysis, left.

Normal birth. Weight at birth: 5750 g. Examination shows E.-D. with completely flaccid paralysis of the arm. Treated with "cheerio-splint". 6/1/41: Arm unchanged. 21/4/41: He now moves the left arm, and is able to elevate it above the shoulder. Reexamination, 19/1/42: Recovery.

Case 9. (B 10109.)

Boy, born 20/10/40. Admitted 20/11/40.

Diagnosis: Erb-Duchenne paralysis, left.

The patient is a brother of B 5570 (Case 35). Weight at birth: 4500 g. Delivery of the left shoulder difficult. Immediately after birth complete paralysis of the left upper extremity was noticed; motion was first recovered by the fingers, then by the extremity. The position of the arm leaves no doubt about the presence of a relatively slight E.-D. Treated with "cheerio-splint". Reexamination, 2/7/41: Recovery. No demonstrable evidence of the previous paralysis. 2/2/42: Still free from symptoms.

Case 10. (B 10199.)

Boy, born 3/12/40. Admitted 6/12/40.

Diagnosis: Erb-Duchenne paralysis, right.

Born in breech presentation; difficulty in the delivery of the upper extremities and head. Asphyxiated at birth. Examination shows typical flaccid E.-D. Treated with "cheerio-splint". 19/3/41: Arm movable to about the same extent as the left. 11/6/41: Recovery.

Case 11. (B 13147.)

Girl, born 20/1/42. Admitted 4/2/42.

Diagnosis: Erb-Duchenne paralysis, left.

Weight at birth 4750 g. The shoulders got stuck and the birth was difficult. The mother states that two of her other six children had a similar paralysis after birth, and that it subsided rapidly. The author saw the child at home when she was six days old. She then presented typical flaccid E.-D., and pronounced paralysis of the radial group. Examination (on admission) shows no change in the paralysis of the arm; volar and ulnar flexion of the hand, but dorsal flexion practicable. Further, there is already a beginning, slight function of the biceps and

apparently of the deltoid, too. Treated with "cheerio-splint". The child has not been seen since but on 14/3/42 the mother stated (by 'phone') that improvement keeps progressing, as the child now begins to lift the arm herself.

Case 12. (B 13234.)

Girl, born 23/12/41. Admitted 16/2/42.

Diagnosis: Erb-Duchenne paralysis, left.

Protracted delivery in vertex presentation. Weight at birth: 4500 g. Asphyxiated at birth. Since birth, complete paralysis of the left upper extremity, but there is said to have been slight movement of the fingers in the last month. Examination shows typical E.-D. paralysis. Further, the pectoralis major appears to be paralyzed. Finally, there is a slight Horner's syndrome. No paralysis of the muscles supplied by the ulnar and median nerves. Treated with "cheerio-splint". The child not examined since.

Case 13. (B 7198.)

Boy, born 11/3/39. Admitted 3/7/39.

Diagnosis: Klumpke paralysis, left.

Delivery in vertex presentation; manual extraction is said to have been employed, not forceps delivery. Previous treatment with massage, electricity and "cheerio-splint", without any favorable result. Examination shows a severe degree of typical Kl., with complete flaccid paralysis of the forearm and hand, besides slight myosis on the left side. 23/10/39: Movement of the shoulder satisfactory. Movements of the elbow also good; fingers kept in a position corresponding to ulnar paralysis. He has been treated with "cheerio-splint"; after this, treatment with finger-extending, thumb-abducing plaster splint. 21/2/40: Threatening contracture of the shoulder in inward rotation; hence, application of "cheerio-splint". 12/6/40: Hand unchanged. Reexamination, 12/12/41: Condition essentially unchanged. Only minimal mobility of the fingers. Treatment with splint continued.

Of the 12 patients with Erb-Duchenne paralysis thus 7 recovered. In one the paralysis subsided but there remains a slight tightening on outward rotation. So, he has recovered, too, in the sense that the nerve supply is restored—which in this connection has to be considered the more important. One patient, who has been under treatment only for a short time, is improving. About two patients nothing can be said, as one has been under treatment only for a very short time and the other

could not be summoned for reexamination. Concerning the latter, however, it can be stated that already on his admission to this clinic he was improving so that a good prognosis could be made. Only one patient shows persistent massive paralysis.

In the one patient with Klumpke paralysis no particular improvement could be noticed.

Of course this material is too small to give any definite information about the rate of recovery but it confirms to some extent the general view of a good prognosis for the Erb-Duchenne paralysis.

In our opinion the treatment of the newborn and of the infant with an obstetrical paralysis of the arm should be expectating, aiming merely to immobilize the paralyzed arm, counteract the abnormal position and relax the paralyzed muscles. This is obtained by bandaging the arm in the so-called "cheerio"-position, *i.e.*, rectangular abduction of the arm in the shoulder and almost complete outward rotation in this joint, together with rectangular flexion in the elbow, supination of the forearm, and—if radial paralysis is present, too—dorsal flexion in the wrist. This bandage is easily made of cardboard padded with cotton or of Cramer splints, or, as done by us, of plaster.

Undoubtedly it is quite safe, however, to desist from any treatment in the first two weeks of life. As mentioned already, the recovery percentage without treatment is stated to be about 80, and at any rate no aggravation of the paralysis is ever observed even when immobilization is not carried through.

After a bandaging period of a couple of weeks, treatment with massage may be commenced if complete recovery hasnot been obtained already, making additional treatment unnecessary. The massage should consist in gentle rubbing to counteract atrophy of the paralyzed muscles from inactivity and passive motions.

Treatment with faradization, which is employed a great deal, is undoubtedly of no value, whereas some improvement may be obtained by very brief seances of treatment with galvanic current.

Here, in these cases, however, the treatment properly consists

exclusively in immobilization by means of the splint, which is carried through at home. The splint is made here in the hospital, where the child stays for a few days in order to get accustomed to the splint. Then the patient returns home and is summoned for examination at certain intervals, varying in length with the degree of the paralysis.

In some clinics in other countries, especially in England and U. S. A., attempts have been made to treat the fresh obstetrical paralysis operatively, an explorative incision being made over the brachial plexus with excision of cicatricial tissue and suturing of the nerves or sometimes merely with excision of such cicatricial tissue as is considered likely to exert a pressure on the nerves. These operative measures have never given any convincing results, however, and they have not been employed here. The basis for these measures is a very pessimistic view concerning the prognosis of the lesion. Among its advocates, mention is to be made of Kennedy, Taylor and Harrenstein.

Thus Taylor is convinced that in the majority of recent cases no complete recovery is obtained, no matter how long a period of treatment and what kind of conservative treatment be employed. His chief arguments in favor of the early operation are as follows: In most of the cases the muscles are paralyzed in groups, resulting in characteristic abnormal positions of the paralyzed extremity, so that the articular surfaces of the long bones gradually become deformed in their growth—simply in order to correspond with these positions. Ligaments and muscles contract, and the final result is an organic deformity. All this may happen even with the best expectating treatment. Taylor further states that in many of the patients on whom he has operated, one or more nerveroots were found to have been torn in two, with the ends displaced, nerve-roots separated entirely from the spinal cord, or injured areas filled with dense scar tissue. Finally, he claims that at an early juncture it is impossible clinically to determine the nature of the injury, so that it takes one or two years to recognize correctly the extent of the injury, and in the meantime the deformity develops. From these considerations he arrives at the conclusion that the earlier

the nerve injury is repaired, either spontaneously or operatively, the more promptly will the nutrition and function of the nerves be restored and prevent the development of a deformity.

In cases which apparently are mild at first, Taylor therefore recommends to expectate a possible spontaneous recovery, which will be completed within about three months. In the more serious cases, in which nearly the entire musculature of the arm is paralyzed primarily, and in which the muscles supplied by the lower roots show no tendency to spontaneous recovery within the first couple of days, there is practically sure to be a permanent injury, involving at least the upper 1 or 2 nerve-roots, and early operative treatment is indicated. In border cases the clinician may choose between an early operation and expectation for three months.

Taylor has operated in 70 cases. In no instance was the result a complete recovery, but except for a few cases in which the injuries were found to be irreparable, the children showed a pronounced improvement, and an almost complete function was obtained in most of them. In addition, he has had 130 patients, in whose cases the operation was refused, and only 3 of these patients recovered spontaneously. Of the total 200 patients only 10 were under 2 months of age.

Really, it is not to be wondered that Taylor found spontaneous recovery only in 3 out of 130 children, of whom only 10 were less than 2 months old. (The age of the 3 recovered patients is not given.) That practically all his patients were over two months of age might indicate indeed that all the cases referred to him were relatively severe—in which no improvement had been obtained by ordinary bandaging—whereas the quite recent cases were not referred to him for treatment. Thus, like most orthopedists, he has no occasion to see the very recent cases, but merely the minority of such patients who have failed to recover after treatment for a couple of months.

Even our little material goes strongly against his view of the prognosis.

Views similar to the ones presented by Taylor are asserted by Kleinberg and by Harrenstein, who gives an expectation

period of 4 months. Since the latter adopted Taylor's view, however, he has operated only on 2 out of the 12 patients referred to him for treatment. In one of these cases an excellent improvement was obtained; in the other, no improvement was noticed before the patient died of meningitis at the age of 6 months, 3 months after the operation.

Finally it is to be mentioned that Sever, too, who previously was absolutely against an early operation, subsequently has taken a somewhat different standpoint, being now inclined to operate, especially in cases of high paralysis where only one or two muscles appear to be completely paralyzed or impaired to such an extent as to preclude a satisfactory function. Further, he is inclined to operate in cases of Klumpke paralysis in which there is no functional improvement whatever.

Sever employs conservative treatment for 3 months, and if this has no effect, he performs an explorative operation. In the cases of Erb-Duchenne paralysis he often waits with the operation till the patient is 4—5 years old because then he can treat the muscular contractures operatively, too. He states, however, that he has had no particularly good results from these plexus operations.

Also Boorstein recommends operative treatment if no improvement is obtained after 4 months of conservative treatment. He states, though, that even severe cases may recover in 6—7 months.

As shown, the last mentioned authors are somewhat more conservative than Taylor. Indeed, the argument set forth by Taylor—that it is impossible in the individual case beforehand to decide on the seriousness of the lesion—may be turned against himself. In many of his improved patients, no doubt, the same result would have been obtained without operative treatment, or possibly even a better result, as the explorative operation is bound to give some scar formation, which he thinks himself may be injurious.

Further it is to be pointed out that several of our recovered patients presented a very severe degree of paralysis, involving also the muscles supplied by the radial nerve. Thus, after 3

months of expectative treatment, one of our patients showed yet no demonstrable function of the biceps, and still complete function was subsequently restored to the paralyzed muscles.

It is not the intention of the writer, however, completely to refute the operative treatment, which undoubtedly is quite appropriate in some cases. But the expectative treatment, I think, should be employed for a considerably longer period than the 3—4 months usually given, and operative treatment should be resorted to only in cases of massive paralysis where protracted conservative treatment gives no suggestion of improvement.

STAGE III

Of patients of this category, which, as mentioned, is characterized by beginning or fully developed contracture, we have treated altogether 12, of whom 7 were boys, 5 girls. The lesion was located on the right side in 6 cases, and on the left in 6.

One of the patients mentioned in this group—B 5468 (Case 17)—does really not belong here as she presented no contracture at all. When, nevertheless, her case is reported in this group, it is because it can not be referred to Stage I or Stage II on account of the age of the patient; nor can it be mentioned with Stage IV, which covers inveterate contractures. This patient really belongs to a separate group that might be designated as "persistent paralysis", but as her case is the only one of its kind in the present material, it is entered here for the sake of convenience.

CASE RECORDS

Case 14. (B 646.)

Boy, born 17/6/35. Admitted 26/2/37.

Diagnosis: Erb-Duchenne paralysis, left.

Forceps delivery. Previous treatment with "cheerio-splint" for 6 months, then with massage and electricity. Examination shows some resistance against outward rotation and impairment of the radial group. Treated with "cheerio-splint". Reexamination, 12/7/40: Still rather pronounced outward rotation-abduction defect. Good use of the hand; he is able to reach his mouth and the top of his head. Owing to the difficulties in transit, unfortunately, the patient could not return for reexamination now.

Case 15. (B 2567.)

Boy, born 7/3/36. Admitted 20/9/37.

Diagnosis: Erb-Duchenne paralysis, left.

Oblique presentation at delivery. Asphyxiated at birth. Examination shows some inward rotation contracture. In addition pronounced rickets. Treated with "cheerio-splint". Reexamination, 16/2/42: Lesion practically recovered. All movements are performed to practically the same extent as in the normal side, merely a little clumsily. Active outward rotation performed with good force.

Case 16. (B 5045.)

Boy, born 18/5/23. Admitted 21/9/38.

Diagnosis: Erb-Duchenne paralysis, left; Scoliosis.

Examination shows merely some slight sequelae of E.-D. in the form of an insignificant inward rotation contracture and slight dorsolumbar scoliosis with a convexity to the left. He has full use of the arm. He works as the only farmhand on a little farm and applies to the clinic merely in order to get a certificate of permission to continue with this work (he is referred to the clinic by a welfare association that took care of him in childhood). The scoliosis as well as E.-D. are so slight that there seems to be no reason to advise any change in occupation.

Case 17. (B 5468.)

Girl born 2/11/31. Admitted 14/11/38.

Diagnosis: Erb-Duchenne paralysis, right.

In the first year after her birth the patient was treated with massage and "cheerio-splint". Examination reveals no contracture. On the other hand, there is complete paralysis of the deltoid and of the muscles on the posterior aspect of the scapula. In addition there is complete paralysis of the biceps. The pectoralis major is rather weak. Function of the latissimus dorsi and of the long head of the triceps preserved. Forearm and hand normal except for paralysis of the brachioradialis. No treatment is instituted. Reexamination, 26/1/42: No change in her condition. The movers of the scapula are vigorous; forearm and hand normal.

Case 18. (B 6576.)

Girl, born 27/2/29. Admitted 21/4/39.

Diagnosis: Erb-Duchenne paralysis, right.

Delivery in breech presentation, by extraction. No treatment before the age of 4 years, when remedial gymnastics and massage were prescribed. Examination reveals a rather pronounced inward rotation contracture and she has difficulty in moving her hand up to her mouth. Treated with cheerio-splint. Reexamination, 19/1/42: Practically no tightening of the subscapularis. Now she can reach her mouth. She writes and sews

with her right hand. Active outward rotation is very feeble, and there is a distinct atrophy of the outward rotators.

Case 19. (B 6853.)

Girl, born 25/12/38. Admitted 24/5/39.

Diagnosis: Erb-Duchenne paralysis, left.

Birth somewhat protracted but accomplished without artificial assistance. Examination shows pronounced inward rotation contracture. The paralysis itself appears to have subsided. Treated with cheerio-splint. Reexamination, 9/1/42: Good mobility of the left arm. Outward rotation almost complete. (After her age, this patient should have been entered under Stage II, but owing to the severe contracture, together with the disappearance of the paralysis, she belongs symptomatologically to Stage III.)

Case 20. (B 8452.)

Woman, born 8/12/18. Admitted 16/2/40.

Diagnosis: Erb-Duchenne paralysis, left.

Previous treatment with massage and redressing bandages. Examination shows only a moderate inward rotation contracture. Hand and forearm normal. There appears to be no particular inconvenience from her lesion. Treated with cheerio-splint. 10/6/40: Condition slightly improved, with a little increase in outward rotation. The patient appears not to carry through the treatment as directed, and in a letter of 16/2/41 she says she could not stand the splint and hence she thought there was no reason to continue the treatment.

Case 21. (B 9359.)

Boy, born 1/2/39. Admitted 23/8/40.

Diagnosis: Erb-Duchenne paralysis, left.

Born by natural delivery. The midwife diagnosed and treated a fracture of the left clavicle after birth, immobilizing the arm tightly to the trunk. Subsequent treatment with massage and bandage with the elbow extended. Examination shows inward rotation of the shoulder, but no resistance to passive outward rotation. Treated with cheerio-splint. 21/4/41: Good improvement. He is able to move his hand up to his mouth but is inclined to use his arm for such motions; still he is able to reach out after an object properly. Reexamination, 16/3/42: Some improvement; condition quite satisfactory.

Case 22. (B 10164.)

Boy, born 31/5/29. Admitted 27/11/40.

Diagnosis: Erb-Duchenne paralysis, right.

Normal delivery. Previous treatment for half a year with plaster

cast. Examination shows slight sequelae of E.-D., without any particular contracture, so that treatment is not indicated, unless some inconvenience unexpectedly should turn up later on.

Case 23. (B 10326.)

Boy, born 16/12/37. Admitted 10/1/41.

Diagnosis: Erb-Duchenne paralysis, right.

Birth difficult. He was treated at once with cheerio-splint for 1—2 months, then massage for some months. Examination shows rather pronounced inward rotation contracture. Treated with cheerio-splint. 3/10/41: Still pronounced inward rotation contracture. As the patient is living on a small, distant island, reexamination has been impracticable now, but the family physician kindly informs us that the mobility of the arm now is good. He can easily place his hand in the nape of his neck, and abduction is almost normal; the outward rotation is judged to be 4/5 of the normal extent.

Case 24. (B 10815.)

Girl, born 12/10/37. Admitted 31/3/41.

Diagnosis: Erb-Duchenne paralysis, right.

At the age of 3 months, treated with cheerio-splint for 3 months. Examination reveals no contracture, and her affection is very slight. Treated with cheerio-splint. Reexamination, 9/3/42: No particular change in her condition. She can easily reach her mouth without elevating the elbow, and she is able to touch the top of her head, the occiput, the opposite shoulder and her back.

Case 25. (B 11770.)

Boy, born 14/10/40. Admitted 6/8/41.

Diagnosis: Erb-Duchenne paralysis, right.

Birth difficult. Weight at birth: 5100 g. After birth, treated with massage and electricity. Examination reveals sequelae of E.-D., only in the form of a slight resistance against outward rotation. Slight impairment of dorsal flexion in the wrist. Treated with cheerio-splint. Reexamination, 23/1/42: Contracture disappeared; function of the arm nearly normal.

The splint treatment has been carried through at home. As a rule, the splint has been made (of plaster) on the day it was prescribed and after it has been equipped with pads and straps the patient is asked to return to the hospital, where he then stays for a few days till he gets accustomed to the splint, whereafter the treatment is continued at home. At intervals, varying

from 1—2 months to about 1 year, the patient is summoned for examination.

From the case histories it will be noticed that in the cases where there has been only a slight or moderate contracture at the institution of treatment, the splint regimen has succeeded in abolishing the contracture or, at any rate, improving it considerably. In one case, No. 15, B 2567, the patient practically recovered. Also another instance of rather pronounced contracture was almost completely abolished (No. 19, B 6853). In these two cases, however, the patients were rather small children, being respectively 1½ and ½ years old. Otherwise the really severe contractures do not yield very much to the splint treatment. In some of our operated patients—mentioned in the next group—the splint treatment was tried before the operation, though either without any effect whatever or merely a slight or insufficient effect.

As to B 5468 (Case 17), who is now a girl of 10 years, she still has paralysis of the deltoid, the outward rotators of the arm and the biceps, whereas her forearm and hand are good. In her case it might be advisable to perform arthrodesis of the shoulder and elbow (or instead of the latter, perhaps merely a bandage), as the movers of the scapula are good. The question of this treatment has been postponed till she reaches the age when her future occupation has to be decided.

Patient B 6576 (Case 18), who had a rather pronounced contracture of the subscapularis, which yielded to the splint treatment, had such a slight degree of outward rotation that the question of transplantation suggests itself; indeed this has been taken under consideration. The eventual operation will consist in transplantation of the teres major ad modum L'Episcopo (see below) or transfer of the teres major tendon to the teres minor tendon.

The patients in this group who presented sequelae of radial paralysis were inconvenienced so little from this defect that there was no reason to consider any operative treatment.

STAGE IV

Inveterate (Stationary) Cases.

As mentioned already, the features encountered at this stage are somewhat different from the ones seen in recent cases.

Now we meet with a fixed inward rotation in the shoulder joint and a slight abduction contracture here. The mobility of the elbow is free, or there might be a slight defect in extension, up to 20—25°. The forearm presents a pronation contracture, varying from an almost normal position to the maximal pronation with complete loss of supination. The mobility of the hand and fingers is normal, and here the muscular power is almost or completely normal. Another characteristic feature is the short round belly of the biceps.

So in these cases the clinical picture is dominated by the contracture, whereas the paralysis itself is abolished.

It is further to be noticed that the scapula on the affected side nearly always is somewhat smaller than that on the normal side, besides being kept at a higher level and more laterally than on the normal side. This elevation of the scapula, which has been taken to support the theory about an intrauterine origin of the lesion advocated by some authors, is simply due to shortening of the clavicle on the same side. I have measured the length of the clavicle in several of these patients, and on an average I have found it to be 1—1½ cm shorter on the affected side. This shortening has to be explained as resulting from the inactivity of the shoulder region, as in recent cases the two clavicles are found to be of the same length.

It will easily be seen that the disablement of the patient is dependent on the inward rotation contracture in the shoulder-joint; and the more pronounced this contracture the greater is the reduction in mobility. This fact is explained quite simply by the anatomical structure of the shoulder-joint, as the head of the humerus, which is the ball-cap, normally is turned upwards about 45°, on which account the arm cannot be abducted above the horizontal plane without outward rotation. On outward rotation the arm can be abducted further till it points straight

up. The more pronounced the inward rotation contracture, the smaller is the possibility of abduction.

Another important shoulder symptom is the backward subluxation of the humerus (in a few cases, complete dislocation), which likewise is due to the severe inward rotation contracture.

It is easy to understand that this inveterate Erb-Duchenne paralysis causes a rather severe disablement, as in many cases the patient is unable to bring his hand up to his head, that is, this hand is of no use to him in eating, combing his hair, shaving, etc. In the cases where the patient is able to touch his face, it is accomplished only with the hand in a less efficient position, namely, with the back of the hand turned upwards and the elbow pointing straight out to the side.

Of patients of this category, in this hospital we have treated altogether 18, namely, 9 male patients and 9 female.

CASE RECORDS

Case 26. (B 66.)

Boy, born 5/1/22. Admitted 30/9/36.

Diagnosis: Erb-Duchenne paralysis, right.

Difficult artificial delivery. Examination shows typical inward rotaton contracture, and also the radial group is weak, especially the extensor pollicis. Further, impairment of the muscular power of the latissimus dorsi and the pectoralis major. The right hand can be lifted only to the level of the nipple. 6/10/36: Tenotomy of the subscapularis. Reexamination, 20/10/37: Passive motions in the shoulder free. Active elevation of the hand to the mouth, though only in pronation. The patient states himself he has improved considerably and now he is never inconvenienced by his lesion. 18/12/41: The father of the patient states (by mail) that the patient now is a cabinet maker's apprentice and gets along well with his work.

Case 27. (B 350.)

Girl, born 7/6/33. Admitted 4/11/36.

Diagnosis: Erb-Duchenne paralysis, left.

At delivery, her left arm is said to have been extracted manually. After birth, splint treatment for 5 months, together with massage and electricity. Examination shows typical inward rotation contracture. Hand normal. 7/11/36: Subscapular tenotomy. Reexamination, 1/12/39: All

active motions performed almost to normal extent, only about 20° lacking in full elevation. Excellent use of the arm.

Case 28. (B 2806.)

Girl, born 19/10/25. Admitted 20/10/37.

Diagnosis: Erb-Duchenne paralysis, right; Scoliosis; Spastic paraplegia; Bilateral pes planovalgus, fixed.

Delivery in breech or transverse presentation, very difficult and strenuous. The patient is a cripple with various deformities, as a 4—5° scoliosis, pronounced flatfoottedness, spastic paraplegia of the lower extremities and inveterate E.-D. (right) with typical inward rotation contracture. After she has finished school, on 2/7/40: Subscapular tenotomy. Reexamination, 18/2/40: The result has to be characterized as rather middling, as the extent of the movements has not been increased essentially. Still, elevation of the hand is increased—to the level of the forehead as against the level of the chin previously. The patient is now learning to be a dressmaker, and she gets along well with this work, being able to sew with the right hand. She thinks herself that her condition has improved considerably.

Case 29. (B 1490.)

Boy, born 10/12/33. Admitted 7/5/37.

Diagnosis: Erb-Duchenne paralysis, right.

Birth difficult, especially the delivery of the shoulders. Weight at birth: 5500 g. Treated with electricity for the first 6 months. No treatment since. Examination shows typical severe inward rotation contracture, together with pronounced paralysis of the radial group, with drop-hand. Subscapular tenotomy is really indicated by the condition of the shoulder, but his hand is too weak and hence he is treated with a dorsal-flexing splint applied to the hand, with abducted thumb. Reexamination, 2/2/42: Still pronounced inward rotation contracture in the shoulder, making him unable to reach his mouth, occiput or opposite shoulder. The hand has improved considerably, its grasp being fairly vigorous, but the volar flexion of the wrist prevents it from being really powerful. Abduction of the thumb about = 0. The question about operative treatment is postponed till the boy becomes somewhat older. Undoubtedly the hand can be activated by means of the powerful flexor carpi ulnaris. At the same time, the question about subscapular tenotomy will be considered.

Case 30. (B 3471.)

Woman, born 9/7/13. Admitted 23/2/38.

Diagnosis: Erb-Duchenne paralysis, right.

Natural delivery. After birth treated with massage. No treatment since. Examination shows typical inward rotation contracture. Subscap-

ular tenotomy is advised, but the patient answered by mail that she had changed her mind and did not want any treatment.

Case 31. (B 3940.)

Girl, born 6/4/23. Admitted 11/4/38.

Diagnosis: Erb-Duchenne paralysis, right.

Delivery severe. After birth she was treated with massage and electricity. Examination shows typical inward rotation contracture and typical drop-hand. The deltoid is very weak, in particular its middle section. 24/5/38: Activation of the right extensor carpi radialis (flexor carpi ulnaris transferred to the extensor carpi radialis). At the same time, application of cheerio-splint. After 3 weeks, no particular subscapular contracture. 11/6/38: Plastic operation on the right deltoid. Good bundles of muscle fibers are found anteriorly and posteriorly, whereas the middle section is represented merely by a flat tendon. Two flaps are formed, an anterior and a posterior, which are shifted over each other, their anterior, posterior and upper corners being sutured to the tip of the acromion. Reexamination, 21/11/41: Considerable improvement, especially of the power of the shoulder, as the deltoid now is as powerful as might be expected from the bulk of the muscle. The function of the hand has become quite normal. She says she now can manage almost any work with her right hand.

Case 32. (B 4189.)

Girl, born 19/1/32. Admitted 20/6/38.

Diagnosis: Erb-Duchenne paralysis, left.

Born by difficult forceps delivery. Treated previously with cheerio-splint. Examination shows typical inward rotation contracture. No paralysis any more. Subscapular tenotomy advised, but the patient never returned for its performance.

Case 33. (B 4808.)

Boy, born 14/7/26. Admitted 29/8/38.

Diagnosis: Erb-Duchenne paralysis, right.

In the first couple of years after birth he was treated with electricity and massage, later with cheerio-splint. Examination: His lesion now appears rather as a radial paralysis, but not complete. He is able to extend the 2' and 3' fingers and abduct the thumb, but extension of the latter is defective. Supination and pronation almost = 0. 4/10/38: Activation of the right mm. extens. dig. long. (Transfer of the flexor carpi ulnaris to the extens. dig. long.) Reexamination, 18/2/42: Result excellent. Extension of 2' and 3' fingers good, that of 4' and 5' fingers lacking about 20° in the basal joints. The thumb is abducted so much that he can grasp an ordinary tumbler. There still remains a typical inward

rotation contracture which may be indication for a subsequent subscapular tenotomy.

Case 34. (B 5113.)

Boy, born 19/4/31. Admitted 26/9/38.

Diagnosis: Erb-Duchenne paralysis, left.

Difficult delivery. From the age of 6 weeks treated with cheerio-splint. Treatment discontinued before the age of 1 year. Subsequent treatment neglected. Examination shows typical inward rotation contracture. Hand normal. 15/10/38: Subscapular tenotomy. Examination 1 year later: Condition very satisfactory. Reexamination, 18/2/42: Condition satisfactory, the outward rotation now being excellent. He is able to reach his mouth with lowered elbow and he can reach the top of his head, nape of the neck and opposite shoulder. But the extent of these movements is largely due to mobility of the scapula, the movements in the shoulder-joint itself being somewhat limited. Roentgenography of the shoulder-joint shows merely some atrophy of the head of the humerus. No particular arthritic changes. The patient is now admitted for the sake of training in movements of the shoulder.

Case 35. (B 5570.)

Girl, born 17/3/31. Admitted 2/12/38.

Diagnosis: Erb-Duchenne paralysis, right.

Born by natural delivery, which is said not to have been particularly severe. After birth she was treated with cheerio-splint for 5 weeks, later with massage and electricity till the age of 9 months. At the age of 3 years she was given massage for a short period. No treatment since. Examination shows typical inward rotation contracture. Treatment with cheerio-splint is tried first but the contracture does not yield to it. 15/2/40: Subscapular tenotomy. Reexamination, 26/1/42: Condition satisfactory, but one might perhaps want the maximal outward rotation of the arm to be a little more easy. She is able to bring her hand up to her mouth with the elbow lowered, and to touch the top of her head and opposite shoulder. She has good use of her hand in her work, sewing and writing with her right hand.

Case 36. (B 6241.)

Girl, born 6/12/35. Admitted 8/3/39.

Diagnosis: Erb-Duchenne paralysis, left.

Protracted and difficult delivery, with extraction. In the first half year she was treated with cheerio-splint. At the age of 2 years, the cheerio-splint was applied again and employed till about half a year before admission. Examination shows some inward rotation contracture, paralysis of the triceps and slight paralysis of the hand. After additional

treatment with cheerio-splint for two years, all paralysis has gone, but there still remains some inward rotation contracture. 16/2/42: Subscapular tenotomy and myotomy of the left pectoralis major (as, besides the subscapularis contracture, there is also a pronounced tightening of the upper parts of the pectoralis major). The patient is still in the hospital, in plaster cast.

Case 37. (B 6319.)

Man, born 11/6/22. Admitted 27/3/39.

Diagnosis: Erb-Duchenne paralysis, right.

Difficult forceps delivery. Examination shows pronounced inward rotation contracture. Roentgenography of the shoulder (stereoscopic) shows a transformation of the scapula that is more pronounced than observed before, presenting in particular a downward bending of the acromion and coracoid process over the anterior surface of the head of the humerus that is almost monstrous. The acromion is so curved that the tangent to the extreme part of its curvature would form a rightangle with the tangent to its transition into the spine of the scapula. Also the coracoid process is bent downwards and elongated noticeably, the two osseous processes thus approaching each other so much as to leave an interval of hardly 1 cm. in width where they pass in front of the head of the humerus. Also the glenoid cavity itself looks markedly deformed and aplastic, and the head of the humerus is distinctly displaced far backwards.

1/4/39: Tenotomy of the subscapularis. This operation does not result in the reposition desired, which otherwise always takes place in cases where the head of the humerus is dislocated or subluxated as soon as the tendon of the subscapularis is divided. It is the acromion and the coracoid process that prevent the shifting of the head of the humerus.

Reexamination, 30/1/42: Only slight objective improvement. For the last 5 months, however, he has been a mechanic's apprentice and got along very well with his work, but he uses the left hand for all essential work and employs the right hand merely for support. He can reach his mouth with the right hand, but only by elevation of the elbow, and he is unable to reach the opposite shoulder or the top of his head. The patient thinks himself, however, that his arm has become considerably better since the operation.

Case 38. (B 7317.)

Boy, born 25/5/31. Admitted 21/8/39.

Diagnosis: Erb-Duchenne paralysis, left.

Natural delivery. He received no treatment till the age of 2 years when remedial gymnastics were employed. Examination shows distinct tightening of the subscapularis, but as it involves merely a relatively

slight contracture, an attempt is made to overcome it by means of a cheerio-splint, but his condition remains unchanged. 29/8/41: Tenotomy of the subscapularis. Reexamination, 14/1/42: Condition perfectly satisfactory. He is able to reach his mouth, occiput and opposite shoulder.

Case 39. (B 9617.)

Boy, born 6/6/34. Admitted 4/9/40.

Diagnosis: Erb-Duchenne paralysis, right.

Difficult delivery. Weight at birth 5500 g. He has been treated with massage and electricity, but not with splint. Examination shows typical inward rotation contracture and paralysis of the radial group. 10/9/40: Tenotomy of the subscapularis and activation of the right extensor carpi. Reexamination, 30/1/42: Condition satisfactory. He can easily reach his mouth and the top of his head. The activation of the hand is functioning well. He has good use of his right hand, employing it both for writing and eating.

Case 40. (B 9856.)

Boy, born 31/10/30. Admitted 9/10/40.

Diagnosis: Erb-Duchenne paralysis, right.

Natural delivery. In his first half year he was treated with electricity, massage and carboard splints. Examination shows typical inward rotation contracture. Hand normal. 21/11/40: Tenotomy of the subscapularis. Reexamination, 30/1/42: Condition perfectly satisfactory. He is able to reach his mouth with lowered elbow, and touch the opposite shoulder, top of the head and occiput. He uses his right hand for everything (eating, writing, dressing, etc.).

Case 41. (B 9985.)

Boy, born 26/3/26. Admitted 30/10/40.

Diagnosis: Erb-Duchenne paralysis, left.

In infancy he was treated with massage and exercises; no splint treatment. Examination shows typical inward rotation contracture. The hand moves freely, and its muscular power is good. 3/12/40: Tenotomy of the subscapularis. Reexamination, 4/3/42: Motions in the shoulder-joint considerably restricted. When the left scapula is fixed in the same position as the right, and the right arm is hanging down along the trunk, the left arm is abducted about 55° and movements from this position are relatively small in every direction. Active movements without fixation of the scapula are all good. He can easily reach his mouth with lowered elbow and he can touch the top of his head and the top of his shoulder, but not the nape of his neck. Roentgenography of the left shoulder-joint shows pronounced arthritis. The head of the humerus is markedly flattened almost "Calvé-Perthes-like" in form. There are small areas of

rarefication of the osseous tissue and the surface of the bone is a little uneven. Similar changes are seen in the glenoid cavity. The patient is working in a general store and states that since his operation his arm has given him no inconvenience whatever.

Case 42. (B 10561.)

Woman, born 12/9/21. Admitted 19/2/41.

Diagnosis: Erb-Duchenne paralysis, right.

Birth by forceps delivery. Examination shows a severe E.-D., with inward rotation contracture. The power of the outward rotation is lowered. There is also a distinct decrease in the power of the radial group. In addition there is a suggestion of Horner's syndrome and slight hemiatrophy of the face. The patient is not able to raise her hand above the level of her chin. 11/3/41: Tenotomy of the subscapularis. Reexamination, 7/11/41: The result is as good as could be expected. She is able to raise her hand to the level of her eyes and touch the opposite shoulder, but not to place her hand in the nape of the neck. She is an office clerk and uses her right hand for typing, also for knitting, etc.

Case 43. (B 12196.)

Girl, born 25/10/26. Admitted 22/9/41.

Diagnosis: Erb-Duchenne paralysis, right.

In early childhood, treatment with electricity; otherwise no treatment. Examination shows typical inward rotation contracture. She is greatly inconvenienced by her affection, being unable to perform the ordinary tasks of housework. 26/9/41: Tenotomy of the subscapularis. Reexamination, 19/1/42: Condition satisfactory. She can bring her hand up to her mouth, the opposite shoulder and nape of the neck. Extent of the movements good, even though it would be desirable if she could assume the cheerio position of the arm more readily; and the active outward rotation is not so complete as desirable.

As seen from these case records, two out of the 18 patients in this group were not treated (Cases 30 and 32). Tenotomy of the subscapularis was advised, for which they were very suitable, but they refused operative treatment.

One patient, B 1490 (Case 29) was treated with bandage but subsequent operative treatment is planned.

The remainning 15 patients were given operative treatment as follows:

Subscapular tenotomy	13	
Plastic op. on deltoid	1	
Activation of ext. dig.	1	(together with subscapular tenotomy)
„ „ ext. carpi	2	(together with subscapular tenotomy in 1, with plastic op. on the deltoid in 1).

The operative results may be tabulated schematically as follows:

	Satisfactory	Some improvement	Little improvement
Subscap. tenotomy	9	1	2
Plast. op. on deltoid	1		
Activ. ext. dig.	1		
Activ. ext. carpi	2		

Nothing can yet be said about the result of the last subscapularis tenotomy (Case 36), as at this writing the patient is still in plaster.

For 3 of the above patients the observation period is rather short, being respectively 5 months (Case 38) 10 months (Case 42) and 4 months (Case 43). These three patients have been entered in the group of "satisfactory results", to which they belonged at the time of the reexamination, when the findings left no reason to think that there condition would not keep satisfactory.

For the remaining patients the observation period has been from 15 months to about 5 years.

Naturally it will always be a matter of judgment when it comes to estimate the effect of an operative measure tenotomy of the subscapularis. Some improvement is practically always bound to result. On the other hand, it will hardly ever be possible to make the arm in question as good as if it had never had anything wrong with it. So this statement about the results is to be taken merely as an attempt to give the sum of the objective findings at the reexamination in comparison to the preoperative condition of the patient, supplemented by stereoscopic photography of the patient before and after the operation, together with the opinion of the patient or his relatives con-

cerning the effectivity of the operative treatment. The last-mentioned point may perhaps be said to be the most decisive as it informs us as to how the patient gets along in daily life with regard to his work, eating, dressing, etc.

The entirely objective examination is really encumbered with

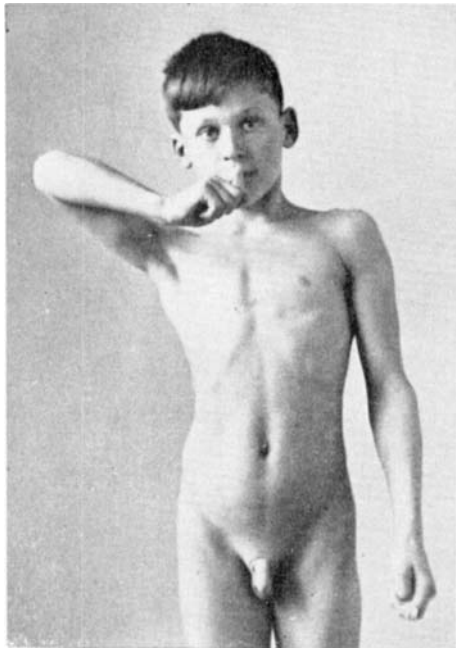


Fig. 3.

A case of inveterate Erb-Duchenne paralysis before subscapularis tenotomy. Note the defect in outward rotation and the clumsy way in which he brings his hand up to his mouth. (Patient B 9856, Case 40.)

many factors of uncertainty—*e.g.*, the gradation of the mobility, which is particularly difficult to give precisely for the shoulder-joint, and comparison of the mobility before and after the operation need, therefore, not express anything positive if the difference is slight; and this holds true especially if it is not the same clinician who examines the patient before and after.

This point is illustrated very well by the fact that even

though the patient on objective examination is found to show but little improvement, he may sometimes think himself that his arm has become considerably better. An instance of this kind is found in the patient entered under "some improvement" (B 9985, Case 41). In this case the examination shows an arthro-

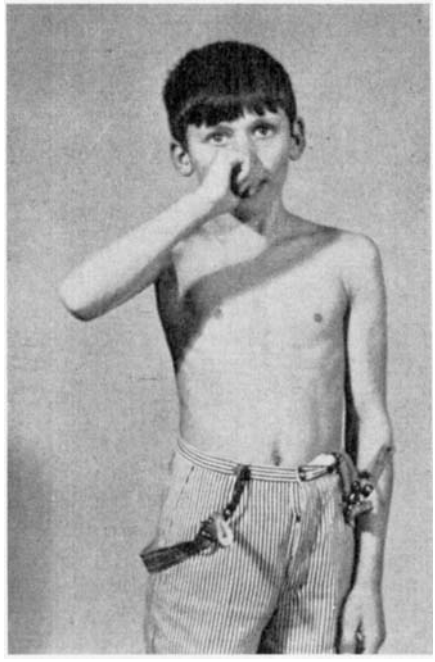
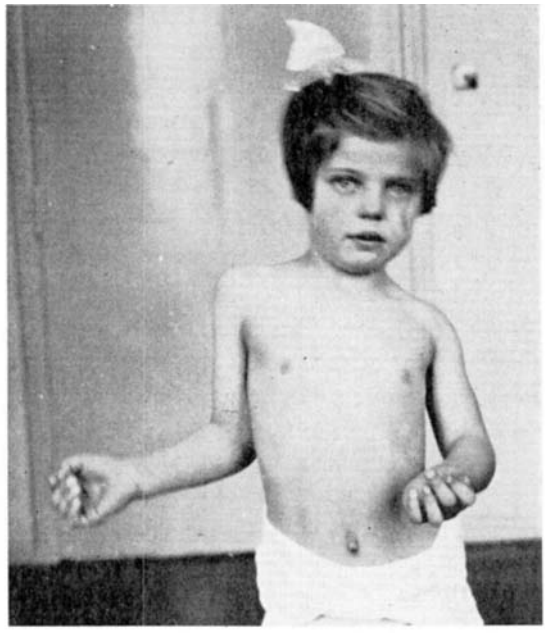
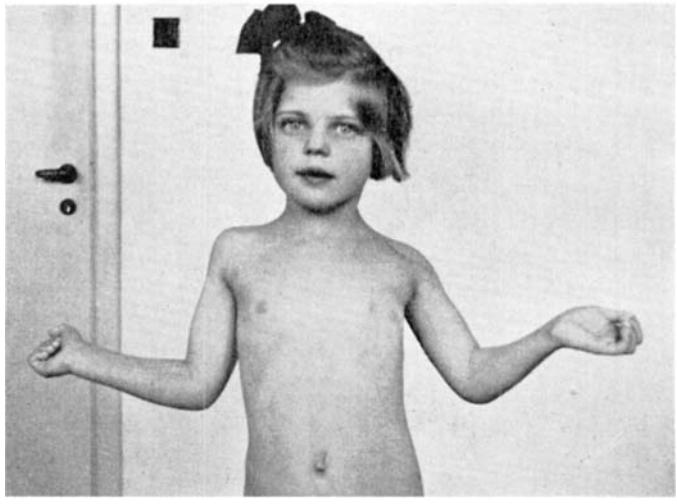


Fig. 4.
Same patient as in Fig. 3, after subscapularis tenotomy. Note the almost normal outward rotation and the normal way in which he brings his hand up to his mouth, with the elbow lowered nicely.

genic contracture with the humerus in about 50° abduction and some outward rotation, with only a few degrees of mobility from this position. The patient states himself, however, that the arm gives him practically no inconvenience since he was operated on. When, nevertheless, he is entered under "Some improvement" it is because this contracture, of course, was far from being aimed at with the operation. But its appearance. I think, can





Figs. 5 and *6.*

Patient B 6241 (Case 36) before and after operative treatment (same patient as in Fig. 7). Note the full outward rotation of the left arm after the operation.

hardly be blamed on the method of operation. Many of these patients present arthritic changes in the shoulder-joint before the operation, owing to inactivity and inward rotation contracture for a good many years. Finally, one could hardly imagine any operation that would be more lenient on the shoulder-joint than just tenotomy of the subscapularis.

Similar considerations hold true with regard to the two patients entered under "Little improvement" (Cases 28, 39). Also these two patients think the condition has become considerably better after the operation. The first of them is afflicted with several orthopedic lesions, which together disabled her rather markedly, and in whose case it was not to be expected that the result would be better than it turned out. The other patient, too, is very glad he has been operated on. He is now learning the trade of a mechanic and gets along well at his work. (As a curious trait it may be mentioned that he asked to get a set of our photos of himself before and after the operation, because he knows another boy with the same affection whom he wanted to convince about the great improvement that might be obtained by operative treatment).

The treatment proper of the sequelae of the Erb-Duchenne paralysis aims to overcome the subscapularis contracture. The other operations performed can be characterized only as adjuvant operations to be used in cases where a single muscle has remained paralyzed, or where the Erb-Duchenne paralysis is complicated by paralysis of the muscles supplied by the radial nerve.

The most rational operation for this purpose in the inveterate cases is the subscapularis tenotomy as given independently by Slomann and by Sever.

As will be noticed, the result has been good in most of the cases, and the treatment of a patient with Erb-Duchenne paralysis is really a thankful task.

In this hospital the employed technique is briefly as follows: Incision over the trigonum Mohrenheimii, and blunt dissection between the pectoralis major and the deltoid, revealing at the floor of the field the coracoid process with the origin of the

short head of the biceps. Just laterally hereto, the distal end of the tendon of the subscapularis is now disclosed by outward rotation of the arm, and this tendon is divided readily (on an instrument introduced under the tendon). At the same time, it is important to perform a sort of capsulotomy, as the tendon usually is rather strongly adherent to the fibrous capsule. When

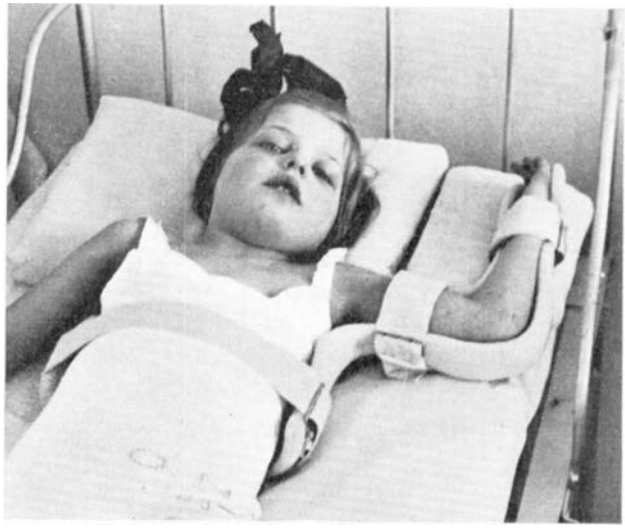


Fig. 7.
Same patient as in Figs. 5 and 6, with application of the abducting and outward rotating plaster splint, the so-called "cheerio-splint".

the subscapularis tendon is divided, the frequently backward-subluxated head of the humerus will nearly always undergo distinct reposition, that is, if not particular conditions assert themselves, as for instance, in Case 39. After suturing of the skin, a plaster bandage is applied, with the arm abducted and outward rotated in cheerio position. After four weeks this bandage is removed, and treatment is instituted with exercises and massage; at the same time a new splint is made, likewise in cheerio position, which the patient uses at night and at rest.

In the case of girls, however, for cosmetic reasons, we have sometimes laid the skin incision in the posterior axillary fold;

but this incision has the drawback that it makes it difficult to get at the fibrous capsule properly. On reexamination we have noticed, indeed, that in these very patients there was a somewhat greater resistance against complete cheerio position of the arm than encountered in the boys, in whom the incision is laid on the anterior aspect of the joint. In the last of our operated patients, B 6241 (Case 36) who was a girl, we therefore laid the incision in the trigonum Mohrenheimii and we have adopted this as the normal method for girls, too, in future operations.

In one case—that of B 12196 (Case 43)—elongation of the teres major was performed too, as there was a pronounced contracture of this muscle.

In another case (No. 36), besides subscapularis tenotomy myotomy of the pectoralis major was performed (division of the upper fibers of this muscles).

Sever employs a somewhat more extensive operation. Briefly, his technique is as follows: Incision from the acromion to insertion of the pectoralis major, the tendon of which is divided completely, and the muscle is pulled medially so as to disclose at the bottom of the field the inner margin of the coracobrachialis, which is cleaned upwards to the coracoid process, the arm being rotated outwards and abducted. The tip of the coracoid process is loosened completely from its base, together with the insertion of the coracobrachialis, the short head of the biceps and the pectoralis minor. These structures are now pulled outwards, and the capsule of the shoulder-joint is seen at the bottom of the wound together with the subscapularis tendon, which is divided on an instrument introduced under it. If the acromion is bent downwards so much that it blocks the reposition of the head of the humerus, the acromion is chiselled sufficiently to allow of the reposition. After closing of the wound, bandaging in elevation, outward rotation and supination. In a certain number of cases in which the pronator teres was strongly contracted, Sever divided this muscle and obtained a good result as to increased supination. Of inconveniences associated with this operation, he states that inward rotation sometimes may be difficult in the first year after the operation, and that the arm when

hanging down along the trunk nearly always gives a rather considerable rotation in the vertical plan of the scapula—which does not look nice.

In 1934 L'Episcopo gave a new method for correction of the deforming inward rotation contracture. For that matter, he considers Severs method the best, but in some cases he has not been quite satisfied with the result. His method is as follows: First the usual Sever operation is performed. Then an new incision is made along the posterior margin of the deltoïd. The long head of the triceps is detached at its insertion, and the tendon of the teres major is divided. After this, an osteoperiosteal flap is made as near the short head of the triceps as possible and the tendon of the teres major is anchored by sutures beneath this flap. In this way, the insertion of the teres major is transferred to a place almost directly opposite the site of the original insertion, and the teres major thus is made to act as an outward rotator instead of an inward rotator. Since 1931 L'Epïscpo has performed this operation 6 times, all with good result.

Treatment with tendon transplantation alone has been employed by Kast who operated a case of congenital paralysis with inward rotation contracture by transferring the tendons of the latissïmus dorsi and teres major back of the humerus and sewing them to the teres minor. Subscapularis tenotomy was not performed. The result is characterized as good. Undoubtedly, however, this operation is serviceable only in very mild cases in which the contracture merely is slight.

In 1932 Kleïnberg reported 10 cases of obstetrical paralysis of the upper extremities, 8 of whom were treated operatively with subperiosteal liberation of the joint capsule and insertion of the outward and inward rotators on the proximal 1½ inches of the humerus. Then the arm was rotated outwards when the lateral flap was sutured more medially, overlapping a little the medïal flap.

The same method has been employed by Herzmark.

In 1924 Kleinberg described another operation for the same purpose, consisting in arthrodesis of the shoulder-joint.

In 1937 Kendrick reported two cases of obstetrical paralysis,

one in a boy of 11 years, the other in a girl of 10 years, who both were operated on ad modum Kleinberg, the method published in 1932. The first patient returned 3 years later with complaint of stiffness of the shoulder, the other returned two years after the operation with the same complaint. In both patients the mobility was found to be reduced and roentgenography showed in the first patient an almost complete disappearance of the head of the humerus and pronounced deformity of the remaining part. In the other patient roentgenography showed deformity of the proximal epiphysis of the humerus with irregularity in the density of the bone.

Still, similar phenomena may result also in patients submitted to subscapularis tenotomy—as in two of our patients (Cases 34 and 41) though in a less pronounced degree (in one of these cases the observation period was somewhat shorter too). Theoretically, however, such changes may conceivably turn up more readily after operations on the skeleton of children or adolescent patients than after operations limited to the soft tissues, where the risk of injuring the blood vessels supplying the bones will be considerably smaller.

Arthrodesis of the shoulder as a method for treatment of obstetrical paralysis of the arm may be said to be indicated only in rare cases, namely: in the presence of severe paralysis of the deltoid in patients with good function of the hand and forearm, besides good movers of the scapula.

As to the rotation osteotomy on the upper part of the humerus, it seems no longer to be really justified. It does not increase the mobility in the shoulder-joint, the reduced mobility of which is indeed the cause of all the trouble, as all the motions may be made freely the moment that the locking is abolished. Still, this operation has several advocates, especially among French orthopedists (*e.g.,* Rendu, Mouchet, Rocher).

So the most rational operative treatment must be an operation that liberates the outward rotation, and this is precisely what the subscapularis tenotomy does. When afterwards the patient is still unable to make use of his arm in every direction and without any difficulty, it is because the protacted inactivity

—often covering many years—has resulted in pronounced muscular atrophy, which has to be remedied by massage and remedial exercises, while the patient at the same time keeps on employing the "cheerio-splint" at night.

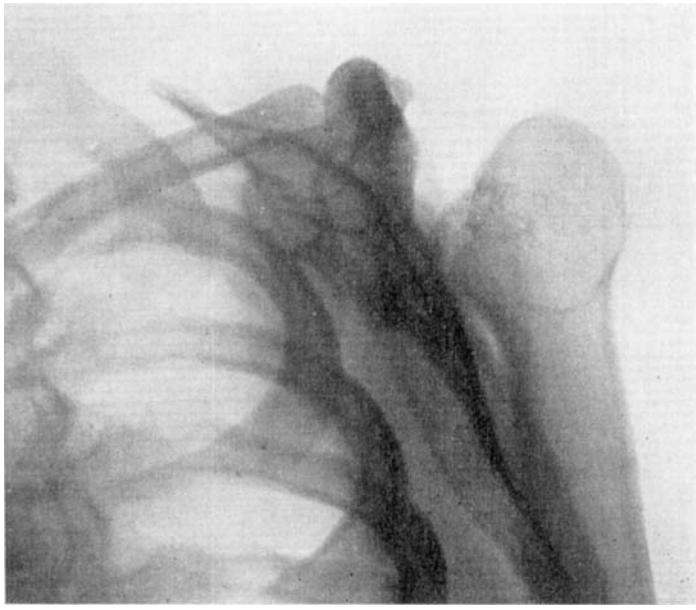


Fig. 8.
X-ray picture of the right shoulder in oblique projection, showing complete dislocation (backwards) of the markedly flattened head of the humerus. This illustrates how severe the joint changes may become in inveterate Erb-Duchenne paralysis. (Patient B 6319, Case 39.)

KLUMPKE'S PARALYSIS

This paralysis, which is due to injury—from overstretching or tearing—to the nerves from C_8 and Th_1, involves especially the musculature of the forearm and hand. But paralysis of the shoulder and upper arm will often be present too, either in the form of Erb-Duchenne paralysis or solitary paralysis of individual muscles; there appears to be no rules for this selection.

Most often the Klumpke paralysis makes its appearance at birth in the form of complete paralysis of the entire arm as evidence of injury to all the nerves from C_5 to Th_1 that enter into the formation of the brachial plexus. Further, the Klumpke paralysis is characterized by certain eye symptoms, the so-called Horner's syndrome: enophthalmus, ptosis, and myosis. This is due to injury to the ramus communicans between the first thoracic nerve and the last cervical or first thoracic ganglion of the sympathetic. This symptom is not pathognomonic of Klumpke's paralysis, as occasionally it is present also in Erb-Duchenne paralysis, and sometimes it may be absent in Klumpke paralysis.

As the birth injury often involves the entire brachial plexus, it will not infrequently be difficult at once to make the exact diagnosis, especially in the absence of Horner's syndrome, and it may require observation for some length of time before the true nature of the lesion manifests itself.

Klumpke's paralysis has to be defined as a paralysis of the brachial plexus involving exclusively or primarily the muscles supplied by the lower cervical nerves and the first thoracic (Bentzon).

So paralysis of the Erb-Duchenne group + radial paralysis + Horner's syndrome is not sufficient for the diagnosis Klumpke's paralysis. At any rate the muscles supplied by the ulnar nerve have to be paralyzed too.

Klumpke's paralysis is further associated with sensory disturbances.

In this hospital we have had 8 cases of Klumpke's paralysis, one of them at an early stage.

CASE RECORDS

Case 44. (B 513.)

Girl, born 18/7/27. Admitted 1/12/36.

Diagnosis: Klumpke paralysis, left.

Forceps delivery. Examination shows total paralysis of the musculature of the forearm. A little faculty for opposition remains, besides slight flexion and extension of the distal phalanges. Anesthesia on the entire radial side of the arm, hand and four radial fingers. No true Horner's syndrome, but distinct flattening of the left half of the face. No treat-

ment attempted. 24/11/41: The family physician states that, with exception of the thumb, the left arm is incapable of any function to speak of. Her present work consists in a little housework at home.

Case 45. (B 976.)

Woman, born 23/5/16. Admitted 19/2/37.

Diagnosis: Klumpke paralysis, left.

Born by forceps delivery. At the age of 5 years, admitted to the Orthopedic Hospital, Copenhagen, where subscapularis tenotomy and activation of the extensor digit. com. sin. were performed. The effect has been quite minimal, however. Mobility in the shoulder-joint fair, although lacking 90° in outward rotation. Severe paralysis of the muscles of the forearm. She is able to fix very light objects with her left hand, but she cannot grasp anything with it, and it is almost powerless. No typical Horner's syndrome; no sensory disturbances. No treatment is given.

Case 46. (B 3203.)

Boy, born 7/6/34. Admitted 12/1/38.

Diagnosis: Klumpke paralysis, left.

Difficult delivery in brow presentation. Examination shows very feeble muscular power of the hand and forearm, with paralysis of the flexors as well as the extensors and also the short muscles of the hand. The state of the shoulder is the same as in inveterate E.-D. with contracture of the subscapularis. Treatment: Night splint giving dorsal flexion of the wrist and fingers, and abduction of the thumb. Reexamination, 24/11/41: Slight progress as to muscle power of the left hand, but it can be used only for fixation. Otherwise no change in the state of the arm.

Case 47. (B 5603.)

Boy, born 16/8/22. Admitted 6/1/39.

Diagnosis: Klumpke paralysis, right.

Protracted and difficult forceps delivery. Asphyxiated at birth. Arm held as in E.-D. Right hand so dystrophic, powerless and immobile that it is considered useless to attempt any orthopedic treatment; it is decided to let the patient train in he use of his left hand as if one-armed. Horner's syndrome present but slight. Also sinistroconvex scoliosis with torsion. General mobility good.

Case 48. (B 7198.)

Boy, born 11/3/39. Admitted 3/7/39.

Diagnosis: Klumpke paralysis, left.

The case of this patient is recorded under Stage II, Group of Infants (Case 13).

Case 49. (B 8750.)

Man, born 7/2/09. Admitted 17/4/40.

Diagnosis: Klumpke paralysis, right.

The patient has never been under treatment before. In the Home for the Crippled he has been trained in joiner's work. For the last half year he has complained of paresthesias of the right forearm and hand, with lowered sensibility here. Examination shows pronounced atrophy of the entire right upper extremity. The muscle power of the hand is very poor. The paresthesias—in the ulnar region—seem attributable to the narrow spacing allotted the structures round the shoulder, where the atrophy and shortening of the clavicle is very pronounced, and where the nerves therefore easily may undergo pressure. No treatment instituted.

Case 50. (B 10609.)

Boy, born 20/3/25. Admitted 28/2/41.

Diagnosis: Klumpke paralysis, right.

He has never been able to use the right arm or hand. Examination shows dystrophy of the entire right upper extremity with diffuse muscular atrophy as well as reduction in the growth of the bones (involving the scapula and clavicle as well as the other bones of the extremity). Marked reduction in the sensibility of the entire right upper extremity, with complete anesthesia on the volar aspect of the forearm and hand, also the greater part of the dorsal surface of the hand. Pronounced subscapularis contracture. The total muscular power of the hand is extremely slight. No pronounced Horner's syndrome, but slight hemiatrophy of the face. Reexamination, 20/10/41: For the past year and a half he has been working on a farm and this has resulted in some functional improvement of the hand. The thumb is now capable of some opposition, and the active mobility of the fingers is almost free, except for extension of the 3 lateral fingers, but the muscular power is insignificant. Still, the function has improved so much that the possibility of subsequent subscapularis tenotomy will have to be considered if this progress keeps on.

Case 51. (B 10561.)

Girl, born 5/9/31. Admitted 21/5/41.

Diagnosis: Klumpke paralysis, right; Erb-Duchenne paralysis, left (slight degree).

Delivery in breech presentation with extraction. Examination shows absence of active mobility in the elbow. The wrist is completely loose. The fingers (right hand) are fixed in flexion and cannot be extended passively. No abduction or flexion in the right shoulder. Horner's syndrome present on the right side. Right forearm in maximal supination; active pronation impossible. Remains of E.-D. on the left side.

No indication is found for orthopedic treatment.

The material thus comprises 8 patients with Klumpke's paralysis, 5 male and 3 female. The lesion was present on the right side in 4, on the left in 4. In one case, Klumpke's paralysis of the right arm was associated with Erb-Duchenne's paralysis on the left side.

One of the patients, B 976 (Case 45), had previously received operative treatment in another hospital, but only with slight benefit.

None of our patients have presented any indication or condition for operative treatment, as there has been no material available for activation of the hand. The only one of these patients in whom operative treatment subsequently may be serviceable is B 10609 (Case 50), in whose case there is a slight possibility of subscapularis tenotomy later on.

As to the operative measures that may be employed in suitable cases of Klumpke's paralysis, they are quite atypical operations which in each case has to be adjusted after the conditions present.

All authors give the prognosis as very poor, and our material illustrates this view very plainly.

Only two of the patients have shown any improvement, and this has been so slight as to make it doubtful whether the hand will ever be of any particular value for working purposes, being serviceable at the most for fixation of light objects.

So in Klumpke's paralysis the prognosis is considerably worse than in Erb-Duchenne's paralysis. The reason for this, no doubt, has to be looked for partly in the severity of the injury to the nerves, partly in the fact that the long nerves here involved regenerate less readily than shorter nerves. In these cases the orthopedist should perhaps be more inclined to suture the nerves early, but, as mentioned, sometimes the diagnosis can be made only after observation for some length of time and the lesser tendency for regeneration in these nerves, owing to their length, will not improve on operation.

SUMMARY

A brief account is given of the prevailing theory about the origin of the obstetrical paralyses, namely: that these lesions arise during delivery of the child, being brought about by forced separation of the shoulder and neck, so that the brachial plexus is overstretched or, in severe cases, torn apart. This theory finds support in experimental investigations (Bentzon) and in the clinical data of such cases—large children, difficult delivery, often in breech presentation. Further, as a rule, the patients recover fairly rapidly—which would not be conceivable if the lesion were due to injuries originating earlier in fetal life (Erlacher, Weil), nor if it were a matter of true congenital malformation, a vitium primae formationis (Schubert). In particular, the writer refutes a connection of this lesion with the congenital elevation of the scapula, because in obstetrical paralysis in the newborn this elevation is merely apparent, owing to inward rotation in the shoulderjoint; and in the inveterate cases it is due to shortening of the clavicle on account of atrophy from inactivity.

Nor can the writer subscribe to the theory about heredity of the lesion (Blencke), as he is more inclined to consider the rare instances of familial occurrence of the lesion as expressions for hereditary appearance of contracted pelvis resulting in difficulties of delivery. Nor is a hereditary affection probable as about 80 % of the patients recover on treatment with simple immobilization.

The writer then presents a material comprising 50 patients with obstetrical paralysis of the upper extremity, 43 cases of the Erb-Duchenne type, 8 of the Klumpke type, one of the patients being afflicted with Erb-Duchenne paralysis on one side and Klumpke paralysis on the other.

The patients are divided into four groups or stages: 1) newborn; 2) infants; 3) cases of slight or fully developed contracture but without deformity; and 4) inveterate (stationary) cases with fully developed contracture and deformity. These categories

of patients are then reviewed, group by group, and abstracts of the respective case records are presented.

With regard to the recent cases (Stages I and II) the writer discusses the question of bloodless treatment (immobilizing splint) contra operative treatment, and arrives at the conclusion that the splint treatment ought to be the standard method, and that the operative treatment should be employed only as a last resort in rare cases after a long period of expectation, as the prognosis is very favorable under the bloodless treatment and as it is never practicable at an early juncture to decide in the individual case whether or not spontaneous regeneration will take place.

In most cases with relatively slight contracture, a good mobility of the arm is obtained by splint treatment. Generally cases belonging to Stage I or II may be prevented from passing into Stage III or IV.

In 9 out of the 12 inveterate cases (Stage IV), a very good result was obtained by subscapularis tenotomy. The technique of this operative treatment is described; a description is also given of Sever's operation, which is based on the same principle.

Mention is further made of other operative measures that may be considered in such cases (transplantation of tendons), although the only one of this kind performed in the material here presented has been myotomy on the pectoralis major and elongation of the teres major.

Also other methods for operative abolition of the subscapularis contracture are mentioned, *e.g.*, Kleinberg's subperiosteal medial transfer of the capsule of the shoulder-joint and the insertion of the muscles inserted on the tubercles of the humerus.

Arthrodesis of the shoulder-joint is discussed, too, an operative measure that may be serviceable in certain rare cases with persistent massive paralysis of the deltoid and the outward rotators.

Rotation osteotomy of the humerus should not be performed in this lesion, as it never can yield more than the subscapularis tenotomy, which is a much simpler operation, and it offers no rational solution of the problem, as it is not aimed at the causal

principle in inveterate cases of Erb-Duchenne paralysis: the locking of the shoulder-joint resulting from the subscapularis contracture.

Finally, a brief account is given of Klumpke's paralysis, the cases here presented confirming the poor prognosis of this lesion.

In conclusion I wish to express my indebtedness to my chief, Dr. P. G. K. Bentzon, physician-in-chief to the Aarhus Orthopedic Hospital for his encouragement to take up the studies here presented and for advice and assistance given me in the performance of this work.

I further wish to acknowledge the financial aid received for this work from the Society and Home for Cripples.

RÉSUMÉ

Il est donné un exposé sommaire de la théorie généralement adoptée maintenant de l'étiologie de la parèse obstétricale, à savoir que celle-ci se produit au cours même de l'accouchement par l'écartement forcé de l'épaule et du cou de l'enfant, ce qui fait que le plexus brachialis est distendu ou, dans des cas graves, déchirés. Cette théorie se trouve confirmée en partie par les recherches expérimentales (Bentzon), en partie par les faits cliniques — gros enfants, accouchements difficiles, souvent en présentation pelvienne, guérison généralement rapide, inconcevable s'il s'agissait de lésions survenues à l'un ou l'autre moment de la vie foetale (Erlacher, Weil), ou s'il s'agissait d'une malformation congénitale, d'un vitium primae formationis (Schubert). On repousse notamment l'idée d'un rapport entre cette affection et l'elevatio scapulae congénitale qui n'est qu'apparente dans la parèse obstétricale chez les nouveaux-nés par suite de la rotation en dedans de l'épaule et qui, dans les cas invétérés, est due à un raccourcissement de la clavicule par suite d'une atrophie d'inactivité.

On ne saurait non plus admettre la théorie prêtant un caractère héréditaire à cette maladie (Blencke), on est bien plutôt

enclin à considérer les rares cas familiaux de cette affection comme résultant d'un rétrécissement héréditaire du bassin d'où s'ensuit des difficultés d'accouchement. Une maladie héréditaire qui, dans environ 80 % des cas, se guérit par un simple traitement immobilisant ne semble par ailleurs guère probable.

Il est présenté ensuite un matériel d'observation portant sur 50 malades souffrant de parèses obstétricales des extrémités supérieures. Parmi ceux-ci il y en avait 43 du type Duchenne-Erb et 8 du type Klumpke, un des malades présentant le type Duchenne-Erb d'un côté et Klumpke de l'autre.

Les malades sont divisés en 4 stades: 1) nouveaux-nés, 2) bébés, 3) cas avec contracture légère ou accusée, mais sans déformité, et, 4) cas invétérés (stationnaires) avec contracture accusée et déformités. Les catégories de malades sont ensuite passées en revue par groupes avec exposé de leur journal.

En ce qui concerne les cas récents (ler et 2ème stades) on discute le traitement non sanglant (traitement couché immobilisant) par opposition au traitement opératif et l'on conclut que le traitement couché doit être la méthode normale de traitement et que l'opération ne doit être pratiquée que dans de rares cas, apres une longue période d'attente et qu'il ne faut y avoir recours que comme ultimum refugium, étant donné que le pronostic est particulièrement favorable dans les cas soumis au traitement non sanglant et que l'on ne peut jamais dire à un moment précoce de la maladie s'il ne se produira pas une régénération spontanée.

Dans les cas avec légère contracture, on obtient la plupart du temps une bonne mobilité du bras par le traitement couché. Les cas au ler et au 2ème stade ne doivent qu'exceptionnellement passer au 3ème stade et encore moins au 4ème.

En ce qui concerne les cas invétérés, on a obtenu des résultats particulièrement favorables dans 9 cas sur 12 par la ténotomie subscapulaire. La technique de cette opération est décrite de même que celle de l'opération Severs qui repose sur le même principe.

On parle également d'autres procédés opératifs dont il peut être question (transplantation de tendons), sans cependant qu'il

ait été pratiqué sur le matériel d'observation envisagé d'autres opérations que la myotomie du muscle pectoral major et l'allongement du muscle teres major.

D'autres méthodes d'opération pour supprimer la contracture subscapulaire sont citées, ainsi le déplacement subpériostal médial de la capsule de l'épaule dit Kleinberg et l'insertion des muscles insérés sur le tubercula.

On parle également de l'arthrodèse de l'épaule, dont il peut être question dans de rares cas avec paralysie massive persistante du deltoïde et des rotateurs externes.

L'ostéotomie de rotation de l'humérus ne doit pas être pratiquée pour cette affection, étant donné qu'elle ne peut fournir de meilleurs résultats que la ténotomie subscapulaire qui est une opération beaucoup plus simple et que, par ailleurs, ce n'est pas là une solution rationnelle puisqu'elle ne tient pas compte des faits causaux de la parèse Duchenne-Erb invétérée, à savoir l'immobilisation de l'épaule par suite de la contracture subscapulaire.

Pour terminer la parèse de Klumpke est citée brièvement et son pronostic défavorable est confirmé.

Je tiens à remercier ici mon chef, M. le Docteur P. G. K. Bentzon qui non seulement m'a incité à faire cette étude, maïs qui n'a fourni au cours de son élaboration un bienveillant appui et de précieux conseils. Je remercie aussi l'Institut Orthopédique de Copenhague pour l'aide économique qui a été accordée à mes travaux.

ZUSAMMENFASSUNG

Es wird eine kurzgefasste Darstellung der jetzt allgemein anerkannten Theorie von der Entstehung der obstetrizischen Parese gegeben, nämlich dass diese während der Geburt selbst entsteht, dadurch dass man Schulter und Hals des Kindes gewaltsam voneinander entfernt, wodurch der Plexus brachialis überdehnt oder in schweren Fällen zerrissen wird. Diese Theorie wird einerseits durch experimentelle Untersuchungen gestützt (Bentzon), andererseits durch die klinischen Umstände selbst:

grosse Kinder, schwere Geburten, oft in Steisslage, und die in der Regel ziemlich rasche Heilung, die nicht denkbar wäre, wenn es sich um Schädigungen handeln würde, die zu irgendeinem Zeitpunkt des Fätallebens entstanden wären (Erlacher, Weil) und ebensowenig, wenn es sich um eine eigentliche kongenitale Missbildung handeln würde, ein vitium primae formationis (Schubert). Insbesondere wird Abstand genommen von einem Zusammenhang des Leidens mit der angeborenen Elevatio scapulae, die bei der obstetrizischen Parese bei Neugeborenen infolge der Rotation des Schultergelenks nach innen nur scheinbar besteht und die bei den inveterierten Fällen von einer Verkürzung der Clavicula infolge einer Inaktivitätsatrophie herrührt.

Verf. kann sich auch nicht der Theorie von der Erblichkeit des Leidens (Blencke) anschliessen, weil er mehr geneigt ist, das in seltenen Fällen familiäre Auftreten des Leidens als Ausdruck eines erblichen Vorkommens von enger Beckenpassage mit daraus folgenden Entbindungsschwierigkeiten aufzufassen. Ein erbliches Leiden, das in ca. 80 % der Fälle durch eine einfache immobilisierende Behandlung geheilt werden könnte, ist ebenfalls nicht wahrscheinlich.

Hierauf wird ein Material von 50 Patienten mit obstetrizischer Parese der oberen Extremität vorgelegt. Hiervon sind 43 Fälle vom Duchenne-Erb'schen Typus und 8 vom Klumpke-schen Typus, da ein Patient D.-E. auf der einen und Kl. auf der anderen Seite hatte.

Die Fälle werden nach 4 Stadien zusammengestellt: 1) Neugeborene, 2) Säuglinge, 3) Fälle mit leichterer oder voll ausgebildeter Kontraktur, aber ohne Deformität und 4) inveterierte (stationäre) Fälle mit voll ausgebildeter Kontraktur und Deformitäten. Die Patientenkategorien werden dann gruppenweise unter Vorlegung von Krankengeschichten durchgegangen.

Bei den frischen Fällen (1. und 2. Stadium) wird die unblutige Behandlung (immobilisierende Ruhebehandlung) contra operative erörtert, und Verf. kommt zu dem Schluss, dass die Ruhebehandlung die Normalmethode sein sollte und dass die operative Behandlung nur in seltenen Fällen nach einer langen

Wartezeit als ultimum refugium benutzt werden sollte; denn die Prognose ist bei der unblutigen Behandlung durchaus gut, und man kann in einem frühen Stadium im einzelnen Fälle niemals entscheiden, ob eine spontane Regeneration eintreten wird.

Bei Fällen mit leichteren Kontrakturen wird in den meisten Fällen durch Ruhebehandlung gute Beweglichkeit der Arme erzielt. Fälle im 1. oder 2. Stadium sollten nur ausnahmsweise in das 3. Stadium und noch weniger in das 4. Stadium übergehen können.

Bei den inveterierten Fällen wurde in 9 von 12 Fällen durch Tenotomia subscapularis ein durchaus gutes Ergebnis erzielt. Die dabei angewandte Technik wird besprochen, und auch die Sever'sche Operation, die auf demselben Prinzip beruht, wird beschrieben.

Auch andere operative Verfahren, die in Frage kommen können (Sehnentransplantationen), werden erwähnt; an dem vorgelegten Material wurden jedoch ausser Myotomie am M. pectoralis major und Verlängerung des M. teres major keine anderen Operationen vorgenommen.

Andere Operationsmethoden zur Aufhebung der Subscapulariskontraktur werden besprochen, so Kleinberg's subperiostale Verlegung medial von der Schultergelenkkapsel und die Insertion der an den Tubercula ansetzenden Muskeln.

Ebenso wird die Arthrodese des Schultergelenks besprochen, die in gewissen seltenen Fällen mit persistierender massiver Lähmung des Deltoideus und der nach aussen drehenden Muskeln in Frage kommen kann.

Eine Rotationsosteotomie am Humerus sollte bei diesem Leiden nicht vorgenommen werden, weil sie erstens niemals mehr leisten kann als die Subscapularistenotomie, die eine weit einfachere Operation ist, und weil sie zweitens keine rationnelle Lösung darstellt; denn sie zielt nicht auf das Kausale bei der inveterierten Duchenne-Erb'schen Parese ab, nämlich die Stillegung des Schultergelenks infolge der Subscapulariskontraktur.

Am Schlusse wird ganz kurz die Klumpke'sche Parese erwähnt, deren schlechte Prognose bestätigt wird.

Schliesslich möchte ich meinem Chef, Chefarzt Dr. med. P.

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