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improvement month by month by various checkups,

As soon as paralysis is noted, the child needs orthopedic treatment,
he needs mechanical Treatment, to prevent deformity. He should be
placed in a comfortable position, his feet should be held at right angles,
and the bedclothes should be so arranged as not to push the feet down
in an unnatural position. An unsupported paralyzed foot in the acute
stage would result in deformity.

The child should be kept quiet until a definite time is reached, and
that definite time we feel is when you can touch the child's limbs, squeeze
the legs, pinch them, and use a little force in pressing the legs or over
the nerve trunks, without discomfort to the patient, or, in other words,
when the tenderness has disappeared. Then we feel that the acute stage
is over and the patient is ready for treatment in the next stage, the
improving stage.

No manipulation is used in the acute stage, nothing but rest.
Usually the child needs general treatment, such as tonics to stimulate
his appetite—the appetite needs improving. He should be kept quiet and,
above all, he should be kept warm. The acute stage may last only two
or three weeks, or it may be four or five months before the child is ready
to receive any real treatment other than rest, as far as improving him is
concerned.

Improving Stage. The next stage is the so-called improving stage.

We have no arbitrary limit as to how long the improving stage will
last. It may be one, two, three or five years, but with proper care and
with care in the use of muscles, the child will improve under proper
conditions after the acute stage has passed, and will continue to improve
year after year. The greatest good is done in the improving stage.

After the acute stage is over, you must have a checkup. You must
know what muscles are paralyzed. You must know how badly they are
paralyzed. I think you will see that demonstrated this afternoon.

After a child has passed the acute stage of infantile paralysis, he
comes here. We want you to see the children early in the improving
stage.

Checkup. The first thing we do is to check up. We go over every
muscle in the whole body. We determine whether or not a muscle is
completely paralyzed.

We say that the muscle is gone if it has lost all power.

If the contraction is very weak, we say that we have a trace.

Then we have the muscle that contracts when gravity is eliminated.
That is called a poor muscle.

We have the muscle that will contract against gravity. That is called
a fair muscle.

Then we have the muscle that will contract against gravity and some
definite force. That is called a good muscle.

So we have a definite checkup, and we try to keep track of the
improvement month by month by various checkups.

Apparatus. It is very gratifying to note that most of these children
to improve very rapidly when muscles are put at rest, and they have
certain types of treatment which we will describe. In the improving stage
if a muscle is paralyzed, or partially paralyzed, or so weak it cannot work
against gravity, or cannot work against gravity with some definite force,
then it needs some type of apparatus to keep it from strain or from
getting tired out. So we use various types of apparatus to keep the arms
in a certain position and the feet at right angles so that certain muscles
will be at rest.

Fatigue. In the improving stage the greatest damage that is done
to the muscles weakened by infantile paralysis is brought about by too
much fatigue. Fatigue is extremely detrimental.

A man who had had infantile paralysis said to me: "In the morning
I feel fine. I can move my limbs, and they feel fairly strong, but by
the time they get through giving me my electric treatment and my
massage—the massage works on me for an hour and a half—I am tired
out.” He was getting too much treatment.

Too much fatigue must be guarded against.

**Muscle Training.** The most valuable type of treatment is that known
as muscle training. Muscle training is the Christian Science of infantile
paralysis. In other words, we ask the child to contract a certain muscle,
and at the same time the physiotherapist works the limb in that direction.
We are trying to get a nerve impulse from the brain of the child down
to this muscle, to this damaged area. We are trying to get him to
concentrate on what is being attempted. Muscle training requires not
only the cooperation of the child but his closest attention, as well. By
having him pay close attention to what is being done, we get his
cooperation.

You will see muscle training demonstrated this afternoon, and you
will realize how valuable it certainly is.

**Heat.** Heat is used in the treatment of the improving stage. A warm
muscle is capable of better function than a cold one. If your feet are cold,
you cannot run a very good foot race. When a child has had infantile
paralysis, his limbs become chilled, they are cold; the temperature is
below normal, sometimes as low as 70 or 60 degrees. Many children
come into the out-patient department with limbs actually frozen so that
they have ulcers on the skin because they have not been kept warm. By
chilling a paralyzed limb a superficial necrosis of the skin is easily
produced.

We use types of simple apparatus, the most common type, radiant
heat, being heat given off from the electric lamps. Hot water bags are also
used, but electricity seems the easiest way. Moist heat is less desirable, as
it increases the skin. Makes the skin tender, and cannot be borne at
so high a temperature as can dry heat. Radiant heat is a dry heat and
can be used for a long time.

In view of the fact that the muscles function better when warm,
we are sure to see that the affected parts are kept as warm as possible by
means of extra clothing.

**Massage and Manipulation.** Massage has not so great a place in the
treatment of infantile paralysis as you might think. It does not bring
power to a muscle except indirectly. It is used, first, to improve circula­
tion; second, to restore heat; and, third, to soften muscles that have been
hardened because of the fact that they have not been used.

**Hydrotherapy.** We give the same muscle training in the pool that
we give on the table. This is called hydrotherapy. We have a child get into
the pool and move his limbs. He also learns to float or swim.

The advantage of the pool is that gravity is eliminated. A child
who cannot walk across the floor can tread across the pool. Gravity
being eliminated, he can use muscles in the water that he could not use
outside of it.

**Electrical Stimulation.** Sometimes we find that a child’s limbs were held in poor position
after the acute attack, and that deformity has developed. That condition
should be taken care of before apparatus is applied.

**Electricity.** To the good old days electricity was used by the
doctors for muscle stimulation. The patient placed one foot in a basin of
water to which an electrode was applied, another electrode was applied
to the muscle to be stimulated, and the current turned on. That type of
treatment may be as effective as carrying around in the pocket the foot
of a rabbit which was shot in a graveyard at midnight. It is no better.

Electricity can be used in the case of an adult by a trained neuro­
ologist, but with children it is practically impossible to use this kind of
stimulation. It is too painful. So we use no electricity so far as muscle
stimulation is concerned.

**Physiotherapy.** Physiotherapy is used after the acute stage, and
we keep it up sometimes for one year, and very frequently for at least
two years if we can.

The advantage of physiotherapy is, first, that the child or individual
gets the desire to get the best out of his injured members. He becomes
interested and, instead of saying, “I am going to have a paralyzed arm; it
is useless to do anything,” he does his best to get all he can out of his
paralyzed limb or member. Instead of being satisfied with his
condition, he gets a desire to recover. He wants to become a useful
citizen again.

In adults it is also educational to have this re-creation through
certain types of work that they do for certain paralyzed muscles, a type
of training to educate these muscles.

*It is an educational process for the children also. They become
interested, and good habits are formed.*

**Surgical Stage.** Usually we say that the surgical stage arrives about
two years after the acute onset; that is, after the child has had the use
of braces, has had training, has been cared for, and his limbs show
no return to their former condition and the muscles show no return to
their former power, then we do certain surgical procedures to help the
child so that the use of braces will no longer be required.

The difference in the use of braces has been very marked in the last
few years. We do not use nearly so many as we used to. As a matter of
fact, surgery has taken the place of a great many of the braces. Braces
are now put under the skin. Such braces have the advantage of not
wearing out, and they are better than braces on the outside.

**Bone Operations.** We have certain types of operations which are
used in the surgical stage, which begins usually two years after the
acute stage. The first is osteotomy, the surgical cutting of a bone for
the procedure that is used for the upper extremities and the spine. We use techniques that are designed to help to control muscle balance, or to correct deformities. These procedures may involve transferring a large portion of one muscle into another muscle to achieve a better balance of forces. They may also be used to correct deformities or to restore function.

We use techniques that involve fusion of bone to correct deformities. This can be done by removing bone and allowing it to grow back at a different angle. This is a very satisfactory operation. Occasionally we have paralysis of the biceps muscle in the upper extremity. In this case, the patient is not able to flex the elbow, but does have good muscles of the forearm. We use techniques that involve transferring a muscle from one part of the body to another to help to control motion. This is particularly useful in the hand, where the motions are so fine and so complicated that tendon transfer is necessary.

This morning I am going to show you just a few of the more simple procedures that are used for the upper extremities and the spine. We use techniques that are designed to help to control muscle balance, or to correct deformities. These procedures may involve transferring a large portion of one muscle into another muscle to achieve a better balance of forces. They may also be used to correct deformities or to restore function.

Case 1. This young man has had an infantile paralysis affecting both lower limbs. As you see, it is necessary for him to wear long leg braces. He cannot walk without assistance. Even with assistance he walks with his knees flexed and his legs dangling along. He walks very well now, and will improve so much that braces on the lower limbs will not cause disability to some other part where it will be more useful.

Years ago we used to make ligaments out of tendons. Some operations are very much more simple than those used in former times. We use techniques that involve fusion of bone to correct deformities. This can be done by removing bone and allowing it to grow back at a different angle. This is a very satisfactory operation. Occasionally we have paralysis of the biceps muscle in the upper extremity. In this case, the patient is not able to flex the elbow, but does have good muscles of the forearm. We use techniques that involve transferring a muscle from one part of the body to another to help to control motion. This is particularly useful in the hand, where the motions are so fine and so complicated that tendon transfer is necessary.

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Case 3. This again is an operation whereby the shoulder has become fixed to the scapula. It gives her a very satisfactory result. She has very good power in the muscles that control the scapula. She can feed herself and use her arm very well.

(Question: Dr. Chatterton, is there enough flexibility in the scapula so that the arm will move against the body?)

Answer: Yes; it will drop down practically straight.)

Case 4. Occasionally we have an individual who has a dislocation of the hip because of absence of muscles around the hip. There are several ways of taking care of this situation, but we have thought that exterior articular fusion—that is, making the hip stiff from the outside—would hold the hip in position. If we would put a piece of bone taken from another portion of the body and allow it to grow across from the ilium to the trochanter major, it would become solid and would keep the hip in place. Also, that if we wanted to take a good sized slice of the ilium, roughen the surface, drive it into the trochanter major, and allow it to grow across from the ilium to the femur, it would form a piece of bone across the joint and make the hip stiff.

With this young man we first tried to make a big, high roof above the socket, expecting that would hold him, but inasmuch as he had no muscles it simply slipped out, so we had to partially fuse his hip.

X-Ray. This shows where the shaft of trochanter major gives him a stable hip. It is much better than one that used to slip out and was constantly getting shorter.

X-Ray. Here is where a slice of the ilium was used to make the hip stiff. It did not happen to be for infantile paralysis, but the principle is the same. The muscles were slipped out of the way, a large piece of ilium about two inches wide, was pried loose and driven into the trochanter major, the tissues slipped across, and it made the hip stiff. You can see a large piece of bone in the trochanter major. It gradually becomes solid and stabilizes the hip.

This happens to be the type of cast which is sometimes used, either like this or down both ways. It is sometimes used after this operation.

X-Ray. Here is where an outside graft was made. A piece of bone from another portion of the body has been inserted at the head of the femur into the ilium, which makes a large piece of bone across the joint.

X-Ray. Here is one that was taken a long time after the operation. You can see what a firm, strong piece of bone it gets to be after a while. It holds the hip perfectly stiff.

Case 5. Of all the deformities that we have, curvature of the spine is one of the most difficult to treat. Whether it is due to infantile paralysis or whether it is due to a rachitic condition, or whether it is due to an unknown condition, a deformity of the spine is very difficult, because you have a chest that is moving, and it is not easy to apply pressure to it.

One of the principles of orthopedic surgery is that in order to correct a deformity, you must over-correct it at first. It would be very difficult to unwind this young lady and put her in the opposite position.

In infantile paralysis we have a great deal of trouble with curvature of the spine. This is due to the fact that we have a stronger muscle on one side of the spine than we have on the opposite side.

If this young lady had had infantile paralysis, the strong muscle would be on this side and would pull her down so that the deformity would begin to bulge out and we would have this marked curve.

We do all we can to develop muscle. We do as much as possible to get them back. We place a spine muscle in the best possible position, hold it there with apparatus, and keep it there for a long time. In spite of apparatus, the muscle always wins if strong. In spite of the best apparatus we can put on—it is very uncomfortable to wear—the deformity goes on and increases. This is true in all types of curve, especially when they get as bad as this young lady happens to be. That is why curvature of the spine is so difficult. To overcome this we have tried to make the spine stable. A little bit later we will speak about trying to make the spine stable by putting a piece of bone or extra support along the side.

If we had given this young lady no treatment, she would have kept on going down until the ribs dropped down into the pelvis. When the ribs rest in the pelvis, one cannot become more deformed. If we should just let her go, this is where deformity would result. You see what she can do all by herself. That is through muscle training. She can almost over-correct her deformity. If she should keep on getting worse, then some more severe treatment might be thought of.

Another difficulty is the fact that you cannot put on apparatus that will hold the spine any too well. In the high dorsal region especially it is very difficult.

Case 6. Here is a young lady who had infantile paralysis. You can see what difficulty she has in trying to sit up.

Early in the paralysis, curvature of the spine are not very apparent. They just suddenly go down all at once and curvature appears. When curvature does begin to show very much, it develops very rapidly.

Here is a young lady who does not look very bad on the outside, but when we get her x-ray picture, she has a very bad deformity. This is going to increase if she does not have support, something to hold her up to a certain time. That time is when her ribs are resting down in her pelvis. Then she will not become much more deformed.

This young lady should have a certain type of exercise. She should be treated to develop all the muscle she can so as to get in the very best position possible. Then if we cannot keep her there, we will perhaps do surgery. She is older. Sometimes the older individuals, by working with them and keeping on support, do not tend to change very much. Younger children change a great deal, even in spite of surgery.

Case 7. This is another case of curvature of the spine. Sometimes the patients have very bad curves. We work with the
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 seemed 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."