

CHAPTER XIII

BRACHIAL BIRTH PALSY

Historical facts—Pathology—Of actual lesions of the plexus—Of injuries of the shoulder joint—Of the upper end of the humerus—Frequency—Etiology—Compression of the plexus—By forceps—By finger—By the clavicle—Partial or complete tearing of cervical nerves—Symptomatology—Diagnosis—Prognosis—Prophylaxis—Treatment.

The first exact description of a case of brachial birth palsy, according to Stransky, was published by Danyan in 1851.

In 1862 Duchenne (in the second edition of his work on electricity) spoke of a brachial palsy seen in a newborn infant in whom the plexus had been injured by the subacromial luxation of the shoulder in birth. In the next edition of this book (1872) he recognized three types of obstetrical paralysis of the upper extremity: (1) due to pressure of the forceps against the plexus, (2) in which the plexus is injured during certain obstetrical manipulations (lowering of the arm in a breech presentation, hooking of the finger into the upper axilla for traction in vertex presentation during delivery of the shoulders), and (3) traumatization of the plexus as the result of a subacromial luxation (quoted from Thomas).

Seeligmüller (1874), in a paper dealing mainly with injury of the facial nerve by the forceps, expressed the belief that in the same manner also the brachial plexus may be injured. The more frequent occurrence of a brachial palsy in breech labors he ascribed to excessive stretching of cervical nerves by severe pulling on the shoulders.

In the same year (1874) Erb published his classic monograph on traumatic brachial paralysis as seen in the adult. He discovered as its cause a lesion of the fifth and sixth cervical nerves at a point about two to three centimeters above the clavicle and just behind the posterior edge of the sternomastoid muscle—now well known as Erb's point. Approximately in this region the fifth and sixth cervical nerves emerge between the scaleni muscles and come to lie

closely underneath the skin. Passing with the rest of the plexus fibers behind the clavicle, they run towards the axilla.

On the basis of these anatomic facts, Schultze (1888) developed the theory of a compression of the brachial plexus by the clavicle, when the shoulder is forcibly elevated and the arm thrown upward and backward.

Erb considered the adult type identical with that described by Duchenne as an obstetrical lesion, and thus the condition became known in medical literature as the Duchenne-Erb type of brachial palsy, often simply referred to as Erb's palsy.

Though many other explanations concerning the origin of brachial birth palsy have been offered in the meantime, the Duchenne-Erb theory of a supraclavicular injury of the plexus in general has remained the predominating one in obstetrical literature up to recent years.

Kuestner (1889) could not deny the possibility of a true brachial paralysis being caused by the direct traumatization of the plexus, but felt forced to the deduction that in the larger number of cases the actual cause for the palsy was to be found in a more or less serious bone injury near the shoulder, a fracture or detachment of the upper epiphysis of the humerus. Only in this manner could he explain to his satisfaction the paradox that the facial nerve "injured by hard steel" almost always recuperated, while the brachial plexus traumatized "only by the pressure of the soft finger of the obstetrician" would prove irreparably damaged in so many instances. In all serious cases, he maintained, in which function remains permanently impaired or actually destroyed, the trauma to the plexus was complicated by an unrecognized injury of the humerus within the shoulder joint.

The suggestion made by Burr (in 1892) that the palsy is due to an injury of the cervical cord met with but scant consideration at the time. In view of our newer information concerning birth injuries of the cervical portion of the spine (see Chapter VI) the possibility cannot be denied that in some cases a cervical injury might produce a clinical picture closely resembling an Erb's paralysis.

Arens (1889) explained the palsy as the result of a hemorrhage in torn plexus fibers, and Carter (1892), seemingly as the first, spoke of severe stretching and eventual tearing of some of the cervical nerves at birth (quoted from Wright). This theory met with ready

acceptance when placed on a firmer basis by the experiments of Fieux (1897). The latter entirely rejected the idea that the palsy could be due to strong pressure exerted against Erb's point by the forceps, the clavicle or the finger of the obstetrician. He claimed that the fifth and sixth cervical nerves are partially or completely torn as the result of overstretching if strong traction is made on the fore-coming or after-coming head, not in an axial direction, but with the head bent towards one shoulder (*tractions asynclitiques*). Only in this manner, Fieux argued, could be explained the occasional limitation of the paralysis to the deltoid. Bollenhagen answered him that an isolated paralysis of this sort in an older child or adult patient would prove nothing, because even in a typical Duchenne-Erb palsy, manifest immediately after birth, function may be gradually restored in all muscles except the deltoid.

It seems pertinent to point out in this connection that much confusion and unnecessary controversy in obstetrical literature concerning the etiology of brachial palsy has been caused by indiscriminate quotations from the writings of orthopedic surgeons and neurologists who, as a rule, speak of symptoms and conditions seen in older children and adults. The obstetrician should base his deductions only on phenomena exhibited by the newborn. But exact information concerning these phenomena is deplorably defective on account of the evident lack of interest of the obstetrician in the problem which indifference in turn prevents the orthopedist from seeing these palsies in the very early stage.

Shoemaker (1899) repeating Fieux's experiments was able to confirm the latter's conclusions though he was inclined to believe, in accord with the older conception, that at least in some of the cases the injury consisted in a severe compression of the plexus near Erb's point.

This identical fact was brought out in a paper of Thoyer-Rozat (1904). Experiments had convinced him that oblique traction will cause a dangerous elongation and eventually a rupture of the roots of the plexus. The observation, however, of a typical palsy in a case in which the possibility of an injury by traction had to be positively excluded, forced the admission that in this case the palsy must have been the result of direct pressure against nerve trunks. He finally suggested that tension might render the nerves more susceptible to traumatization by pressure.

Anatomic facts, to be described later, irrefutably prove that partial or complete laceration of cervical nerves actually does occur.

Still another hypothesis concerning the origin of brachial paralysis has been offered by Stransky (1902). In a survey of the entire literature on the subject he became impressed by the striking frequency in which reports stated that these babies were born in a state of asphyxiation. Referring to the widely accepted view that circulatory disturbances together with toxic conditions play an important rôle in the causation of palsies as, e.g., seen in chronic alcoholics or after a general anesthesia, he suggested that possibly the increased venosity and thus abnormal toxicity of the blood of the asphyxiated newborn may stand in an etiologic connection to birth palsies.

Whitman (1905) is generally credited with having cleared up the relation of a posterior subluxation of the humerus to brachial palsy. He differentiated between a primary shoulder dislocation due to a direct trauma sustained during birth and a subluxation developing secondarily to a brachial paralysis.

A great mass of controversial literature has accumulated on this problem of luxation. There exists still a third type of luxation, a rare and truly congenital form, observed by Bramann, Zander, Luft, and others. In a comparison with the very similar congenital hip joint luxation, Kroenlein (as cited by Luft) calculated that there occur probably only 5 congenital shoulder subluxations to every 90 congenital hip dislocations. The X-ray pictures in the congenital type are likely to show defects of the scapula, a rudimentary development of the glenoid cavity, or a characteristic flattening of the head of the humerus.

Kuestner thought that a luxation as the direct result of a birth trauma was impossible, because a force sufficient to dislocate the head of the humerus would be more than sufficient to cause rather a detachment of the epiphysis which accident would prevent a luxation. Most elaborate experiments made on cadavers of newborn infants by Serrés (mentioned by Luft) have uniformly failed to produce a luxation of the humerus.

As a matter of fact, most of recent writers (with the possible exception of Thomas) look upon this subluxation merely as a sequela of a primary paralysis.

Much confusion, also in this question of luxation, however, has

resulted from the unwarranted but common practice of applying the term congenital to all lesions seemingly existing since birth.

In the majority of instances the phenomena of the paralysis disappear; nevertheless orthopedic surgeons and neurologists in adult patients very frequently meet with distortions of an arm seemingly caused by a brachial palsy. This evident discrepancy impressed Lange (1912). He concluded that in most instances the paralysis was only apparent—a pseudoparalysis. No actual lesion of the nerve trunk had occurred in these cases, but an extensive traumatization of the ligaments and of the capsule of the shoulder joint. A subsequent shrinkage of scar tissue has finally produced the condition seen in the adult, an inward rotation and slight abduction of the arm with limitation in outward rotation and elevation.

Lange's theory has met with approval and still is maintained especially by those orthopedic surgeons who endeavor to prove the advantage of surgical procedures, attacking the shoulder joint itself, over operations directed towards restoration of plexus function by the anastomosis of severed nerve trunks (typified in the work of Platt, Sever, Sharpe, Taylor, and others).

Other surgeons combine Kuestner's original conception with the teachings of Lange. They speak of birth injuries of the shoulder joint causing detachment or even fracture of the epiphysis (Pelta-sohn, Vulpius) or of other bony parts of the joint often associated with lacerations of ligaments or of the joint capsule, immediately causing only a pseudoparalysis. But subsequent embedding of nerves in scar tissue (Gaugele), or a callus from a fracture might in the opinion of others result in a secondary true paralysis of some of the nerve trunks passing through the axilla. In this latter manner the origin of types of brachial palsy can be explained which do not represent the characteristic Erb's palsy.

Pathology.—For the moment disregarding doubtful and unsettled points in the etiology, I shall speak from the standpoint of the obstetrician only of certain pathologic-anatomic findings in newborn babies in whom all or some of the muscles of the upper extremity are found in a condition of true or seeming paralysis.

The operative findings of Kennedy, Clark, Taylor and Prout, Fairbank, Platt, and many others, have definitely established the possibility of *actual lesions of the plexus* at or near the junction of the fifth and sixth primary division of the cervical nerves, as a rule, affecting most extensively the fifth.

Clark, Taylor, and Prout divided the neural lesions into immediate and remote. The immediate lesion consists in a tearing of the perineural sheath, surrounding and supporting the nerve trunk, and the incidental rupture of blood vessels belonging to it. There is, furthermore, a severance of some of the nerve strands, more or less complete, depending upon the severity and nature of the injury. The remote result is brought about and its extent determined by (1) the healing of the perineural sheath, (2) the organization of the blood clot, and (3) the ultimate contraction of the cicatrix upon the nerve strands which not only prevents their regeneration, but determines a pressure neuritis in those not severed and on which it may chance to impinge.

According to Fairbank the actual damage varies from a slight tearing of the perineural sheath and hemorrhage into the nerve itself, to complete laceration of the nerve trunk. The milder types are the more common and, therefore, in the majority of cases, complete recovery ensues. The anterior primary division of one or more nerves may be actually pulled out of the spinal cord.

Eversmann in a careful dissection found a tumorlike mass in which the fifth cervical nerve near its junction to the sixth was firmly embedded. The mass proved to be an extensive inflammatory infiltration which had led to the complete destruction of the nerve fibers within the mass.

Anatomic proof for a traumatization of plexus nerves can be assumed for clinical observations like the following: A case of brachial palsy seen by Stahl in which after a forceps extraction a deep scar had formed from a gangrene, running along the edge of the trapezius muscle. Fairbank pointed out that occasionally a tender swelling can be palpated on the neck of the newborn in the region of the plexus. A most remarkable recent observation of Kofferath must be mentioned in this connection: Immediately after an easy low forceps extraction, the infant showed the unmistakable signs of some respiratory embarrassment. On the right side of the neck suggillations could be seen from the pressure of the forceps blade. The next day the child had a typical Erb's palsy of the right arm. Further investigation under x-ray revealed that the right half of the diaphragm was standing higher than the left as the result of a paralysis of the right phrenic nerve. This combination, in the belief of Kofferath, permits no doubt concerning the trau-

matic origin of both paralyses in view of the fact that the phrenic nerve passes very closely to the brachial plexus.

Turning our attention next to the pathology of a primary *injury of the shoulder joint*, we must differentiate between laceration of the joint capsule, a detachment of the upper epiphysis of the humerus and a luxation of its head.

Lange's theory was not based on the actual observation of *capsule lesions* in the newborn. In one adult case operated by him he found the cause of the paralysis to be the embedding of the axillary nerves in dense connective tissue, presumably the result of a tear of the capsule. Identical findings in adults have been noted by Gaugele. Thomas, though arguing in favor of Lange's theory, does not mention the fact that he ever discovered in his operations anatomic evidence of capsule lacerations at birth. Platt makes the specific statement that anatomic confirmation of this injury from actual exploration of the joint is lacking. In his own experience with the open operation, performed for the relief of the secondary subluxation, he had never seen any signs pointing to the occurrence of a previous laceration of the joint capsule.

Anatomic proof of *epiphyseal injury* at birth in the main is based on radiographic findings, though occasionally the detached epiphysis can be palpated.

According to Peltasohn a radiogram may show a change in the direction of the diaphyseal axis at the level of the attachment of the epiphysis, an abnormal gap between diaphysis and the end of the clavicle, or a lateral dislocation of the very small bone nucleus of the epiphysis. As the infant grows older the nucleus does not seem to enlarge normally and later exhibits an irregularity in its contour. Haenisch demonstrated in roentgenograms of five cases that the small ossification center of the epiphysis could be seen lying laterally instead of in the median line above the upper end of the diaphysis. Of these five infants three were cured by operation. Van Neck claimed to have been able to differentiate by means of radiography (in 5 cases) between a mere detachment and a detachment complicated by an actual fracture of the epiphysis. Platt, however, considers the interpretation of such radiographic findings meticulous and unconvincing, and feels compelled to the conclusion that evidence in favor of a pure epiphyseal lesion, presenting the clinical picture of a brachial birth palsy, is wanting.

There cannot be any doubt that a *posterior subluxation of the head of the humerus* is commonly seen in the adult patients in whom the signs of a brachial palsy were manifest at birth.

In the opinion of the many advocates of a mechanical restoration of this dislocation in the younger child, and of its operative correction in the neglected adult case (Bonnaire and Ecalle, Fairbank, Gaugele, Platt, Sever, Thomas, Whitman, etc.) it is this particular feature of correcting the dislocation which explains the more permanent and better functional results of their technic over those obtainable by surgical procedures which solely aim to restore the interrupted nerve connections (Taylor, etc.).

As stated before, rather generally this dislocation to-day is looked upon as a secondary development. The obstetrician will be concerned only with pathologic evidence of a possible luxation of the humerus effected by the trauma of birth.

The posterior subluxation, which as a clinical phenomenon represents an undisputable fact, according to Platt, could be theoretically explained by the laceration of the antero-inferior part of the joint capsule by violent traction and torsion of the arm. This would provide all the factors necessary for the slow forcing back of the head of the humerus by the contracting cicatricial tissue.

Gaugele found in 4 operated cases of subluxation evidences of apparent injuries to the epiphysis and extensive scar formation around the joint. He assumed that the head of the humerus had been pushed from the glenoid cavity by a large hematoma. Realizing that so much blood could not have escaped from the epiphysis, he developed his hypothesis of the injury of the joint capsule which contains larger vessels. There was, however, no anatomic proof that a hematoma had caused the luxation at birth as he assumed.

The occasional palpation of the head of the humerus as a hard protrusion in the axilla of a newborn, exhibiting symptoms of a paralysis, cannot be accepted as proof of a luxation because, as emphasized by Bonnaire and Ecalle, the palpated hard body might be the detached epiphysis.

The presence of a true luxation in the newborn could be established only by the radiographic proof that the ossification nucleus of the upper epiphysis, discovered in an abnormal location, actually lies exactly in the axis of the diaphysis. To prove this it will be necessary to take X-ray pictures from different directions. I am not aware of the fact that such evidence has ever been furnished.

Present information concerning the pathology of brachial palsy can be summarized as follows: conclusive evidence has been furnished that in a large number of the cases the fifth and sixth cer-

vical nerves, usually near or at their junction, have been injured. Radiograms and certain findings during later operations prove that in some instances the upper epiphysis of the humerus is detached or even fractured during birth. In a very limited number of cases operative findings suggest an injury of the joint capsule. There is no anatomic or other proof extant that the posterior subluxation, so frequently seen in adult patients, has actually occurred during labor.

Frequency.—Statistics from large maternity services, as quoted in most textbooks, place the frequency of a brachial birth palsy as approximately 1 case from every 2000 deliveries. There cannot be any doubt that this figure falls far below its actual frequency. This figure unavoidably is calculated without the inclusion of the still-born infants, of whom many had been severely injured at birth and presumably would have exhibited a typical palsy, had they not succumbed to other injuries. This figure furthermore applies solely to an obstetric material managed more or less expertly. That inexpert attention during delivery necessarily increases the incidence of this injury has been most convincingly, one may say dramatically, shown by Prouff and Guillemot (*Annales de Gyn. et d'Obst.*, 1897) who reported an "endemic" of 30 cases of brachial palsy in the practice of a single midwife.

There are no reliable statistics available to determine whether this palsy is more common after vertex or breech labors, though the latter seemingly represents the view generally prevailing among obstetricians. Fairbank quotes Tubby and Sherren as respectively claiming to have found both types of labor equally or almost equally represented in the cases seen by them, while he found in his own series of 39 palsies, 32 subsequent to vertex and only 7 to breech presentations. Also Bullard ascertained for 43 cases, that 40 were vertex labors, in 28 instances terminated with forceps. There were but 3 breech cases in his series. Of the vertex labors the obstetric records stated in 18 instances that the shoulders offered difficulty, while in 5 it was expressly noted that the shoulders were not held.

Since these latter statistics have been furnished by orthopedic surgeons, and obstetricians in general continue to adhere to the belief that breech labor offers the better opportunity for an injury of the brachial plexus, the discrepancy would suggest the deduction that the injuries sustained in vertex labors possibly are severer and are more likely to result in a permanent deformity of the affected

arm. A further study of the problem from this angle would seem most desirable.

Etiology.—A critical analysis of the many theories concerning the origin of brachial birth palsy, given approximately in their chronological sequence in the introductory paragraphs of this chapter, readily permits their division into two groups, the one assuming a traumatization of cervical nerves by pressure or traction, the other surmising that the primary cause of the actual or seeming paralysis is found in an injury of the shoulder joint, a detachment of the epiphysis, a laceration of the capsule or a luxation of the humerus.

Such a critical analysis of the literature will further show that the real advantage of this grouping of the possible causative factors in the main applies to the problem of appropriate immediate or late efforts to cure the paralysis or functional deficiency of the affected arm. From this point of view these two groups will be considered later in this chapter.

The obstetrician is chiefly interested in the question of the etiology of brachial paralysis only in so far as it is definitely established that during delivery, both in vertex and breech labors, some of the cervical nerve roots are injured with fair frequency, and occasionally also the shoulder joint.

Considering first nerve injuries, which manifestly are the more common, I shall discuss the particular features of common obstetrical conditions and procedures which clinically or experimentally have been demonstrated either to cause severe pressure on nerves, supplying the muscles of the arm, or to lead to their excessive stretching and eventual tearing.

DIRECT COMPRESSION BY THE END OF A FORCEPS' BLADE.—This mode of injury, first discussed by Seeligmüller, has been confirmed by numerous clinical observations. Often the traumatization of the region of Erb's point is proved by saggillations or the formation of a palpable infiltration, or a localized gangrene, at times followed by a deep scar (case of Stahl). In most instances of this sort the lesion is slight and the paralytic symptoms disappear quickly. In other cases complete severance of the nerve fibers either as the result of the trauma itself or of their destruction by secondary inflammatory processes, or their continued compression by scar tissue precludes functional recovery. As well emphasized by Stolper, the tip of a forceps' blade is most likely to come to lie near Erb's point when the

forceps are applied as though the head were in a normal occipital presentation while actually it is deflexed.

PRESSURE EXERTED BY THE FINGER.—Erb, in his original contribution, mentioned the Mauriceau-Smellie method of extraction of the aftercoming head as presumably the most common cause of a brachial palsy. This etiological factor is well recognized, and most teachers of obstetrics lay stress on the importance of placing the tips of index and middle fingers, forked above the shoulders, not on the sides of the neck, but on the sternum of the infant. Obstetricians, not enjoying the possession of long fingers, can prevent the end phalanx from lying just above Erb's point and from digging during forcible traction into the infant's neck, if they will deliberately keep the ends of these two fingers in extension and not flexed, as would be their more natural attitude in the attempt to pull on the shoulders.

COMPRESSION BETWEEN CLAVICLE AND RIBS.—In support of Erb's theory, Schultze tried to demonstrate that strong elevation of the arm with a simultaneous posterior flexion elevates the shoulder in such a manner that the clavicle is pressed laterally against the neck approximately in the region of Erb's point. A strong curvature of the clavicle and scant development of adipose tissue behind it would favor a harmful compression of the plexus between the clavicle and the underlying ribs. Approximately this situation obtains, if in a breech labor an arm is thrown above the head.

Experimental studies recently published by Weil support strongly this conception of a possible traumatization of the brachial plexus by the clavicle. He found that when in a newborn the shoulder is pressed against the neck, the outer third of the clavicle approaches the transverse processes of the fifth and sixth cervical vertebrae so closely that it actually squeezes the plexus fibers. This pressure is correspondingly increased when a lateral flexion of the head causes a convex curve of the cervical spine directed towards the same side. Thus the narrow space between clavicle and spinal processes is further reduced. In most instances he could notice that under this pressure the movable portion of the plexus would slip forward from underneath the clavicle. The fixed portion of the plexus, however, in this procedure, is severely compressed and may be injured. Excessive wedging of the shoulder against the neck, therefore, will always endanger the brachial plexus. A situation of this kind may develop both in vertex and breech labors. Indeed, this

attitude may have been maintained, for mechanical reasons, by the fetus before labor and then is likely to become exaggerated during labor.

Weil's investigations also furnish support for a hypothesis that in some instances the brachial palsy of the newborn may represent a truly congenital defect of development of the plexus as the result of continued malattitude of the shoulders during intra-uterine life. This possible origin of an Erb's palsy would be analogous to a congenital type of facial palsy and torticollis respectively described in Chapters VIII and XI.

In several instances recorded in literature the plexus was found to have been injured by one end of a broken clavicle (e.g., an observation of DeLee mentioned in his textbook).

PARTIAL OR COMPLETE TEARING OF CERVICAL NERVES.—The actual occurrence of such lesions has been irrefutably established by dissections made on newborn infants, and by anatomic findings in numerous operations. In experiments, variously arranged, the attempt has been made to reproduce the mechanical conditions under which, in the course of labor, cervical nerves are assumed to be dangerously stretched and eventually torn.

Clark, Taylor and Prout found that traction on the head, while the shoulders are firmly fixed, causes the nerves of the neck to become taut. On increasing the traction force the uppermost fibers begin to fray and to tear. Further force affects the lower fibers in the same manner. Whenever considerable violence is applied, finally also the deeper cervical fascia is torn.

In a repetition of these experiments by Sever it was shown that considerable force is required to rupture the fifth and cervical nerves. The supraclavicular nerve usually snapped before any other. Sever noted that the lower nerves could be placed in extreme tension only by a simultaneous abduction and elevation of the arm.

According to Weil, traction on an arm stretches the plexus only slightly, more so if the arm is in adduction than in abduction, but never to a degree that could prove dangerous to the integrity of the plexus. The fibers, however, became very tense if the head at the same time was forcibly bent to the other side. Weil thought that these experiments, though failing to result in actual tearing of nerve trunks, still do not exclude the possibility of serious damage to them. A structural lesion might be expected to develop in a nerve in which strong tension is maintained for a long time. Therefore, a brachial

palsy might not only be the result of certain violent manipulations during which cervical nerves had been actually torn, but possibly is also dependent upon the persistence of certain injurious positions of head, shoulder, or arm in the course of labor, in which plexus fibers remain in a state of excessive tension.

Summarizing the question of nerve injuries in the causation of brachial birth palsy, in the light of the foregoing information, we may state: (1) the plexus is occasionally injured by the forceps and (2) possibly more often traumatized by a finger during improperly executed traction in the delivery of the aftercoming head. (3) Cervical nerve fibers under special mechanical conditions are injured by compression between clavicle and underlying bone structures, both in vertex and breech labors, and (4) probably less often are actually lacerated by excessive traction. Cervical nerve roots, by violent manipulations, may be torn out of the spinal cord.

Less space will be required for an adequate consideration of the various shoulder lesions regarded of etiological importance in the causation of brachial palsy by some authors.

Since no evidence has been furnished to prove that during a spontaneous labor or through obstetrical manipulations the capsule of the shoulder joint can be torn or the head of the humerus pushed from the glenoidal fossa, the obstetrician does not need to concern himself with these injuries. Epiphyseal detachment, on the other hand, is widely recognized as a possible accident, especially when unusual difficulty is experienced in bringing down an arm caught in the nape of the neck. In most instances of this injury we are, however, dealing probably only with a pseudoparalysis. On account of the joint trauma the arm is held in a position which, on superficial examination, strongly simulates a typical brachial palsy.

For therapeutic reasons, it is essential to determine in each case, immediately after birth, whether the cause of the evident functional disability of the arm is an injury of the brachial plexus or a trauma of the shoulder joint.

Symptomatology.—Speaking solely of the newborn, the predominating feature in the clinical picture of a typical brachial birth palsy is the fact that the affected arm hangs limply from the shoulder in an inward rotation with the fingers usually held clenched. Continued observation will permit one to ascertain that the baby does not raise, abduct, or rotate the arm or bend it at the elbow. Since there is no possibility of determining in the newborn infant, as in the adult, that

this apparent impairment of mobility is due to a paralysis of certain muscles, it can be easily understood why without further careful investigation the incorrect diagnosis of brachial palsy is practically without exceptions made when in fact an injury of the shoulder is responsible for the anomalous attitude of the arm.

In the case of the typical Erb's palsy, the muscles innervated by the fifth and sixth cervical nerves are more or less involved, namely, the deltoid, supra- and infra-spinatus, teres major, biceps and supinator longus (brachioradialis), occasionally also the anterior serratus, coracobrachialis and supinator brevis.

If the traumatism in rarer instances extends to the seventh and eighth cervical and even first thoracic nerves, the muscles of the entire arm become paralyzed. Wrist drop and flaccid fingers are added as symptoms easily recognizable even in the newborn.

There exists still another form of brachial palsy of the newborn, only rarely observed, which is distinctly different from the Duchenne-Erb type. The paralysis is limited to the muscles of the lower arm innervated chiefly by the seventh and eighth cervical nerves (Klumpke's type). In these cases in addition to the paralysis of some or all of the muscles of the forearm, often fibers, as well, going from the lower cervical nerves to the cervical sympathetic may be affected, resulting in a miosis and narrowing of the palpebral fissure with endophthalmus (Sever, Fairbank).

At times only individual nerves of the arm are found to be paralyzed, usually as the result of localized traumatization. This condition will be dealt with in the next chapter.

Diagnosis.—Certain facts mentioned in foregoing pages make it obvious that the more or less characteristic attitude of the arm immediately after delivery will permit the definite diagnosis of an injury to the brachial plexus only if radiographic examination excludes a possible lesion of the shoulder joint.

In regard to the study of the shoulder of the newborn in the X-ray picture, it must be admitted that the problem offers many difficulties. Very little definite information is extant concerning the appearance of this joint and of the small ossification centers in the picture under normal conditions. Only roentgenograms taken from various angles can show that the small nucleus of the epiphysis does or does not lie exactly in the axis of the diaphysis, or that there is an abnormally wide gape between the diaphysis and epiphysis or the clavicle.

Nevertheless, I am convinced that careful radiographic study must be a part of the routine examination of every evident or suspected case of brachial birth palsy. In view of information presented in Chapter XII it can be reasonably expected that such a routine would bring to light in many of these cases an entirely unsuspected fracture of the clavicle. I have referred to the fact that in a few well-authenticated observations the end of a fractured clavicle had traumatized the plexus. A comparison of some of the mechanical factors in obstetrical manipulations, held responsible for the causation of clavicular fractures, with those supposed to account for plexus injuries, as, e.g., the asynclitic tractions, shows that they are practically identical. If fracture of the clavicle actually represents a common, though usually overlooked, birth injury, it would seem possible that it plays an important and still unrecognized rôle in the etiology of brachial palsy.

Only a radiographic examination will establish the correct diagnosis in a case of congenital deformity of the shoulder joint or allow the differentiation between a true palsy and a pseudoparalysis.

A fracture in the cervical portion of the spine (Burr) or an osteochondritis of congenital syphilitic origin (several cases mentioned by Backhaus) may present a clinical picture so closely resembling a brachial palsy that only the X-ray examination will furnish a clue for the correct diagnosis.

Pain is a symptom of very limited diagnostic value. Tenderness to pressure over Erb's point is occasionally mentioned as a sign of traumatization of the plexus. Subjective pain, indicated by fretfulness and irritability of the newborn, in the opinion of Taylor, proves the actual tearing of nerve trunks. From the viewpoint of prognosis such peevishness of the child then would suggest that in this case spontaneous restoration of function cannot be expected.

A joint injury would necessarily cause discomfort, and it seems possible that in such a case the child would hold the arm of the affected side more or less rigidly against the side of the thorax as an automatic protection against painful movements of the shoulder joint.

Symptoms of intracranial hypertension must suggest the possible central origin of a paralysis as the result of an intracephalic birth trauma.

Since authentic cases of infantile paralysis in newborn infants are

known in literature, this condition will also have to be considered in the differential diagnosis of a birth palsy.

Prognosis.—In by far the larger number of cases the symptoms of a brachial paralysis begin to improve promptly and disappear within a comparatively short time, exactly as in a facial palsy. However, much more frequently than in a facial palsy, the functional impairment becomes permanent. There are various reasons for this fact. In a few instances some of the nerve trunks have been completely crushed or actually torn apart. In others, as assumed by most writers, the paralytic condition of certain muscles, especially of the biceps, together with traction exerted by the weight of the arm, secondarily leads to a subluxation of the head. Cases seen soon after birth with undoubted palsy and no joint injury after some months are found with the palsy recovered but the joint subluxated (Fairbank). It also is possible that a primary pseudoparalysis develops into a true paralysis when some of the axillary nerves become embedded into a callus or into shrinking scar tissue developing in the immediate surroundings of an injured joint. Therefore, the obstetrician is not justified in rendering an absolutely favorable prognosis in any case.

The final outcome of the Klumpke type of forearm paralysis is notoriously bad. It is claimed that a spontaneous recovery of function has never been observed.

Prophylaxis.—In speaking of the etiology of brachial birth palsy I had occasion to emphasize certain details in the application of the forceps, in the execution of the Mauriceau-Smellie maneuver and in freeing an arm caught above the aftercoming head, which tend to minimize the danger to the cervical nerves.

As far as the injury of the plexus or of the shoulder by severe traction is concerned, only the general principle can be pointed out that wherever there is difficulty with the shoulders, either in vertex or breech presentations, forcible traction should be made, as far as such is possible, only along the long axis of the child and never against or on a head in lateral flexion.

Treatment.—Within the scope of this volume solely the immediate treatment can be considered. Sever, Platt, Fairbank, Boorstein and many other recent contributors have convincingly demonstrated the dangers and regrettable consequences of the still customary indifference of the obstetrician towards the anomaly, presumably due to his expectation of a spontaneous functional restora-

tion. All these writers insist upon prompt therapeutic attention in every case.

Since undeniably spontaneous recovery occurs in by far the larger number of cases, the early treatment necessarily must be conservative. The arm is placed in the position of physiologic rest (Sever), that is, held by means of an appropriate splint in abduction, elevation and outward rotation. Twice daily the arm is taken down for massage and the following manipulations: external rotation with or without abduction of the shoulder; full flexion and extension of the elbow; full supination of the forearm; dorsiflexion of wrist and fingers, and adduction of the externally rotated arm while the scapula is depressed by a hand on the shoulder (Fairbank).

In the belief of Sever a treatment of this sort, instituted without delay in every case, would leave but few instances in which the paralytic symptoms would not disappear, and would permit no infant to develop a secondary internal rotation contracture and a posterior subluxation of the shoulder joint.

Orthopedists differ as to the time during which such conservative efforts can be safely continued. Fairbank thinks that three months probably represent the limit, while Sever is willing to extend the trial to one year.

The still customary fixation of the affected arm along the thorax is rather generally deprecated by modern orthopedists. It has its very limited value only in certain types of shoulder injury.

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BIRTH INJURIES OF THE CHILD

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