

individual curves and straighten them all we can. We get the muscles in the very best condition possible. Then we put the patients in plaster and hold them in the very best possible position. That is one method.

Then we operate. With the back in the very best possible position we put in an extra piece of bone to stiffen or stabilize the most deformed part of the spine. We start where the spine is fairly normal, where there is still muscle, and develop or build it up through one or two operations for stabilizing the spine. With the large bone graft becoming firm and hard and holding the spine in the best possible position, the patient will be able some day to stand up without having the spine drop to one side.

This young lady, instead of having a deformity such as she now has, which is very marked, will at least be up so that her ribs are out of her pelvis. She will be able to breathe normally, and will develop much more than she would if she were allowed to go on as she is, and her ribs were permitted to drop down into her pelvis and deform her chest and displace her internal organs.

X-Ray. You can see the bone graft which has been put in her back, a long, thin piece of bone which is inserted along the side of the spine.

Case 8. This young lady's operation is only two weeks old. She was treated in the same way as the preceding patient, being placed in the very best possible position when plaster was put on her. Then her spine was fixed.

She has the same style of brace the other girl was wearing, which holds her limb straight and keeps it in the best possible position.

Case 9. This young lady has had the operation done on her shoulder, where the humerus has been fixed to the scapula. She also had paralysis of her forearm. She has no biceps at all. She has had the muscles of her forearm transferred up two inches onto the lower end of the humerus, so that she has good power this way. Her arm will even straighten out after a time. She had a dangling arm before.

Her shoulder does not seem so strong today. The last time I saw her it seems to me she was doing everything with it. Today she won't do anything. Instead of having a dangling, loose arm, it will be straight and will have good power.

X-Ray. This is her photograph, taken after the operation. It shows the arm that hung to her side and was worthless. She will develop a great deal of motion in her shoulder. She can do quite a good deal with her scapula. She ought to do more.

Mrs. La Du: We certainly want to thank you, Dr. Chatterton, for this very interesting and instructive presentation of what you are doing for infantile paralysis cases. I am sure we will all feel that we know a great deal more about it after having listened to your discussion of the subject.

The next subject in our symposium this morning will be by Dr. Williamson, also a member of the hospital staff. He is going to show us the "Apparatus as Used Pre-ambulatory."

APPARATUS AS USED PRE-AMBULATORY

G. A. Williamson, M.D., St. Paul, Minn.

Mrs. La Du, Superintendents of State Institutions, Ladies and Gentlemen: The treatment of poliomyelitis dates back to about 1840, when a German physician by the name of Von Heine wrote for us a scientific description of the disease and recommended certain principles of treatment. He was the first to recommend the use of braces, the use of massage, the use of heat, and the use of certain exercises. Since that time we have been doing more and more along the lines of massage and muscle training and exercises and with braces for the support of these paralyzed extremities.

The phase of treatment to be considered extends over a period of about two years, the first six months being the most important. After that one may expect to find a general, more gradual improvement for a period of about two years.

The cases we admit to this institution come in about six weeks after the initial illness. The first stage of the treatment is a muscle test, which is an evaluation of muscle power in each voluntary muscle in the body, with special attention to the paralyzed extremity. After the muscle test is made, one has a definite record of which muscles are paralyzed and the relative degree of paralysis. Then you can direct your attention primarily to the muscles needing the most active treatment.

Most of our cases are put to bed and are kept in the prone position for about six months. Muscle tests are repeated at intervals so that the power of various muscles can be watched, gradual improvement or lack of improvement determined, and the questions of further treatment in bed or getting the patient up on his or her feet decided.

I have a number of cases here that I desire to present to you as examples of the initial stages of treatment; that is, the treatment in bed with proper splinting.

Poliomyelitis is a great catastrophe to the nervous system. The acute inflammatory reaction which takes place in and around the motor cells of the spinal cord has a very damaging effect on the nerve cells, and may lead to impairment, to a greater or lesser degree, of the motor function in certain cells controlling the action of the muscles. The degeneration of the nerve cell which takes place as a result of the inflammatory process may be a partial one leading to temporary loss of function or a total one leading to permanent loss of function.

An important requirement in treatment is complete physiological rest of the patient; that is, rest in bed, with careful attention paid to prevention of fatigue and to the proper nourishment of the body. Fatigue is a factor very detrimental to the recovery of power in the weakened or paralyzed muscles.

By evaluation of the muscle power, we have determined which muscles are weakened or paralyzed, and, therefore, which muscles need

most of our attention from the standpoint of physiotherapy. Proper splints are applied to hold the extremities in a position of physiological rest, and physiotherapy in the form of heat, gentle massage, and muscle training is started.

Case I. This girl has involvement of all four extremities and trunk; that is, certain muscles of the arms and legs, the abdominal muscles and the back muscles. Her paralysis occurred in October, 1931, and she was admitted to this institution about the end of November or the first of December. Her muscle test was made, all of her muscle power evaluated, and we have involvements about as follows—I will name some of the principal muscles involved and try to indicate the necessity for splints as applied. In the lower extremities the quadriceps or knee-extending muscles have both been affected. On the right side there is still a mere trace of power, while on the left side the muscle is completely paralyzed. In order to keep these muscles in a position of rest or relaxation so that conditions would be right for as much recovery of power as possible, long plaster of Paris splints were applied from the tips of the toes to high on the thighs, holding the knees flexed 2-3 degrees. The feet were held at a right angle in order to hold the muscles below the knee at rest also. We are careful to see that the knees are not allowed to hyperextend in the splints; as this leads to stretching of the posterior portion of the capsule and the knee flexor muscles, resulting in a loose, relaxed, troublesome knee, and impedes the recovery of power in the hip flexor muscles. Small crossbars are fastened to the back of the foot portion of the splints to prevent rolling.

The abdominal and back muscles are put at rest by keeping the patient flat on her back on a hard bed or upon a frame. This position is maintained for about six months in order to allow for the optimum recovery of strength. If allowed to sit up, the weight of the body would cause a bending of the trunk forward or to the side, stretching the back muscles, and the abdominal contents would press forward, stretching the weakened or paralyzed abdominal muscles. A scoliosis, or spinal curvature, is the result of this lack of protection.

The involvement of the upper extremities has made the use of aeroplane splints necessary in order to hold the arm at a right angle from the body, relaxing the deltoid muscle on the shoulder. The elbow is held at a right angle in order to hold the elbow flexors and elbow extensors in a neutral position. The forearm, wrist, and fingers are also supported in a position of rest.

A reading table attached to the bed has been devised to hold books in a suitable position for reading from a prone position so that the patient can continue with her school work. It is necessary to have someone turn the pages of her books because of the extent of her paralysis.

In addition to the application of splints, massage and heat, special exercises for the weakened muscle are given.

Case II. This patient has infantile paralysis involving both lower extremities and her trunk muscles. The date of the onset of her illness

was October 4, 1931, and six weeks later, November 21, 1931, she was brought to the hospital for active treatment.

In this case we applied the same principles of treatment as were outlined in Case I.

At the present time she exhibits definite improvement in her muscle power as a response to treatment. The quadriceps, or knee extensor muscle, on the left side can now hold the knee straight as the limb is raised from the bed. The muscles below the knee show a very excellent return of power, so that the expected end result following a period of active training will be sufficient return of power to enable her to get about without mechanical support on this extremity. In the right lower extremity it does not appear so hopeful as there is merely a trace of power in the quadriceps or knee extensor muscle, and no sign of power below the knee. She will undoubtedly require support in the form of a brace on this side. Her back muscles are good, but due to weakness in the abdominal muscles she will require the support of a corset.

The treatment afforded her at present is as follows: (1) She is kept prone in bed. (2) The feet are held in splints, with the feet at a right angle, with the legs and the knees flexed just off the straight position (about 175°), so that her muscles are held in a position of complete relaxation. (3) Muscle training, baking, massage, and exercises in warm water round out her schedule.

It is of interest to note the type of cradle which is used to keep the bedclothes from pressing down on her feet. Three half hoops connected by longitudinal bars make a framework over which the bedclothes are draped. A large pad, a pillow or a small wooden box with one side knocked out may be placed at the foot of the bed under the bedclothes to keep the weight of the bedding from pressing down on the feet and to keep them at right angles. The general practitioner caring for these cases in the home should think of this method of preventing some of the deformities which too frequently occur and which are always the evidence of lack of proper treatment.

Case III. This is a recent case of anterior poliomyelitis, involving both upper extremities and trunk muscles. The lower extremities have escaped entirely, although they are the most commonly involved. Involvement of one leg is most frequent, with involvement of both legs next, and both arms in third place.

The initial illness, with the usual symptoms, dates back to August 24, 1931. The early care was undertaken at the University Hospital until she was transferred to this hospital in December, 1931.

Early check-up of her muscle power showed insufficient power in the deltoid muscles to abduct the extremities from the body against the force of gravity. In the left upper extremity the biceps or elbow flexor muscle was completely paralyzed, as was the triceps or elbow extensor muscle, and as a result she could neither bend nor straighten her elbow against gravity. In the right upper extremity she had sufficient power in

the biceps to bend the elbow against a small amount of resistance and sufficient power in the triceps to straighten the elbow against gravity.

As has been explained, the power of the muscles is rated according to several standards. The normal muscle, of course, is strongest. Next comes the "good" muscle, which will move the limb against gravity and resistance; next the "fair" muscle, which moves the limb against gravity; next the "poor" muscle, which moves the limb when the force of gravity is removed; next the "trace" of power, which is exhibited by a flicker of contraction in the muscle; and last the "gone" muscle, which is completely paralyzed. Variations of these standards, such as "good plus," "fair minus," and so on, are self-explanatory. It is this careful rating of muscle power which gives us the accurate record of the presence or absence of improvement under treatment, and determines the type of splint, and later the type of brace which is to be applied to the patient.

In this case, in order to protect the weakened deltoid, biceps, triceps and forearm muscles, aeroplane splints have been applied holding the shoulder at a right angle from the body, the elbow midway between flexion and extension, with the wrist and fingers supported. The power in the biceps and triceps muscles on the right side has improved to such an extent that the forearm is held on the splint by clips, so she can slip off the splint to bend the elbow to turn pages of a book on her study table, feed herself, and so on. The involvement of the back and abdominal muscles makes it necessary to keep her prone on the bed in order to prevent strain of these muscles, which would lead to a diminished chance for recovery and subsequent deformity.

She is, of course, having the other treatments in the pool and physiotherapy rooms as previously outlined.

Case IV. This case is one which requires a great deal of personal supervision by the physiotherapists who are trained to evaluate the power in the muscles, to exercise them properly, guarding carefully against fatigue, and to prevent the extremities from assuming positions of deformity. With over fifty new cases from this last epidemic occurring in August, September and October of last year, we can promise to the physiotherapists **much hard work and painstaking effort if the cases are to receive sufficient care.**

The muscle tests on this girl show the involvement to be confined to the lower extremities and back muscles. There has been definite improvement since her admission in October, and there is no doubt that she will be able to get about without support in the near future.

The case is shown in order to demonstrate how easily a patient can be fitted with the proper supports by the physician in the country working with limited facilities. A circular plaster of Paris cast has been applied to the lower extremities extending from the toes to the upper portion of the thigh, being careful to hold the foot at a right angle and the knee flexed 2-3 degrees. A short crossbar has been fitted to the under surface of the heel to prevent the limb from rolling from side to side.

The cast may be bivalved, or split longitudinally into two halves, so that it may be removed and reapplied at will following physiotherapy treatments.

It is very necessary to prevent stiffness from developing in the joints due to prolonged fixation in splints by being sure that each joint is moved actively or passively once each day. This single motion daily is enough to prevent the formation of adhesions in or around the joints.

Case V. This is a September, 1931, case and is shown principally to demonstrate the way paralysis or weakness in the back or abdominal muscles is protected. We can either keep the patient prone on a bed which is free from any sagging, or she can be put on a Bradford frame similar to the one shown. This frame is made from ordinary gas-pipe to fit the patient, and is covered with canvas which can be drawn very taut by means of the lacing on the under surface. The child can be fastened down on the frame and easily carried from place to place without interfering with the course of treatment.

Case VI. This case is from Clay County, Minnesota, and shows involvement confined to both lower extremities. The splints in use are here demonstrated, and a complete recovery is expected due to the mild involvement and satisfactory response to treatment.

Case VII. The mild nature of the involvement of this case from August, 1931, makes it possible to demonstrate another method of protecting the shoulder muscles when they are weakened. By tying this light leather wristlet or strap to the head of the bed her arm is held in abduction and externally rotated. Cumbersome apparatus is not needed with such a mild involvement.

Case VIII. My last case is shown to demonstrate the stage we reach in the treatment just before the patient is allowed to begin to get up. Models of both lower extremities were taken a short time ago and long braces were made by a method which will be described by the next speaker. It will be noted that the braces hold her extremities in the same position of muscular relaxation which was assumed in the splints. By cutting the upper part of the shoe in the manner shown, unsightly bulging around the side bars of the braces is prevented. Crutches will also be used as a means of further support when this girl begins to get around.

Mrs. La Du: Thank you, Dr. Williamson.

Now that Dr. Williamson has shown us the apparatus used pre-ambulatory, Dr. von der Weyer will show us the ambulatory apparatus.